Productivity Growth, Trade & Poverty

Will Martin

World Bank

Presentation for IATRC Meeting, Seville,

3 June 2013

Roadmap

- Small open economies

- Large economies

- Interactions with trade distortions

- Distributional implications

Small, open economies

Sources of productivity growth

- Process improvements
  - Movement of the frontier
  - Changes in efficiency relative to frontier
  - Changes in the variety of inputs available

- Product improvements
  - Changes in the amount of the good required to meet consumer need
  - Changes in the variety of goods supplied

Broad trade impact: small, open economies

S_0

S_1

M_1

M_0
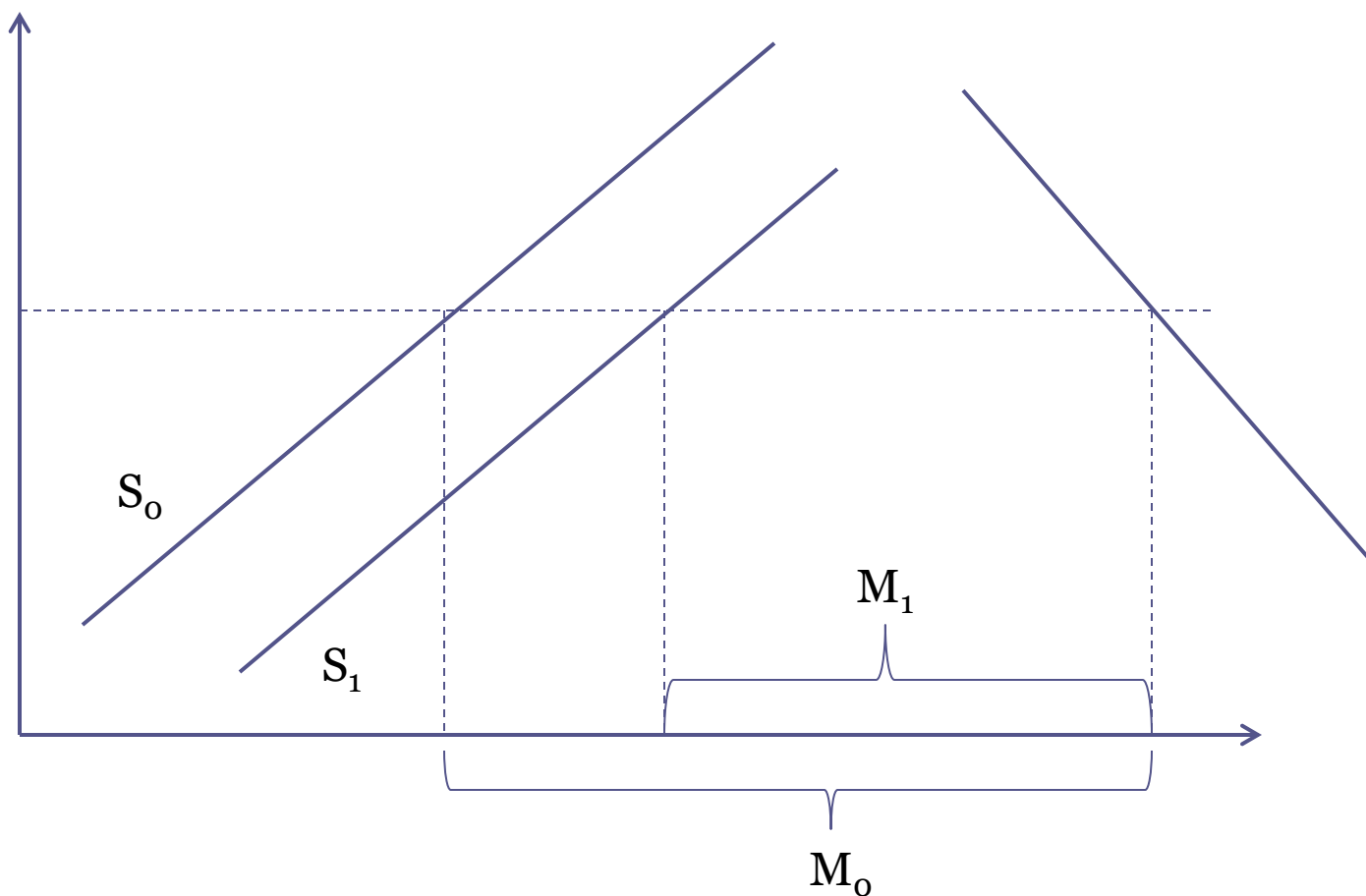
Relation between Y gain & output

- Most productivity measurement focuses on Y changes
  - What is the reduction in input needed/unit of output?
    - NB inputs may be intermediates or factors
    - Redn in inputs may have different impacts on output & on trade
      - How much is on marginal needs & how much infra-marginal

