ECON0016 T1 - Demand Side

1 Demand Side vs. Supply Side

Demand Side

Focuses on aggregate spending by agents. The **demand identity** for a (closed) economy often is:

$$y_D = c + i + g + (x - m),$$

though for a closed economy $(x - m)$ is omitted. Demand-side policies include monetary and fiscal policies.

Supply Side

Focuses on how firms produce. A typical production function might be:

$$y_S = a\, f(k, n),$$

where a is technology, k is capital, and n is labor. Price- and wage-setting processes lead to equilibrium output and inflation. Supply-side policies often include labor-market reforms or competition policy.

2 The Three Equation Model (IS–PC–MR)

- **IS:** Demand side model incorporating consumption, investment, and government spending.
- **PC:** Phillips Curve summarizing the supply side and nominal stickiness.
- **MR:** Monetary Rule, describing how policy (often via interest rates) responds to inflation or other targets.

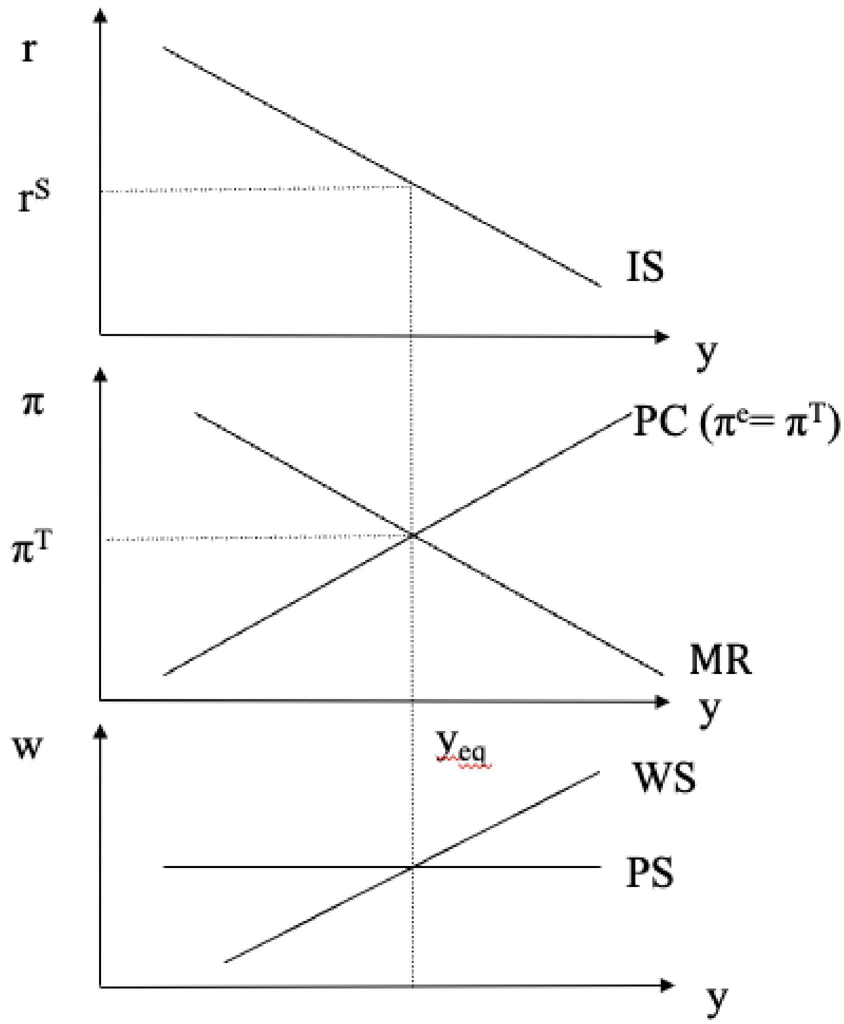

Figure 1: 3-Equation Model

3 Demand Identity and Behavioral Equations

In a closed economy:

$$ad = c + i + g,$$

and equilibrium requires $y = ad$. Behavioral equations specify how c and i depend on factors like income and the interest rate. For instance,

$$c_t = c_t(\Lambda_c) = c_0(\Lambda_c) + c_y(\Lambda_c)\, y_t + c_r(\Lambda_c)\, r_t,$$

$$i_t = i_t(\Lambda_i) = i_0(\Lambda_i) + i_y(\Lambda_i)\, y_t + i_r(\Lambda_i)\, r_t.$$

