

# Introduction to Principles of Microeconomics and Financial Project Evaluation

also business

Lecture 5: What is society's MARR?  
(Also known as the *social discount rate*)

September 16, 2022

# Recommended Reading and Viewing

- Willmore, C. (2021). *Alex and their WACC* [Handout].
- Tools 2 and 6 (Bounded Rationality and Opportunity Cost) on pp. 9-11 and 20 - 21 of Willmore, C. (2022). *A Tiny Toolkit* [Pamphlet].  
<https://onlineacademiccommunity.uvic.ca/willmore/wp-content/uploads/sites/5845/2022/08/atinytoolkit.pdf>
- Climate Changer. (2018). Discount Rates: How simple maths can sustain our planet. <https://youtu.be/xKJqsn1WKTc>
- Conservation Strategy Fund. (2014). Cost-Benefit Discounting [Video File]. <https://youtu.be/MoI1yT7tczY>

# Case Studies

- Al Yaqoobi, A., & Ausloos, M. (2022). An Intergenerational Issue: The Equity Issues Due to Public–Private Partnerships; The Critical Aspect of the Social Discount Rate Choice for Future Generations. *Journal of Risk and Financial Management*, 15(2), 49.  
<https://doi.org/10.3390/jrfm15020049>
- Foltyn-Zarychta, M., Buła, R., & Pera, K. (2021). Discounting for Energy Transition Policies—Estimation of the Social Discount Rate for Poland. *Energies*, 14(3), 741. <https://doi.org/10.3390/en14030741>

# (Optional) Reading & Viewing on Shadow Wages

- McIntosh, E. (2010). Shadow pricing in health care cost-benefit analyses. In McIntosh, E., Clarke, P., Frew, E. J., & Louviere, J. (Eds.). *Applied methods of cost-benefit analysis in health care*. Oxford University Press. Retrieved from <https://ebookcentral-proquest-com.ezproxy.library.uvic.ca/lib/uvic/reader.action?docID=975570&ppg=54>
  - A thorough, readable and practical discussion of shadow pricing in an applied context.
- Kriti Bedi. (2020, March 23). Meaning of shadow price/what is shadow price/UNIDO Approach [Video File]. [https://youtu.be/3acj2RI\\_mH0](https://youtu.be/3acj2RI_mH0)

# (Optional) Case Studies on Shadow Pricing

- Almeida, A. N. & Bravo-Ureta, B. E. (2019). Agricultural productivity, shadow wages and off-farm labor decisions in Nicaragua. *Economic Systems*, 43(1), 99-110. <https://doi-org.ezproxy.library.uvic.ca/10.1016/j.ecosys.2018.09.002>
- Trung, L. D. & Oostendorp, R. H. (2017). Regional Labor Market Integration, Shadow Wages and Poverty in Vietnam. *World Development*, 89, 34-56. <https://doi-org.ezproxy.library.uvic.ca/10.1016/j.worlddev.2016.07.011>

# Other sources

- Boardman, A.E., Moore, M. A. & Vining, A. R. (2010). The Social Discount Rate for Canada Based on Future Growth in Consumption. *Canadian Public Policy*, 36(3), pp. 325 – 343. Retrieved from <https://muse-jhu-edu.ezproxy.library.uvic.ca/article/396282>
- Evans, D. J. (2005). The Elasticity of Marginal Utility of Consumption: Estimates for 20 OECD Countries. *Fiscal Studies*, 26(2), pp. 197 – 224. Retrieved from <https://www-jstor-org.ezproxy.library.uvic.ca/stable/24440019>
- Ford, C. (2020, September 17). 1,100 jobs to be created as Lighthouse Lab Covid-19 testing facility confirmed for North East [Web Page]. Retrieved from <https://www.business-live.co.uk/economic-development/1100-jobs-created-lighthouse-lab-18950303>
- Sartori, D., Vignetti, S. & Del Bo, C. (2015). In *Guide to Cost-Benefit Analysis of Investment Projects*. EU: European Commission. Retrieved from [https://ec.europa.eu/regional\\_policy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020](https://ec.europa.eu/regional_policy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020)