- Point developed using PS & shifts in supply curves
  - Classic example of a parallel vs a pivotal shift in supply
  - With income gains measured using producer surplus

- Need to look more closely at nature of productivity change
  - Can be done using modern, dual approaches

Parallel shift in the supply curve

PS increase =abcd
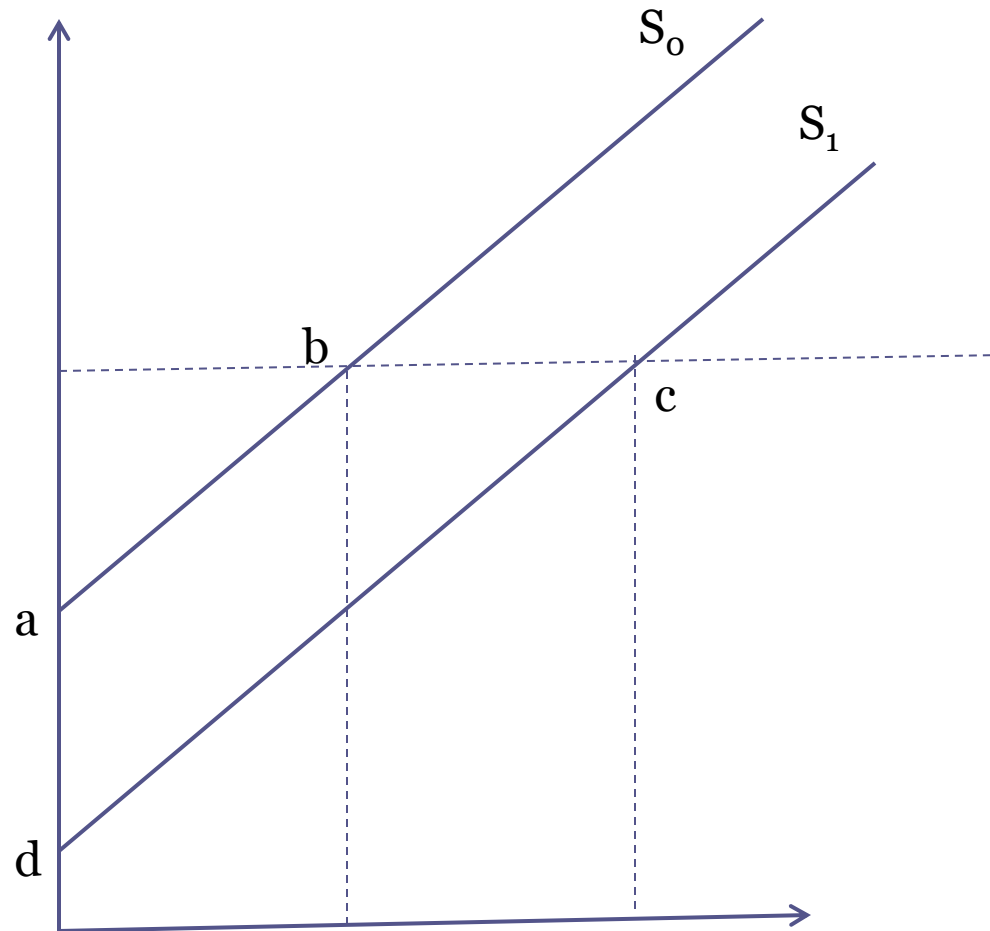
"Pivotal" shift in the supply curve