4 The IS Curve

Household Spending Components

- Non-durable consumption (often cyclical).
- Durable consumption (provides utility over multiple periods; may be treated like investment).
- Housing (investment-related).

Heterogeneity and the Representative Agent

One may acknowledge heterogeneous households ($c_{h,t}$ for household h) or assume a single *representative household*. While simpler, the representative-agent assumption may overlook complexities, especially under credit constraints.

5 Modeling Consumption: The Permanent Income Hypothesis (PIH)

Key Points

- Individuals allocate resources (assets + current/future income) *across their lifetime*.
- Agents are forward-looking: consumption depends on interest rates, asset values, expectations of future income/taxes.
- Optimal consumption tends to be smoother than (possibly volatile) income.

Basic Assumptions

- Representative agent with infinite lifetime.
- Time-separable, convex preferences (concave utility function).
- Forward-looking behavior.

Consumption Smoothing over Business and Life Cycles

Agents save during high-income phases and borrow during low-income phases to maintain a stable consumption path. Over a lifetime, they might borrow when young, repay in peak-earning years, and run down savings after retirement.

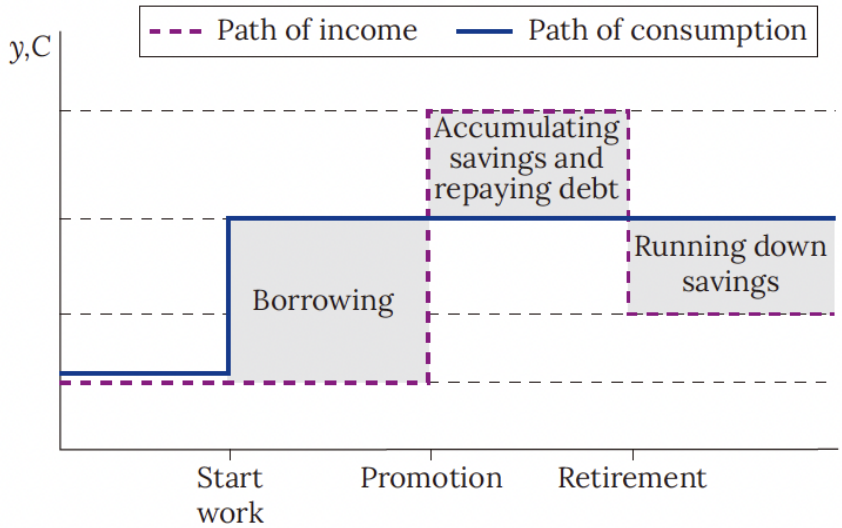

Figure 2: Lifetime consumption smoothing

Why Smooth Consumption? (Two-Period Example)

Consider a utility function and budget constraint:

$$U = \log(c_1) + \log(c_2), \quad c_1 + c_2 = 10.$$

Solving yields $c_1 = c_2 = 5$, implying equal marginal utilities. This simple illustration shows that with diminishing marginal utility and a concave utility function, consumption is smooth if individuals can freely borrow or save.

