Covid-19 Vaccine Investment Strategy for Developing Countries

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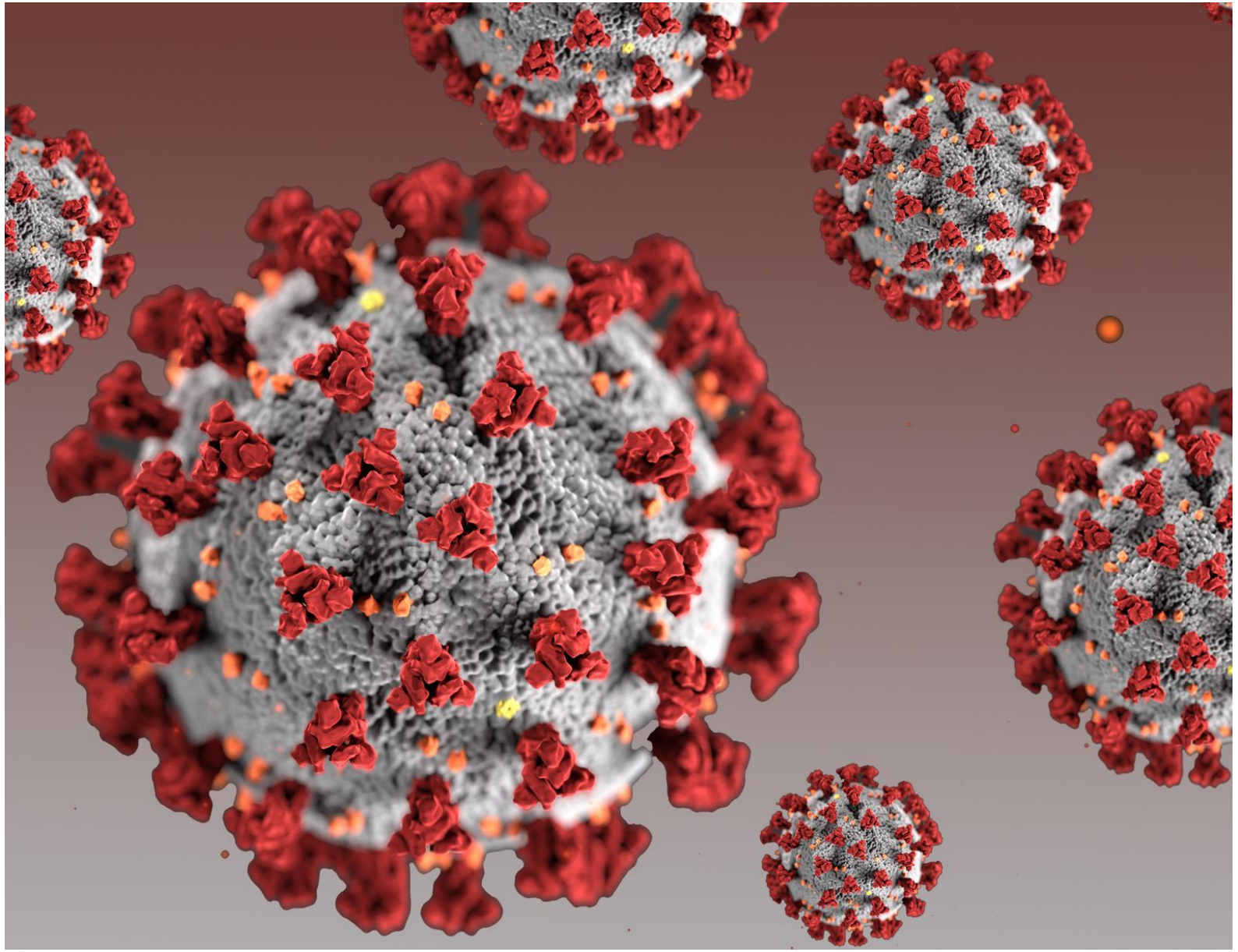
See https://www.acceleratinght.org/home