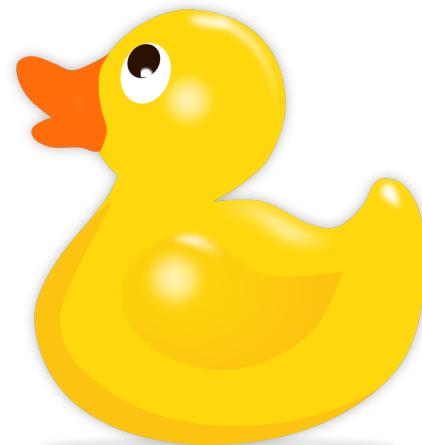
## Talk to the duck! (Self-test)

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- It's often said that raising interest rates (the cost of borrowing, and a benefit of lending) puts the brakes on the economy.
- If you can explain to the duck why this is true, using the concept of the MARR, you're in pretty good shape.
- N.B. The duck is untrained in economics and has a limited understanding of math.

Economists predict slowdown for Australian economy as interest rates continue to rise -Sep. 6, 2022

([Source](#))



(Wikimedia)

# Essentials

# Finding the MARR is “simple” in business

- Conceptually simple, anyway.
- Suppose you’re trying to find the MARR for a company.
- Step 1: Make a list of everything that the company knows it can do with its money.
- Step 2: Make sure you have numbers telling you how “good” each of those opportunities is – benefits & costs, money in & money out.
- Step 3: Convert all those measures of “how good” an opportunity is to the same units – for the MARR, traditionally “% return per year”.
- Step 4: Pick the biggest number. Done. That’s the company’s MARR.
- There are two major catches.

# Catch 1: That's a LOT of stuff to look at

- Catch 1: EVERYTHING the company knows it can do with its money?
- That could be an intractably long list of complicated projects.
- Solution: This catch never vanishes, so in practice companies tend to limit themselves to obvious MARR candidates that are well understood.
- For reasons of sharing information, courting investors, etc., these also tend to be opportunities shared by all sorts of different companies (and investors, and governments, and...)
- This is an example of *bounded rationality* (doing what you can, given a human being's limited ability to obtain, retain & process information), and *satisficing* (going for a “good enough” result).
- Let's look at a few of the usual suspects:

# Common MARRs used in business

- For more details, see (Chit, A et al., 2015):
- Depends on how the business raises money for the project:
- Interest on bonds (if paid for with bond issue)
- Rate of return in other available investments with similar risk (why give money to YOUR project if you can do better elsewhere?)
- Weighted Average Cost of Capital - WACC (weighted average cost of capital – i.e. of the different sources you use to raise money)
- Adjusted market-wide return using the CAPM (CAPital Pricing Model) formula. Adjusts for firm's risks & market expectations.
- Read the "Alex and their WACC" handout for an extended example.

## Catch 2: Rates as common units of comparison

- This one's actually not too bad.
- ANY project of the form “Costs now, benefits later” (or vice-versa) can be summarized in term of a rate.
- “Costs Now → Benefits T time periods from now” can be phrased as
- “Costs Now = (Costs + Return) T time periods from now”
- → Return = Benefits – Costs, T time periods from now and the RATE of return is just
- Rate of Return = Return/Costs per T time periods. That is, just
- Pay \$80 now, get \$85 one week from now → Costs = \$80, benefits = \$85 one week from now → Return =  $(\$85 - \$80) = \$5$  one week from now, over and above the \$80 you put in.
- → Rate of Return =  $5/80$  per week = 6.25% per week.

# I don't know... Seems awfully specific.

- It generalizes. And you'll learn how, later in the course.
- A % per week can be easily turned into an equivalent % per year, with just a few extra steps compared to turning, say, cm/day into km/hr.
- It's not just 'pay a single cost today, get a single benefit later' that you can summarize with a rate of return.
- You can do this for ANY project with only one sign change in the cash flows over time –
- e.g. getting \$1,000,000 from the bank, in exchange for paying the bank \$5,000 a month for the next 25 years. (It's about 3.54% per year, if you're wondering. You'll be able to check this once we talk about annuities.)
- When there's more than one sign change in the sequence of cash flows representing a project, it's trickier – but there are (Imperfect) ways to deal with that.
- Also: rates of return can be negative (e.g. if benefits < costs).

# Why so much on the MARR?

- We will almost *never* be deciding whether a project is “good” by comparing it to “nothing at all” (0 costs, 0 benefits).
- To be a practical, useful recommendation, we need to be able to say this project *is at least as rewarding as anything else we could be doing with the same resources*.
- In most of our calculations, the MARR will be the measure of ‘anything else we could be doing’. Most of the figures you’ll learn how to calculate, even those supposedly measuring “profit”, are *in comparison to the opportunity summarized by the MARR. Different MARR, different number.*
- This can be very important if your projects span generations or affect entire societies.
- We’ll look at society’s MARR after a short detour.