Infinite-Horizon Maximization

(i) Utility Function

Suppose an individual has an infinite lifetime and a time-separable utility:

$$U_t \;=\; \sum_{i=0}^{\infty} \frac{\log\left(c^e_{t+i}\right)}{(1+\rho)^i},$$

where

$$\rho \;=\; \text{subjective discount factor}, \qquad \frac{1}{(1+\rho)^i} \;=\; \text{present-value discount factor.}$$

(ii) Budget Constraint

$$\sum_{i=0}^{\infty} \frac{c^e_{t+i}}{(1+r)^i} \;=\; (1+r)\,a_{t-1} \;+\; \sum_{i=0}^{\infty} \frac{y^e_{t+i}}{(1+r)^i} \;=\; \psi^e_t,$$

where

- r = interest rate,
- a_{t-1} = asset level / savings from the previous period,
- y^e_{t+1} = income earned after tax,
- LHS = present value of expected consumption,
- RHS = present value of expected lifetime income.

$$(1+r)\,a_{t-1} \quad \text{(assets saved up)}, \qquad \sum_{i=1}^{\infty} \frac{y^e_{t+i}}{(1+r)^i} \quad \text{(flow of expected income after tax)}.$$

(iii) Maximization Problem

Households choose consumption to maximize lifetime utility:

$$\max_{\{c^e_{t+i}\}_{i=0}^{\infty}} \sum_{i=0}^{\infty} \frac{\log\left(c^e_{t+i}\right)}{(1+\rho)^i} \quad \text{subject to} \quad \psi^e_t.$$

Assume $\rho = r$, meaning the individual's valuation of the future is the same as the market's intertemporal trade-off. Also, assume

$$MU_1 = MU_2 = \cdots = MU_i.$$

Solving the problem yields the Euler Equation:

$$c_1 = c^e_2 = \cdots = c_{t+i}.$$

Hence, consumption is smooth (in expectation) in each period.

Permanent Income Hypothesis (PIH)

$$\sum_{i=1}^{\infty} \frac{c^e_{t+i}}{(1+r)^i} = \psi^e_t \quad \text{since} \quad c_t = c^e_{t+1} = \cdots = c^e_{t+i},$$

which can be rewritten as

$$\psi^e_t = \frac{c_t}{1-\frac{1}{1+r}}.$$

Note that

$$1 - \frac{1}{1+r} = \frac{(1+r)-1}{1+r} = \frac{r}{1+r}.$$

Hence,

$$c_t = \frac{r}{1+r}\,\psi^e_t = \frac{r}{1+r}\left[(1{+}r)\,a_{t-1} + \sum_{i=0}^{\infty} \frac{y^e_{t+i}}{(1+r)^i}\right] = \frac{r}{1+r}\left[(1{+}r)\,a_{t-1} {+} \sum_{i=1}^{\infty} \frac{y^e_{t+i}}{(1+r)^i}\right] {+} \frac{r}{1+r}\,y_t,$$

where

$$\text{MPC} \;=\; \frac{r}{1+r}.$$

Consumption is the annuity value (discounted value) of expected lifetime wealth, known as "permanent income."
Individuals choose their consumption such that it remains constant over time, given their current expectations of future income.

Permanent Income Hypothesis: Implication

(a) *Consumption is always a fraction of permanent income, so individuals maintain stable consumption.*

(b) *Consumption is not affected by predictable changes in income.*

(c) *What changes consumption c_t? News and surprises (unanticipated and unpredicted events).*

1) **Temporary changes in income:** These are smoothed ($\text{MPC} = \frac{r}{1+r}$). Therefore,

$$\Delta c_t \;=\; \frac{r}{1+r}\,\Delta y_t^e.$$

2) **Permanent change in income:** This has a one-to-one impact on consumption ($\text{MPC} = 1$). Hence,

$$\Delta c_t \;=\; \frac{r}{1+r}\cdot\frac{1+r}{r} \;=\; 1.$$

6 Consumption with Credit Constraints

Excess Smoothness and Excess Sensitivity

- **Excess Smoothness:** Individuals who receive good news about future pay might *fail* to borrow immediately, instead waiting for actual higher paychecks.
- **Excess Sensitivity:** Consumption might jump sharply once a higher paycheck arrives.