PS increase =abc

Same impact on
trade. Much smaller
PS gains

S_o

S_1

S_2

b

c

a
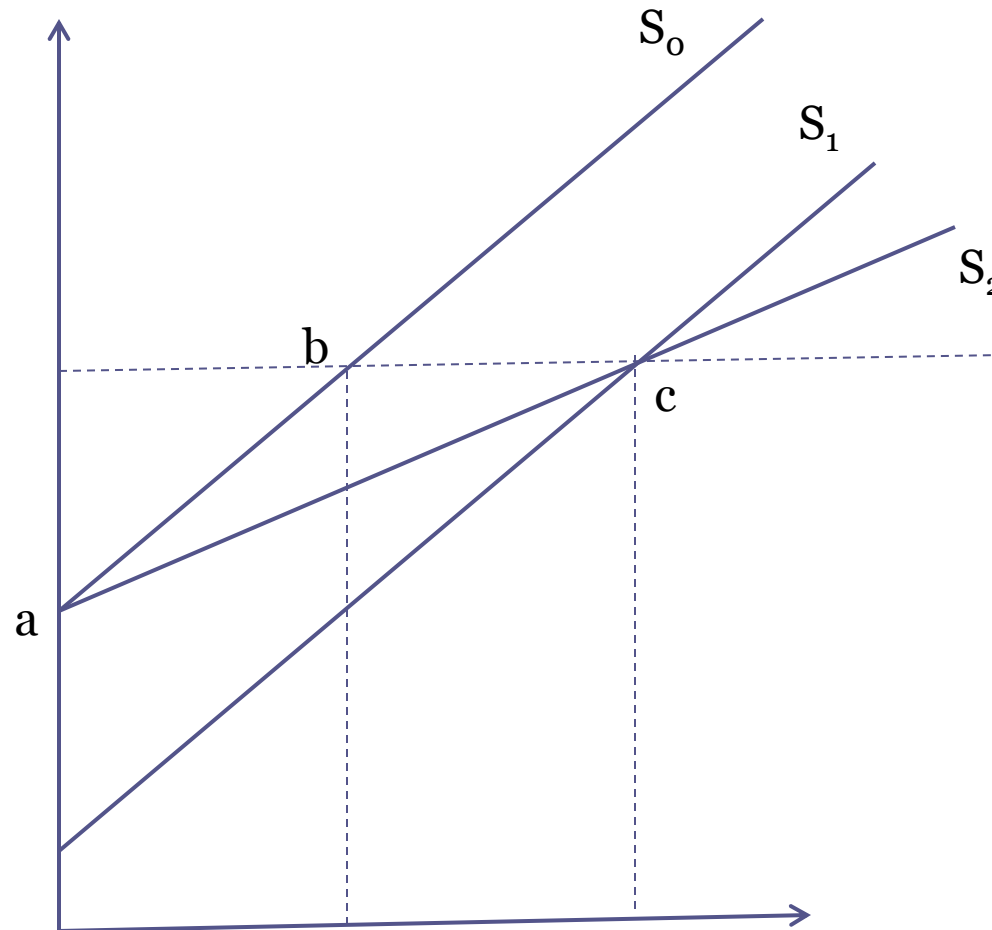
Income gains depend on nature of change

- The implications depend on specifics like
  - Whether the supply moves horizontally to the right
    - eg an increase in the effective supply of an essential input
  - Or shifts down vertically
    - eg a reduction in cost on all units
  - Or the same effective output yields more actual output
    - eg a rise in actual output from the same bundle of inputs

- Each can be represented using fully-specified profit functions

Profit function: horizontal shift

- Assume a quadratic profit function

  - $\Pi = \alpha_o + \alpha'P + \tfrac{1}{2}P'AP$ where P= $[p'\ \tau']'$

- For a tech change that affects only one output

  - $\Delta\Pi = \ p_i\, a_{ij}\, \Delta\tau_j \ = p_i\, \Delta q_i$

    - Note the output rise depends only on the size of the shock, not on the supply elasticity