# Terminology: We also call the MARR a ‘discount rate’.

- The MARR is a discount rate; not all discount rates are MARRs.
- Why discount rate?
- Even without considering inflation & uncertainty (later in the course!):
- **A dollar tomorrow is worth less than a dollar today...**
- ...because you can turn a dollar today into MORE than a dollar tomorrow.
- → We pay LESS than \$1 today for a sure promise of \$1, 10 years from now.
- **The future dollar is discounted by a factor proportional to the MARR:**
- If your MARR is 10% per year, that means you can grow your money at 10% per year, so you can turn \$1 today into \$1.10 one year from now. That also means that a promise of \$1.10 one year from now is only “worth” \$1 to you today. Money next year is *discounted* relative to money today.

# The Social Discount Rate: What perspective?

- What about society? How much should society value costs & benefits today, vs. in the future (perhaps to future generations)?
- Two main perspectives:
- Social Rate of Return on Private Investments (SSRI): Societal rates are mostly used for evaluating public projects. Public projects crowd out private investment, and the discount rate should reflect this opportunity cost. Leads to high discount rates. Used by Canada.
- Social Rate of Time Preference (SRTP): 'Society' has a rate at which it's willing to trade off present and future consumption. Public projects should consider this, and take into account the well-being of all generations. Widely used in Europe.
- China uses a weighted average of the two approaches.

## SSRI: Public investment crowds out private investment

- Using this perspective, some Canadian agencies recommend an 8% rate of return, plus 3% and 10% ‘sensitivity’ calculations.
- Very loosely, Boardman et al. (2010) report a study that breaks down the SSRI into the weighted average of the opportunity cost of:
  - Inflation-adjusted, before-tax return on investment (ROI).
  - Inflation-adjusted, after-tax return on savings
  - Inflation-adjusted cost of foreign borrowing.
- The Boardman paper suggests replacing ROI with WACC (cost of borrowing), and the other two with the inflation-adjusted, expected after-tax return to government bonds.

# SRTP: How society trades off present & future.

- Ideally: government should somehow add up individual preferences for consumption now vs later and use those in planning, while taking into account future generations.
- How? One famous method uses the **Ramsey equation**:
- **SRTP = p + e x g**
- **p = pure time preference**
- **e = elasticity of marginal utility of income**
- **In English:** (roughly) adjusts for \$1 meaning more to someone poor, than someone rich.
- **Utility:** An important economic term meaning satisfaction/happiness/well-being. The goal of doing things is to gain or not lose utility. More is better.
- **g = growth rate of per capita consumption**
- **In English:** (roughly) tracks whether the average person is getting richer or poorer through time.

# p: Pure Time Preference

- Why should *society* prefer consumption now to consumption later?
- This parameter is usually seen as the sum of two factors: myopia and extinction risk.
- **Myopia**: People are impatient, and want things now. (1%-3%/year measured.)
  - e.g.: A toddler left alone in a room with a marshmallow, being told she can have two if she leaves it alone for an hour.
- Considered immoral to set this different from zero: future generations hurt just because they're born later. 0.1% sometimes argued as a compromise.
- **Extinction Risk**: Consumption now is better than consumption later because society may not be around later.
- Can be estimated by annual death rate of population. (Deaths/Population)

# e: Elasticity of Marginal Utility of Income

- Marginal utility of income (benefit from an extra \$) falls with income: an extra \$ means more to someone with very few \$ than to someone rich.
- → If society's income is rising over time, a dollar today brings more utility than a dollar later.
- How can we measure this for a whole society?
- In a democratic society, the tax system can be seen as a 'social judgment' about transferring consumption across people and time.
- Ideally, tax rates at different incomes should impose an 'equal absolute sacrifice of satisfaction' (Evans, 2005).
- In that case, letting  $t$  be the average tax rate and  $t'$  the marginal tax rate (tax on the next \$) for an average taxpayer, it can be shown (Evans, 2005) that
- $e = \ln(1 - t')/\ln(1 - t)$
- On average for the OECD, Evans finds  $e$  is about 1.4.

