Quantitative Techniques for Macroeconomic Analysis

Key Concepts

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Lecture Outline

- Using and Calculating Growth Rates (Percent Changes) in Key Indicators
- Calculating Nominal, Real, and Price Changes – General Case
- Domestic and Foreign Prices, Nominal Exchange Rate, and Real Exchange Rate
- Calculating Percent Changes in Nominal Exports and Imports from Changes in Foreign Prices, Exchange Rates, and Volumes
- Elasticities
- Summary
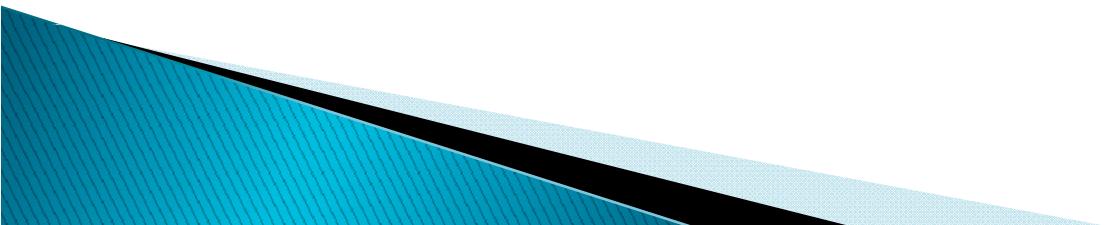
Using Growth Rates to Forecast Variables

- In economics, variables are sometimes forecast as percent changes of their previous (e.g., last year's) values
- Example: GDP in 2010 is forecast as 5 percent higher than GDP in 2009
- To forecast new value in this way:
  - New value = old value * (1 + growth rate/100)
- Example: 2009 GDP = 2,000, growth = 6%

$$GDP_{2010} = GDP_{2009}*(1 + 6/100) = 2,000 * 1.06 = 2,120$$
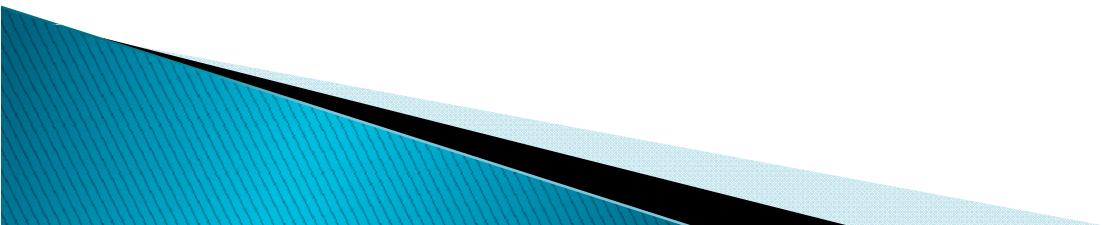
Calculating Growth Rates (Percentage Changes) in Variables

- Growth rates (percentage changes) can also be extracted from data:
- Can calculate percent change as
  ◦ $((X_{new} - X_{old}) / X_{old}) * 100$
  ◦ Example: calculate growth from 1,000 to 1,100
- In EXCEL, often easier to express as
  ◦ $(X_{new}/X_{old} - 1) * 100$
- Mathematically, result is the same:
  ◦ $((X_{new} - X_{old}) / X_{old}) * 100 = (X_{new}/X_{old} - X_{old}/X_{old}) * 100 = (X_{new}/X_{old} - 1) * 100$
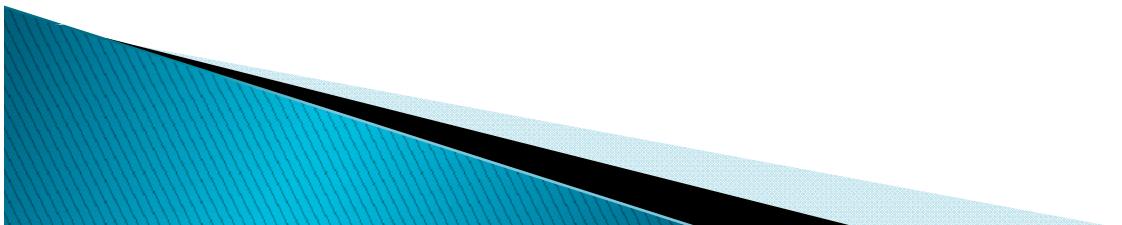
# Calculating Nominal Changes from Changes in Volumes and Prices