Horizontal shift in supply

Profit gain abcd=bcef

S_0

S_1

b

c

a

d

f

e
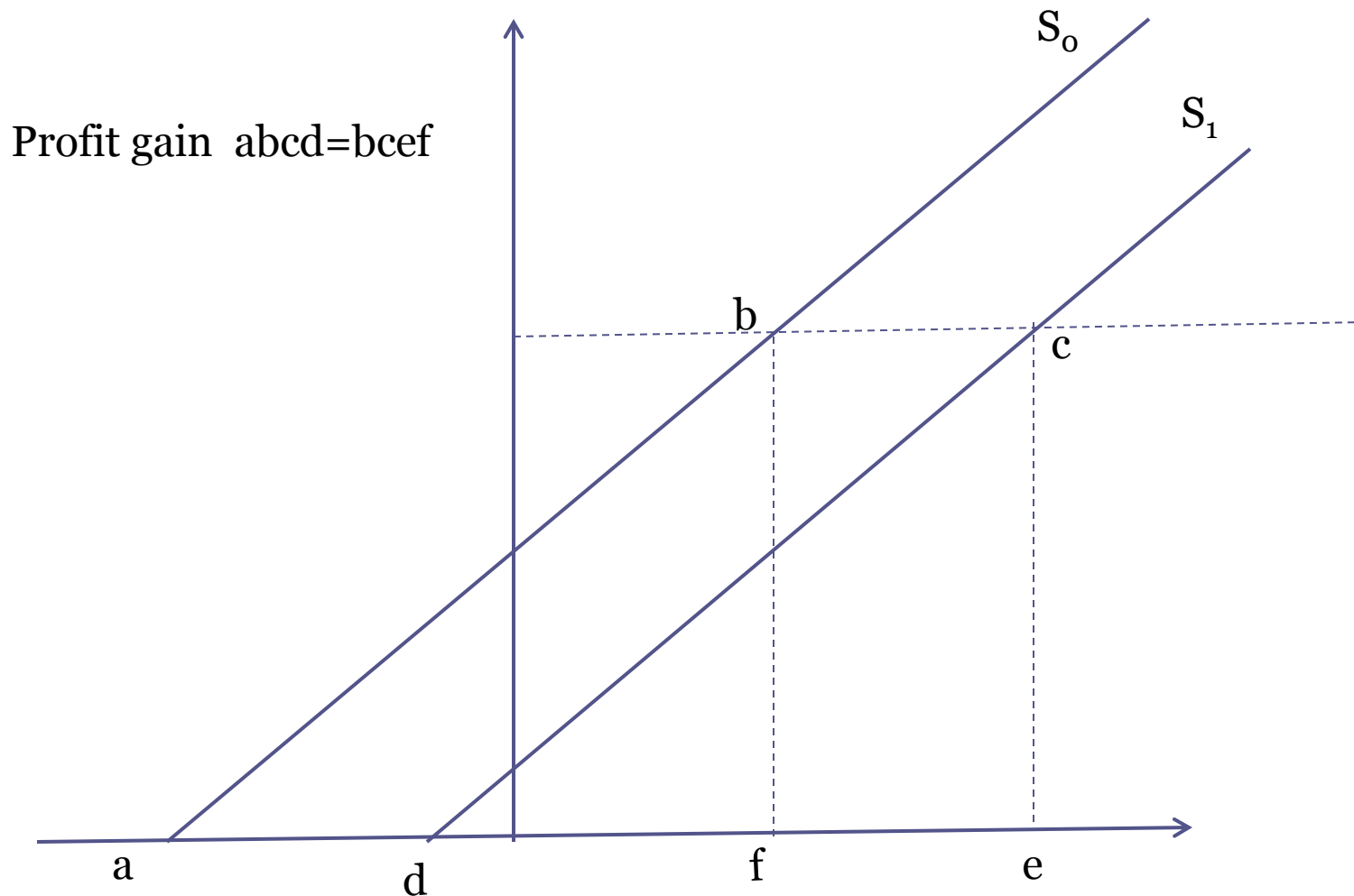
A cost-reducing technology

- Use the Π function to trace out a virtual supply curve
  And solve for short & long run effects

- $\Delta\Pi = q_o.\Delta\tau + \frac{1}{2} \Delta p \Delta q$

- In this case, the output rise depends on the elasticity as well as the size of the shock

Uniform cost reduction

S_o

S_1

b

e

c

a

d

Income gain   abcd + bce

Δ trade depends on elasticity

PS underestimates gains
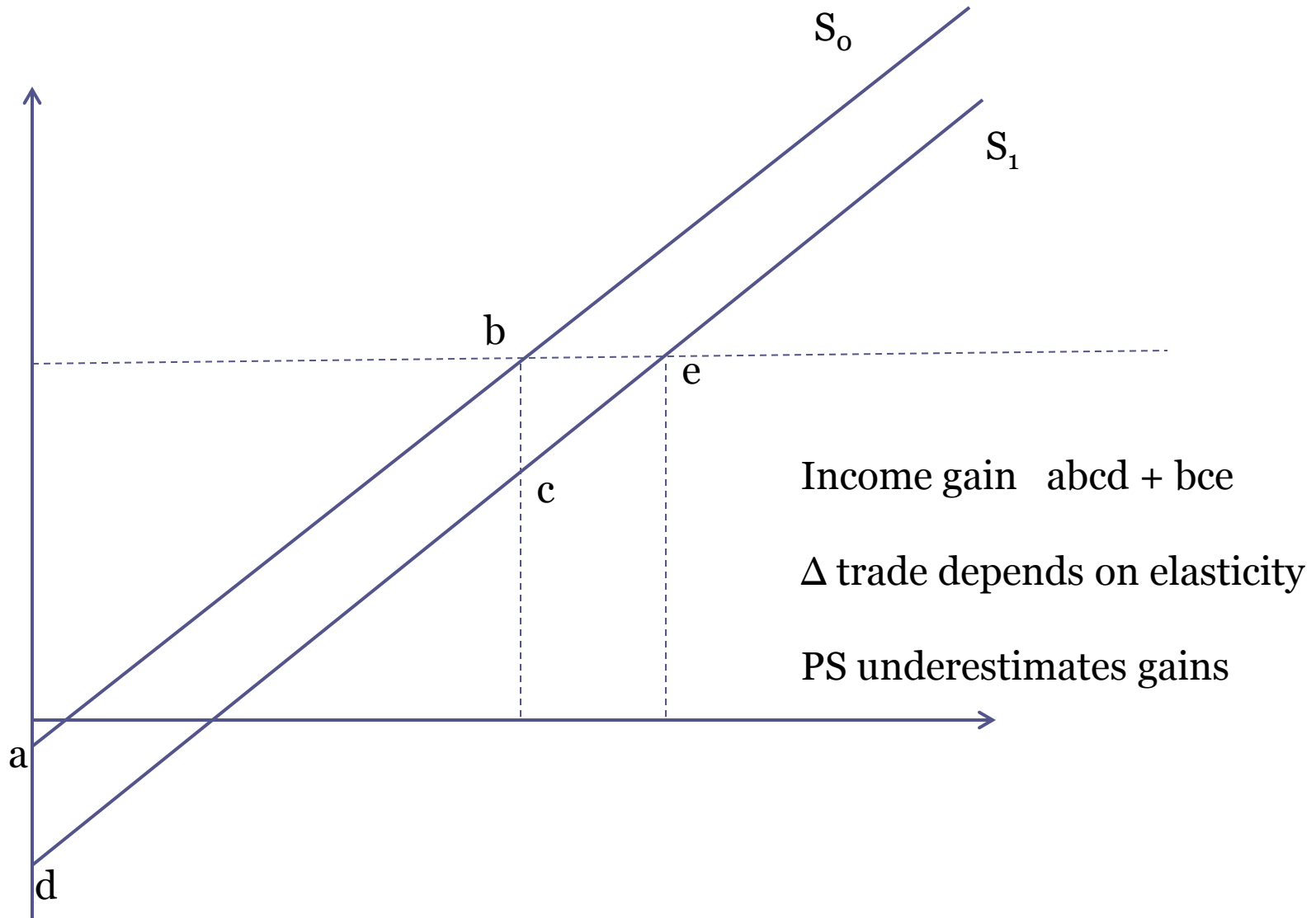
Most common approach: actual vs effective