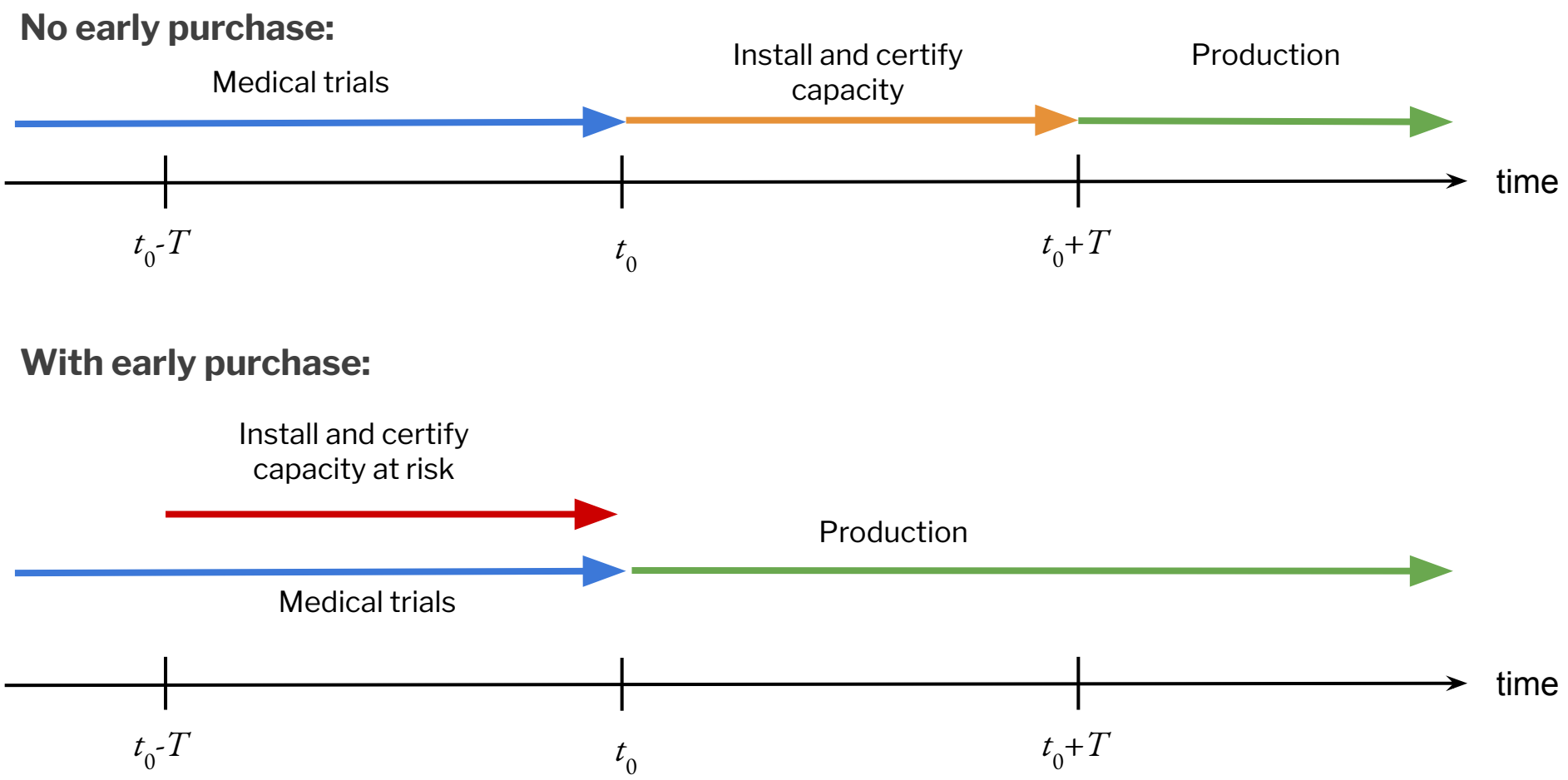
Benefits of advancing vaccines

- World Bank estimates a $12 trillion loss in 2020-2021 due to COVID-19
- Implies ~$500B gain from accelerating vaccine development by one month
- Before adding in mortality and health losses

Normal vaccine timeline

- At least 3-4 years from initial testing to commercial use
- Capacity installation only after trials (at least 6 months)
- Firms build limited capacity to serve high income market initially, long delays before all countries served

Vaccine investment timeline with and without early access



Existing deals to purchase vaccines in advance of approval.

e.g. - US paid AstraZeneca $1.2bn for 300m doses

COVAX funded element to cover low income countries

Is it worth it?

- Financing capacity installation in parallel with testing may accelerate vaccine availability by 6 months
- But risks wasting money on a vaccine that fails

Back of envelope calculation for US deal with AstraZeneca:

- If investing $1.2 billion in a vaccine gives only a 10% chance of accelerating a vaccine by 6 months. Benefit / cost ratio is 45.
- $1.2 billion investment is worth it if we knew it would accelerate a vaccine by just 10 hours.