‣ Exact formula:
(1 + %chg volume/100) * (1 + %chg price/100) =
(1+ %chg nominal value/100)

‣ Approximation:
%chg volume + %chg price ≈ %chg nominal value
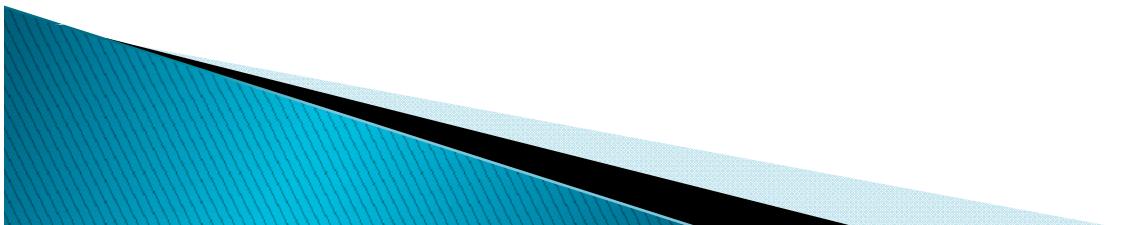
Calculating Nominal Changes from Changes in Volumes and Prices – continued

- To extract the percent change in nominal value, note that the answer equals (1+ %chg nominal value/100). So one can subtract 1 from the answer and then multiply the result by 100.
- Example: suppose volume change = 2%, price change = 10%. Then we have
  - (1 + 2/100) * (1 + 10/100) = (1.122)
  - (1.122 – 1) * 100 = 12.2%
- Check: is answer close to 10% + 2%?
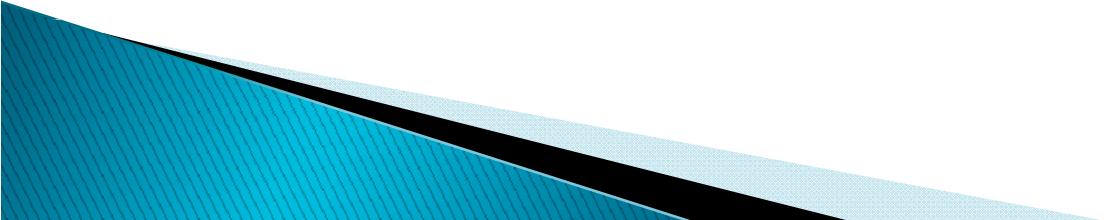
Moving Among Changes in Nominal Values, Volumes, and Prices

- So long as you have two of the following – price change, volume change, and nominal change – you can calculate the third
- Example: nominal change = 12%, price change = 5 percent
  - Real change =
    (1 + %chg nominal/100) /(1 + %chg price/100) =
    (1+12/100) / (1+5/100) = (1.066667).
    To calculate percent change, subtract 1 and multiply result by 100:
  - (1.06667 – 1) * 100 = 6.667%, or about 6.7%
  - Check: Is answer close to 12% – 5% = 7%?
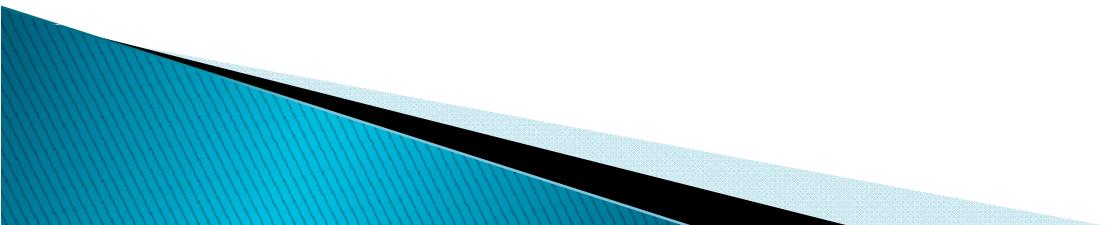
Value of Using Real, Price, and Nominal Changes for Forecasting