Hand-to-Mouth (HTM) Consumption

HTM individuals consume all income each period, violating the standard PIH. Reasons include:

- Low income with basic needs.
- Impatience (high subjective rate of preference).
- Credit constraints preventing borrowing.

There are also "Wealthy" HTM individuals with high debts who spend all new income servicing these obligations.

Hybrid Consumption Model

Reckon with Hand-To-Mouth (HTM) consumption behavior. When income increases, HTM households consume all of this income rise $\Rightarrow$ MPC = 1.

Suppose the share of PIH households is σ and the share of HTM households is $1-\sigma$, then

$$c_t = \sigma c_t^{\text{PIH}} + (1-\sigma) c_t^{\text{HTM}}.$$

Split PIH consumption into two parts: *Expected income* + *Current income*

$$c_t^{\text{PIH}} = \frac{r}{1+r}\left[(1+r)a_{t-1} + \sum_{i=1}^{\infty} \frac{y_{t+i}^e}{(1+r)^i}\right] + \frac{r}{1+r} y_t, \quad c_t^{\text{HTM}} = y_t.$$

Thus,

$$c_t = \sigma \frac{r}{1+r}\psi_t^E + \sigma \frac{r}{1+r} y_t + (1-\sigma) y_t = \sigma \hat{c}_0 + \left[\underbrace{\sigma \cdot \frac{r}{1+r} + (1-\sigma)}_{c_1}\right] y_t,$$

where

$$\hat{c}_0 \equiv \frac{r}{1+r}\left[(1+r)a_{t-1} + \sum_{i=1}^{\infty} \frac{y_{t+i}^e}{(1+r)^i}\right].$$

Notice that $\sigma \cdot \frac{r}{1+r}$ is very small, hence the MPC is closely approximated by the share of HTM households $1-\sigma$.

Interpretation

- Changes in expected lifetime wealth affect consumption through the *autonomous consumption* term.
- MPC increases with the proportion of HTM households.
  $\Rightarrow$ In a recession when unemployment increases, the proportion of HTM households rises, and so does the MPC.

7 Government Spending Multipliers

Definition

The government-spending multiplier measures:

$$\frac{\Delta y}{\Delta g}.$$

Empirically, it can be difficult to identify due to reverse causation and other confounding factors. A common rule of thumb for many economies is a multiplier around 1–1.5.

Multiplier in Theory

Take a consumption function,

$$c = c_0(\Lambda_c) + c_y(\Lambda_c)(1-\tau)\,y,$$

and in equilibrium (closed economy):

$$y = c_0(\Lambda_c) + c_y(\Lambda_c)\,(1-\tau)\,y + i + g.$$

Solving for y gives:

$$y = \frac{c_0 + i + g}{1 - c_y(1-\tau)}.$$

Hence,

$$\text{Multiplier} = \frac{\partial y}{\partial g} = \frac{1}{1 - c_y(1-\tau)}.$$

- Higher tax rate (τ) reduces the multiplier.
- Higher average MPC (c_y) raises the multiplier.

Case: Many Hand-to-Mouth Agents

When $(1-\alpha)$ is large, the average MPC approaches 1, leading to a larger multiplier. In an extreme case,

$$\Delta y/\Delta g \approx \frac{1}{1-(1-\tau)} = \frac{1}{\tau}.$$

Conversely, if nearly all are PIH, $c_y \to 0$, so $\Delta y/\Delta g \approx 1$.

8 Investment and the IS Curve

Investment with Accelerator and Interest-Rate Effects

One can specify an investment function:

$$I = a_0 + a_Y\,Y - a_1\,r.$$

Then the AD (aggregate demand) becomes

$$y_D = c_0 + c_1(1-\tau)\,y + a_0 + a_Y\,y - a_1\,r + G.$$

In equilibrium:

$$y = c_0 + c_1(1-\tau)\,y + a_0 + a_Y\,y - a_1\,r + G.$$

IS Curve and Its Shape

The **IS** curve represents (r, y) pairs that satisfy goods-market equilibrium. It is downward sloping: lower r stimulates interest-sensitive components of consumption/investment, raising output. A steep IS means limited interest-rate sensitivity; a flatter IS suggests strong sensitivity.