- Here we use actual vs effective inputs
  - but also used for input-augmenting technological change

- $\Pi = \alpha_o + \alpha' p^* + \frac{1}{2} p^{*'} A p^*$
  - Where $p_i^* = p_i \cdot \tau_i$ and $q_i^* = q_i / \tau_i$

- $q_i = \tau_i (\alpha_i + \Sigma \alpha_{ij} p_j \tau_j)$

- NB: two impacts of τ, multiplicatively & through prices
  - Reflects two channels of effect– more from initial inputs, & more from higher profitability pulling in inputs
  - Not innocuous– has different implications for trade from other forms of technical change

Increasing actual output/unit of effective output

Profit gain bcef +cdf
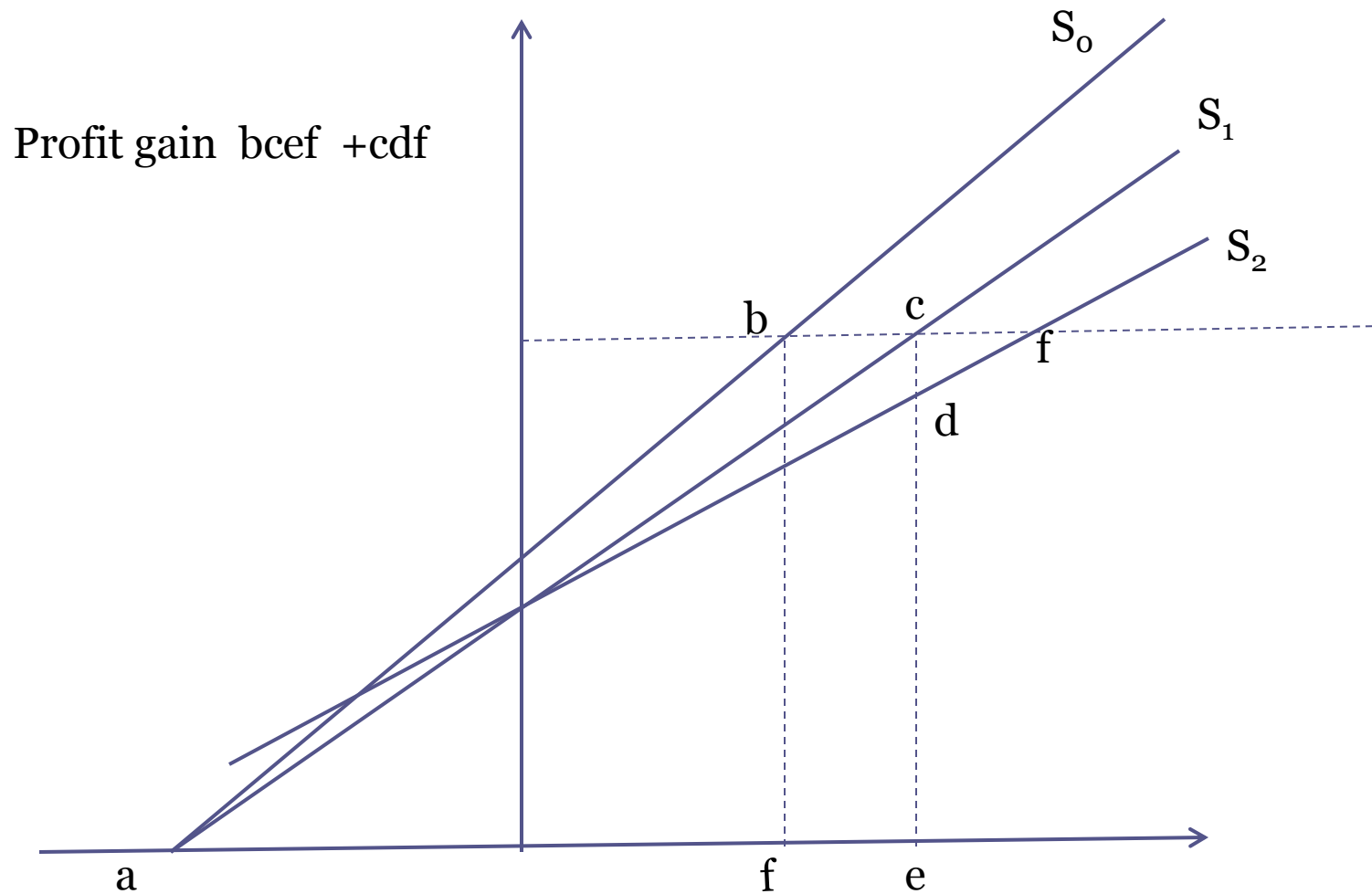
Productivity ↑ raises inputs in almost all cases