▸ To forecast nominal exports or imports:
  ◦ Model may forecast the percent change in real exports or imports
  ◦ Data source may provide a forecast of percent changes in export or import prices
  ◦ Calculation rule allows you to forecast change in nominal exports or imports:
  ◦ (1+%chg volume/100) * (1+%chg price/100) = (1+ %chg nominal value/100) = "B"
  ◦ To extract percent change in nominal exports or imports, calculate ("B" − 1) * 100 = "C"
  ◦ New value = Old value * (1 + "C"/100)
  ◦ Note: arriving at price change may require several steps (combining changes in exch. rt., for. prices)

Value of Using Real, Price, and Nominal Changes for Forecasting – continued

▸ Example:
  ◦ Imports in 2009 = US$1.5 billion
  ◦ Model predicts 5 percent real import growth
 ◦ Data source predicts 3 percent foreign price rise

▸ To forecast imports in 2010:
  ◦ (1 + %chg volume/100) * (1 + %chg price/100) = (1+ %chg nominal value/100) = (1+5/100)*(1+3/100) = (1.0815)
  ◦ Extract the percent change: (1.0815 – 1) * 100 = 8.15%
  ◦ $Imports_{2010}=Imports_{2009}*(1 + 8.15/100)=1.5*1.0815=1.62$
  ◦ Forecast of 2010 imports is about US$1.62 billion
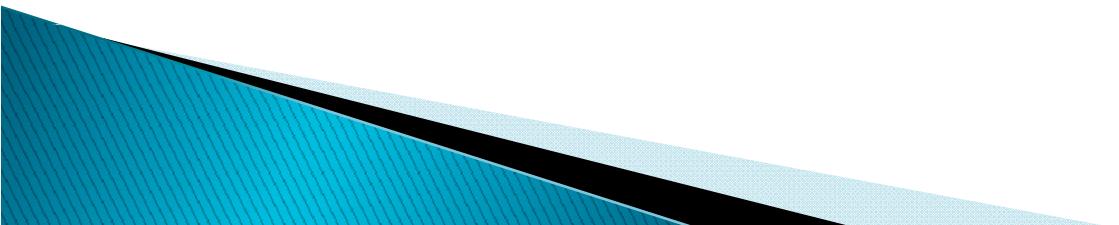
Calculating Percent Changes in a Domestic Price Index from Changes in Foreign Prices

- ▸ **Changes in domestic export or import prices reflect changes in foreign prices and changes in the exchange rate:**
  - ◦ (1 + %chg Domestic price of exports/100) = (1 + %chg exchange rate/100) * (1 + %chg foreign prices/100)
  - ◦ To extract percent change, subtract 1 and then multiply answer by 100
  - ◦ To measure change in domestic prices, must use change in local currency/foreign currency rate
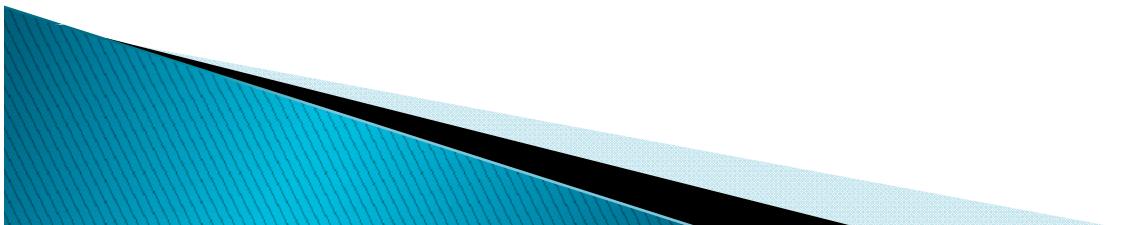
Calculating Change in Domestic Price of Exports or Imports; Growth in Nominal Val.