Shifts in the IS

- Increased government spending (G) shifts the IS right.
- Increased asset prices (positive wealth effects) can also shift the IS right.

Fiscal and Monetary Policy on the IS Curve

- Fiscal policy shifts the IS. The effect depends on the multiplier and how the spending or taxes are financed.
- Monetary policy influences r (through the nominal rate i and expected inflation, π^E). Via
$$r = i - \pi^E,$$
a change in i (set by the central bank) moves the economy along the IS curve.

9 Tobin's q Theory of Investment

Firm Value Maximization

A firm maximizes
$$V = \sum_{t=0}^{\infty} \frac{d_t}{(1+r)^t},$$
where d_t is dividends. If $a\,f(k_t)$ is output and i_t is new investment, then $d_t + i_t = a\,f(k_t)$. Capital depreciates at rate δ:
$$k_{t+1} = k_t(1-\delta) + i_t.$$

Marginal Benefit vs. Marginal Cost of Investing

The marginal benefit of adding capital is related to $\frac{\partial}{\partial k}\big(af(k)\big)$, and the marginal cost is the cost of diverting dividend. Setting MB = MC leads to:
$$af_k\left[\frac{1}{1+r} + \frac{(1-\delta)}{(1+r)^2} + \cdots\right] = 1,$$
summing a geometric series. This defines Tobin's q:
$$q = \frac{a\,f_k}{r+\delta}.$$

- If $q = 1$, capital is at its optimal steady state (k^*).
- If $q > 1$, invest more than just to replace depreciated capital.
- If $q < 1$, the capital stock is above its optimum.

Table 1: Determinants of Tobin's q

Variable	**Effect on q**	**Effect on I**
r	$\downarrow$	$\downarrow$
δ	$\downarrow$	$\downarrow$
A	$\uparrow$	$\uparrow$
f_K	$\uparrow$	$\uparrow$

Determinants of Investment

- Higher r increases the denominator, lowers q, and thus reduces investment.
- Higher depreciation δ also reduces q.
- Better technology a raises marginal product, increases q, stimulating investment.

Average Q Model

Empirically, one often uses *average* Q:

$$\text{Avg}\,Q = \frac{\text{Stock market value of firm}}{\text{Replacement cost of capital}}.$$

Under perfect competition, average $Q = q$. If $\text{Avg}\,Q > 1$, it might reflect overvaluation or some mismeasurement, but it often signals that expansion of capital stock is profitable.

Empirical Evidence on Investment

(a) Credit Constraints: Role of Cash Flow

- Traditional theory posits that current cash flow should not directly influence investment, as market valuations would internalize any credit restrictions.
- Empirical findings contradict this, suggesting that credit market imperfections induce a "cash flow term" in firms' investment functions.
- Firms subject to tighter credit constraints exhibit greater sensitivity of investment to internal cash flow (akin to credit-constrained households reacting strongly to credit supply changes).

(b) Uncertainty: The Option Value of Waiting

- Heightened uncertainty raises the value of waiting before committing to irreversible capital expenditures.
- Firms have an incentive to defer investment when future market conditions appear unpredictable, preserving the "real option" to invest later.

(c) Investment and Animal Spirits

- According to Tobin's q theory, firms invest more if the expected return on capital exceeds its cost.
- Psychological factors ("animal spirits") can amplify or dampen investment, causing shifts beyond fundamentals-driven behavior.

(d) Using Survey Data to Augment Aggregate Investment

- Survey-based evidence (e.g., Bachman and Zha) indicates that managers' assessment of sales levels and future expectations critically influences investment decisions.
- The use of subjective managerial data helps clarify how outlook adjustments affect aggregate investment beyond standard quantitative models.