- Not consistent with the usual story that higher productivity saves labor and allows it to move to other sectors

- Consistent with experience in successful exporters

- Need to think hard about trade situation when considering impacts of productivity on sectoral input use

Factor bias also has implications for trade & income distribution

- Labor-saving technical change likely more important when agriculture is highly labor intensive

- Labor-augmenting technical change becomes more important after the Lewis point– as wages rise
  - endogenous (Hayami-Ruttan) technical change may help

Large economies

Large or closed countries & the world

- Now productivity rises push down output prices
  - Relatively large effects where the output rise is large relative to the producer income gain
    - Actual-effective distinction

- If the elasticity of demand is low, the decline in price may well reduce producer incomes
  - Particularly likely in closed economies where demand is just the domestic demand curve
  - And for the world as a whole
  - Inputs particularly likely to be "freed" up in this case

Welfare impacts depend on terms of trade

- TFP growth causes exporters' terms of trade to deteriorate

- Causes importers' terms of trade to improve

- Some of the income gains are shared with consumers in the rest of the world

Impact of trade distortions

Impact of trade distortions

- Depends heavily upon whether the distortion and the productivity change work in the same direction
- If a good is subsidized by a tariff or subsidy, the benefits from the productivity gain are reduced
  - If sufficiently heavily subsidized, the productivity gain may be immiserizing
  - Further, this loss accrues as a reduction in government revenues or higher subsidy payouts
    - So should probably be multiplied by the MCF

Size & trade distortions

- From a national perspective, large countries export too much, or import too much, under free trade
  - Optimal export tax for an exporter
  - Optimal import tax for an importer

- Nash-optimal trade tax internalizes the externality faced by a country
  - Allowing evaluation to focus just on net returns

- From a global viewpoint, focus on net returns adequate

Distributional implications

Consider TFP shocks by sector

- Productivity shock scaled to raise 1 percent of GDP
  - Larger shock for smaller sectors– interested in poverty intensity
    - Agriculture
    - Industry
    - Services
- Measure poverty impacts for sample of 30 developing countries
  - Producers benefit from the productivity shock
  - Everyone affected by changes in prices relative to CPI
- Two types of sequencing
  - Each country does shock independently
    - We calculate hypothetical global poverty change
  - All countries experience higher productivity together

# Resulting productivity shocks

	India	China	Indonesia	Bangladesh
Agriculture	5.6	8.8	5.7	3.7
Industry	3.1	1.8	2.7	4.0
Services	2.0	2.9	2.2	2.1