- U.S. dollar export price rises by 2%
- Exchange rate of Japanese Yen per U.S. dollar depreciates from 105 to 110
- Percent change in domestic export prices:
  - (1 + %chg Domestic price of exports/100) = (1 + %chg exchange rate/100) * (1 + %chg foreign prices/100)
  - (1+%chg Export prices/100) = (110/105)*(1.02) = 1.06857
  - %chg in Export prices = (1.06857–1)*100 = 6.86%
- **General rule** for combining multiple percentage changes: multiply series of (1 + %chg X/100) terms
- **Example**: forecast of growth in nominal imports:
  - (1 + %chg Domestic price of imports/100) = (1 + %chg exchange rate/100) * (1 + %chg foreign prices/100)
  - (1 + %chg nominal imports/100) = (1 + %chg Domestic price of imports/100) * (1 + %chg import volume/100)
  - Percent change = ((1 + %chg nominal imports/100) – 1)*100

Calculating Real Exchange Rates

- Real exchange rate = Nominal rate times ratio of Home prices to Foreign prices
- Example: $RER_{\$,F\$} = \$/F\$ * (P^h / P^f)$
- Calculating percent change in RER is similar to calculating pct. chg. in a nominal variable, i.e., as a product of the underlying variables:
  - $(1+\%chg$ nominal $ER/100) * ((1+\%chg$ in $P^h/100) / (1+\%chg$ in $P^f/100))$
  - Extract the percent change by subtracting 1 and then multiplying by 100
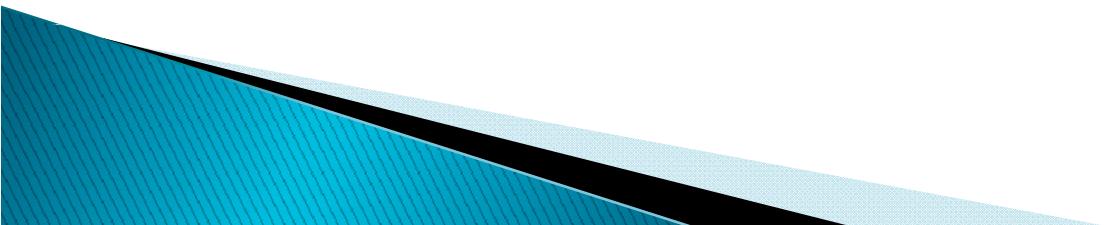
Calculating Real Exchange Rates: Example

- Thai Bhat depreciates from 30 to 32 per U.S. dollar
- U.S. prices (CPI or GDP deflator) rise by 3 percent
- Indian prices (same index as U.S.) rise by 8 percent
- Calculate percent change in RER as follows:
- (1+%chg RER/100) = ((1/32)/(1/30)) * (1+8/100)/(1+3/100) = (.03125/.03333)*(1.08)/(1.03) = 0.98301
- Extract the percent change: (.983 – 1) * 100 =   (–.017) * 100 = –1.7 percent

Elasticities

▸ Elasticities measure the percent change in a variable when a second variable to which it is related grows by 1 percent

▸ Example: $\epsilon_{\text{real imports, real GDP}} = 1.1$ means that real imports grow 1.1 percent for each 1 percent rise in real GDP, i.e., 10 percent faster

▸ Elasticities >1 are considered "elastic"