## g: Expected per-capita consumption growth

- This helps us keep track of whether future generations are more (or less) well off than the current generation, and by how much.
- If consumption is growing over time, it makes sense to discount benefits (and costs) to future generations, making the poorest generation (ours) a priority.
- Similarly, if consumption is falling over time (say, due to agricultural problems related to climate change), it makes sense to prioritize the future (at least to some extent).
- In practice, we can use estimates of real per capita GDP growth (inflation-adjusted, per-person growth in production) or income growth as a measure of g.

## (OPTIONAL) After hours

- Market prices and opportunity costs
- Shadow pricing
- How we've tried measuring shadow wages

# Market prices and opportunity cost

- Ideally, when deciding what to do, we should use prices that measure the *opportunity cost* of the resource we're using (machines, working hours, etc.)
- Under certain conditions, *market prices* will give us a *lot* of information about these opportunity costs – and be pretty much equal to them.
- Loosely: when buyers, sellers & goods are mostly interchangeable, trading is free, no big gaps in information, no transportation costs, etc.
- This does NOT describe much of the world we live in!
- Market *distortions* → lots of noise in the opportunity cost signal.
- BUT for engineering projects, common (& hopefully not harmful?) to use.
- For *societal* projects, though, such as public health, it DOES matter.

# Shadow Prices (and wages)

- *Shadow Prices* are an attempt to correct for the noise in the signal.
- *Wages* are the price paid for work, so ***shadow wages are a measure of the opportunity cost of time spent working.***
- Example where this matters: Informal health care by family of patient.
- Account-wise: looks ‘free!’ Economics-wise: VERY EXPENSIVE.
- Treating family member care as ‘free’ → health authorities inappropriately shifting too much to the community.
- Caregiver burnout is common & harmful. (See the Lilly et al. papers)
- One approach: value informal work at rate of similar paid work.

## **Box 3.4 Additional costs associated with informal care include the following**

### **Additional 'costs'**

Time spent travelling by patients, relatives, carers

Time spent waiting for consultation, during consultation, treatment, and rehabilitation

Leisure time lost (if time allocated to unpaid activity involves a displacement of non-working time)