Global poverty impacts, % points
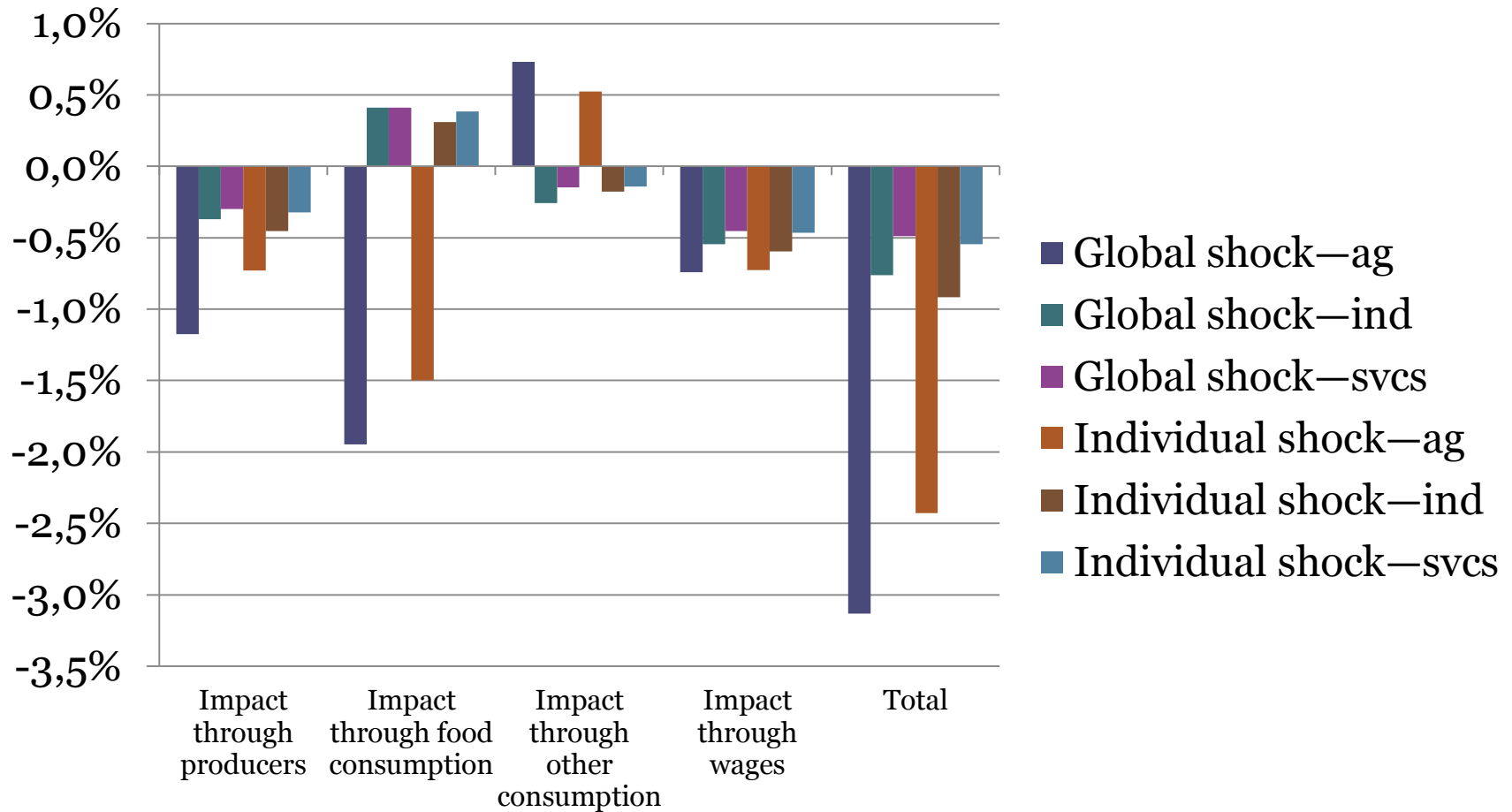
Findings of empirical analysis: agric