▸ Elasticities < 1 are considered "inelastic"
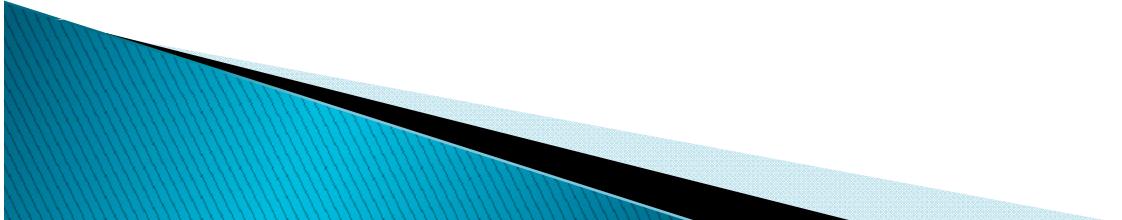
Use of Elasticities

▸ Elasticities can help in forecasting when we have a forecast of one variable (e.g., GDP) and a model relating some other variable to it.

▸ Example: real consumption may be assumed to have an elasticity of 0.95 (or some other value) to real GDP.

▸ If forecast growth in real GDP is 5 percent and $\epsilon_{\text{real consumption, real GDP}} = 0.95$, forecast growth in real consumption = .95*5 = 4.75%.
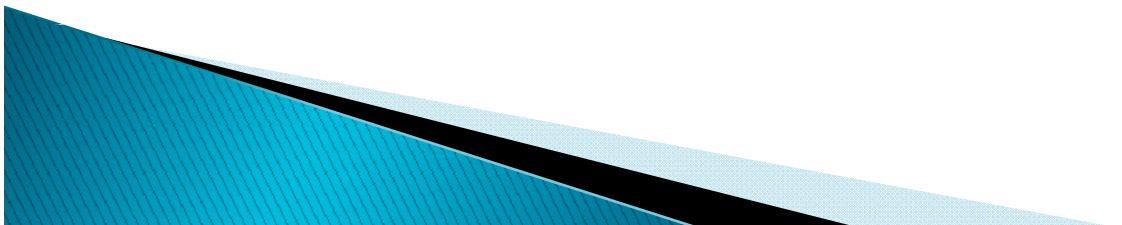
Applications

- Elasticities have many uses in economics, for example:
    - Forecasting growth in real private consumption as a function of the growth in real GDP
    - Forecasting impact on volume of gasoline sales of a change in oil prices or gasoline excise taxes
    - Forecasting rise in real imports as a function of growth in real GDP or change in real exch. rate
    - Assessing the growth in revenue relative to GDP
    - Forecasting effect of growth in personal income on individual income tax revenues
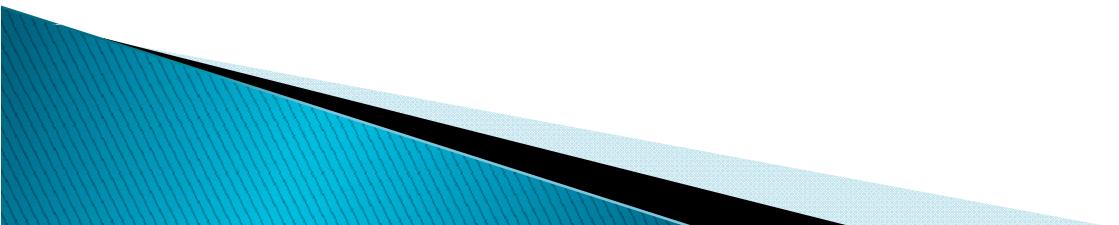
Summary of Techniques

- Forecasting a variable as a percent change in its past value
- Calculating growth rates of variables
- Calculating percent changes in nominal variables from percent changes in volumes and prices, and vice-versa
- Calculating percent changes in real exchange rates and in domestic prices of imports and exports
- Using above to calculate percent changes in nominal exports and imports
- Calculating and using elasticities