### **Shadow price**

**Value of time**

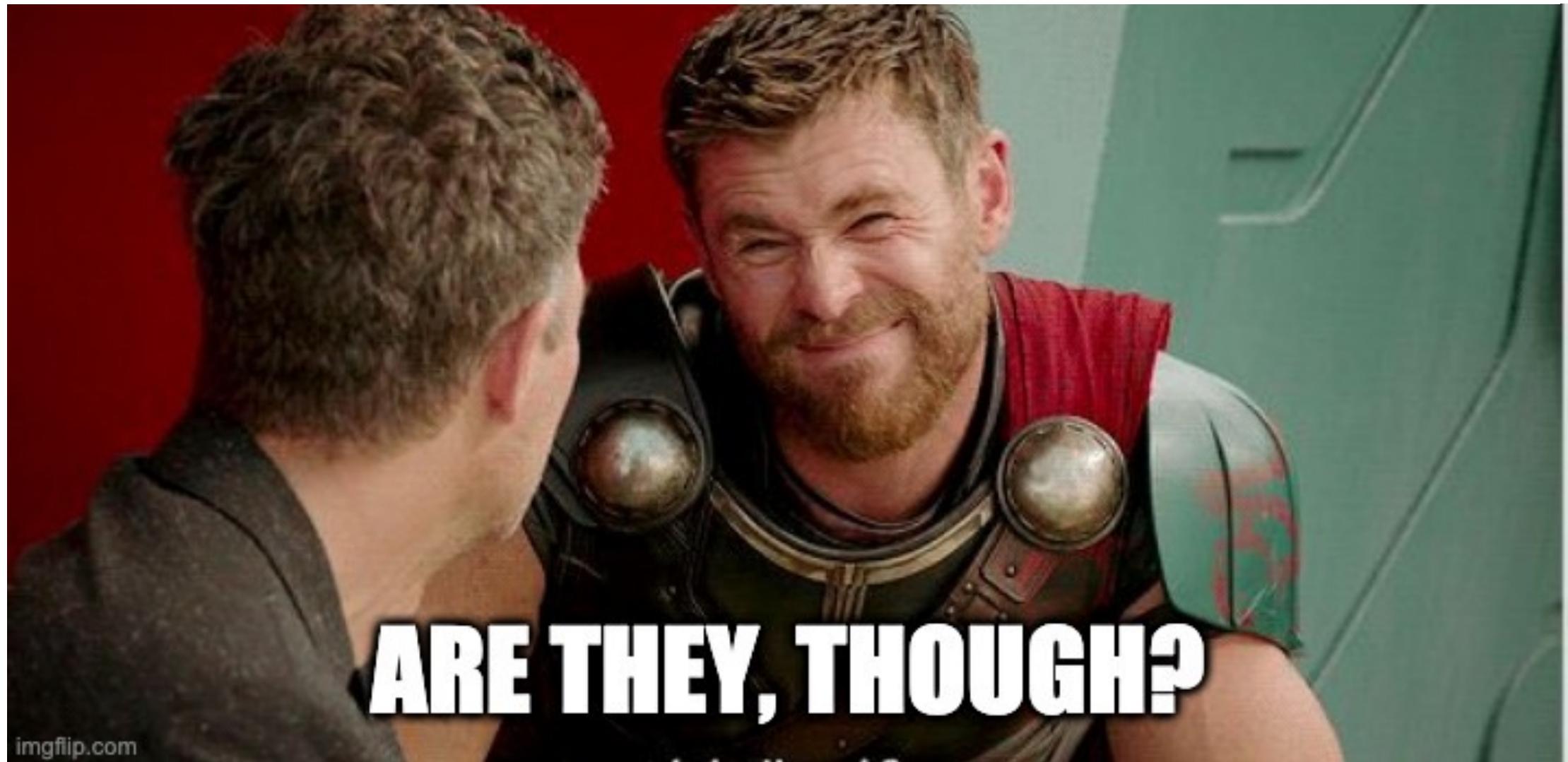
**Value of waiting time**

**Opportunity cost of time**

**Value of leisure activities forgone**

(McIntosh, 2015)

# **1,100 jobs to be created as Lighthouse Lab Covid-19 testing facility confirmed for North East**



# “We’ve created so many jobs! (Sartori *et al.*, 5.6)

- A LOT of projects claim job ‘creation’ as a benefit.
- Many of these claims are over-stated.
- If the project employs workers that *would have been unemployed* if the project didn’t exist, then yes! Job creation is a benefit. The **shadow price (opportunity cost) of work << the wages paid**.
- What if we’re in a full employment economy? The project employs workers that would be working somewhere else, otherwise.
- Shadow wage is about equal to actual wage... or could even be higher!
- (e.g. If workers stop building affordable housing to build a statue of the mayor.)
- At best, **part** of each job (Wage - Shadow Wage) was created.

# How have we tried measuring Shadow Wages?

- So... how do we measure the opportunity cost of labour?
- Measure how much a worker adds to production in the work they're going to (if any) vs the work they left.
- (Could approximate this by wages in each, *if* the labour market is competitive.)
- Adjust for work being pleasant or unpleasant (utility goes up or down?)
- For countries with migrant labour, migration also included: if someone migrates from A to B for work, cost of their job in B is the forgone output in A.
- Also need to include (un)employment benefits, etc.
- All this is a LOT of work, requiring a LOT of data that is not always available...

# Compromise: A weighted average

- $SWR = \beta m_1 + (1 - \beta)w_2$
- SWR = Shadow Wage Rate
- 1,2 = Market Sectors. The project is in Sector 2, the workers come from Sector 1.
- $m_1$  = Marginal product of worker in sector they're leaving.
- $w_2$  = Wages in a *competitive* labour market in Sector 2.
- (Need to assume a competitive market so wages are an accurate measure of productivity.)
- $\beta$  = Regional welfare weight (more on this later). Imagine workers moving from a traditional cultural industry to working in a canned corn factory.

# EU approach: 4 classes (Sartori *et al.*, Annex IV)

- This one-size-fits-all approach can be tweaked.
- The EU uses 4 sub-cases: FSE, QKU, ULD, RLD
- **FSE: Fairly Socially Efficient.** Unemployment is frictional (vs structural), workers are paid close to their marginal product.
- **QKU: Quasi-Keynesian Unemployment.** Sticky wages lead to high unemployment, both short-run and long-run.
- **ULD: Urban Labour Dualism.** Mostly urban. Both formal & informal work. The informal sector attracts workers from agriculture.
- **RLD: Rural Labour Dualism.** Mostly rural. Both formal & informal sectors, but excess labour is absorbed by agriculture. High emigration.