- Global agric productivity shock reduces poverty most
  - Estimated global reduction of 3.1 percentage points
  - Benefits farmers as prices decline less than income gain
  - Consumers benefit from lower food prices
  - Wage earners benefit from higher wages
- Individual countries can lower poverty independently
  - No need for coordination
  - Poverty reductions smaller but significant (2.4% pts)
- Individual action opportunity- collective action problem
  - Policy makers prefer farm income gains, gains in self sufficiency
    - But get mainly consumer gains
    - WTO wisely does not get in the way
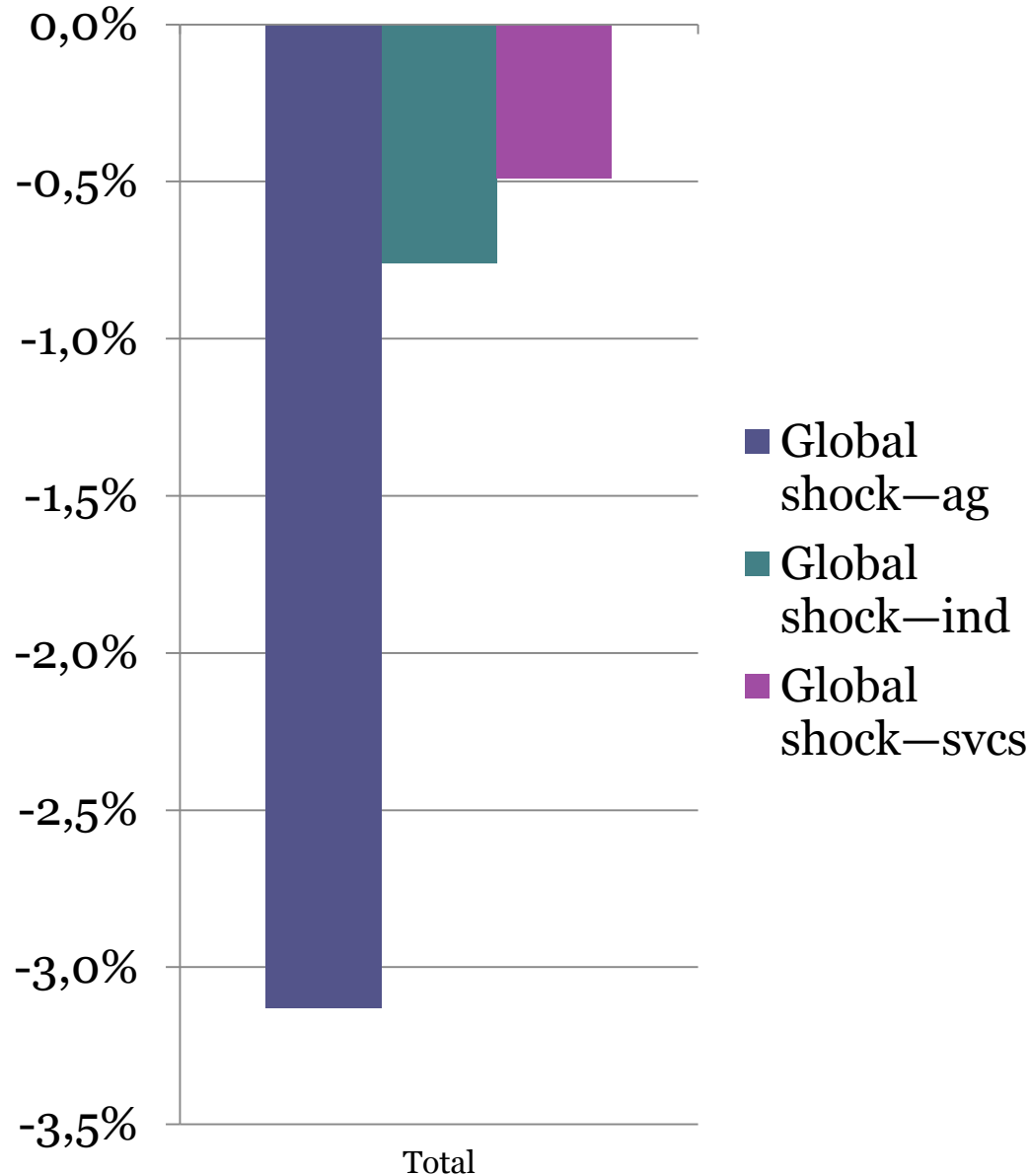
Global poverty impacts

- The poverty impact of an increase in agricultural productivity growth is much larger than for industry or services

- Much more intensive in unskilled labor on the production side

- Much more important for poor consumers on the consumption side

Legend:
- Global shock—ag
- Global shock—ind
- Global shock—svcs

Y-axis: 0,0%, -0,5%, -1,0%, -1,5%, -2,0%, -2,5%, -3,0%, -3,5%

X-axis: Total

Conclusions

- Impacts on of productivity growth on trade
  - May differ considerably depending on nature of change
  - Interaction with trade distortions affect welfare results
- Size & openness of economy affect prices
  - In small, open economies, higher productivity tends to increase resource use
  - Only frees up farm labor in large or closed economies
- Agricultural productivity growth much more beneficial for poverty reduction than other sectors
  - Labor intensity of prodn & importance of consumer gain

References

Ivanic, M and Martin, W. (2013), Poverty impacts of productivity growth in different sectors, Mimeo.

Martin, W. and Alston, J. (1997), 'Producer surplus without apology?: evaluating investments in R&D' *Economic Record,* 73(221):146-58, June.

Matsuyama, K. (1992), 'Agricultural productivity, comparative advantage and economic growth' *Journal of Economic Theory* 58(2):317-34.