Roadmap

- Introduction
- Optimal portfolio at current prices
- International equilibrium and role of international cooperation
- Conclusion and policy implications

Optimal portfolio at current prices

Key assumptions

Benefits

- Economic harm caused by Covid-19 from World Bank figures (5%-10% of GDP)
  - Include health benefits but results driven by economic benefits,
- Discount benefits by 50% - imperfect vaccines, probability that a treatment or other mitigation strategy will alleviate COVID-19 before a vaccine is available.
- Large share of benefits come from vaccinating health-care workers & elderly

Vaccine supply: 100+ vaccine candidates

- Probabilities of vaccine success (conservative, based on data on vaccine stage, platform)
- Correlations
- Costs

Assumed contractual form

Newspaper reports talk about countries “buying doses”,

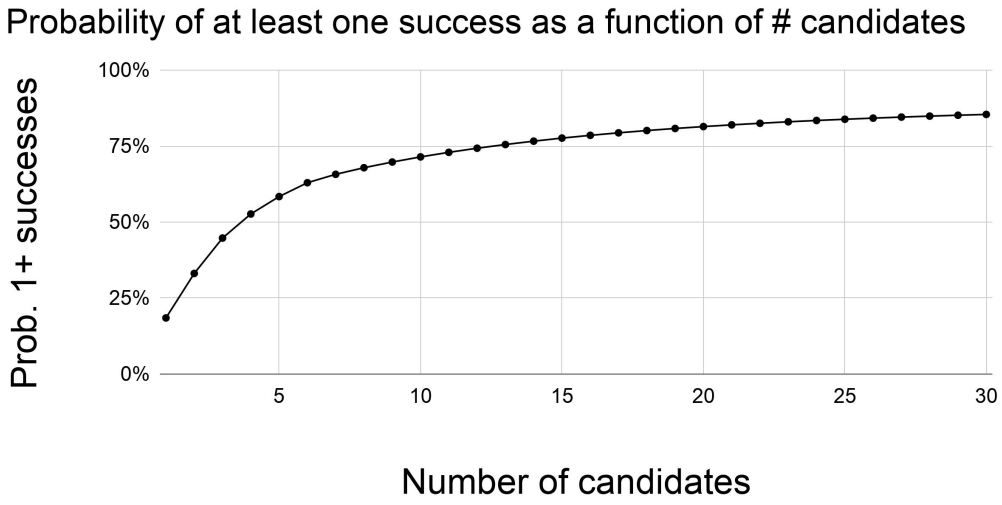
- Do not specify time of delivery, but early doses more valuable

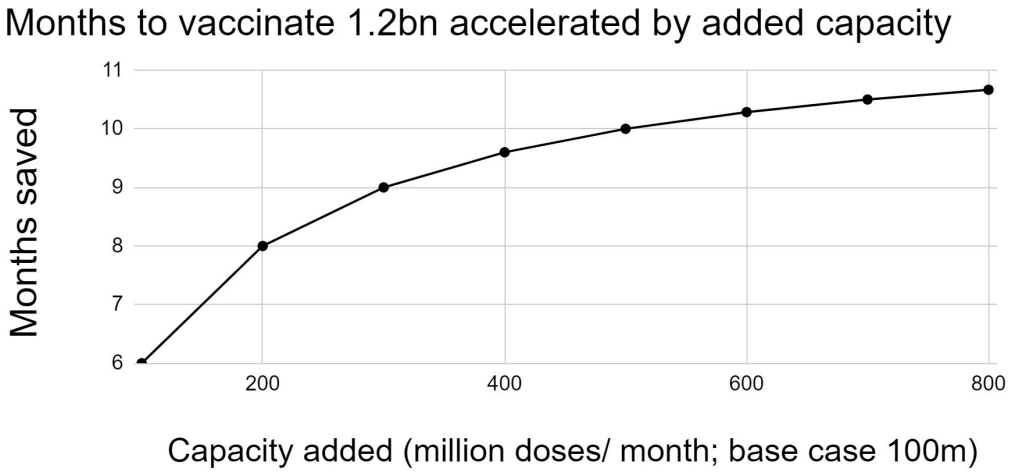
We model buyers as paying for capacity, option to purchase vaccine

- One way to obtain doses earlier is to pay up front to install manufacturing capacity
- In return, purchaser obtains option to buy doses from that capacity at close to marginal cost.
- This is efficient: if vaccine does not succeed, buyers do not pay for production cost

Diminishing returns to number of candidates, capacity per candidate

- Diminishing returns to adding more candidates
  - Start with strongest candidates
  - Probabilities capped at one
- The more capacity per candidate, the faster population can be vaccinated but:
  - First units go to high risk population
  - Doubling capacity doubles costs; halves time to vaccinate; subsequent doubling has higher costs, lower benefits
- Implies very high returns to investing in at least some candidates and capacity



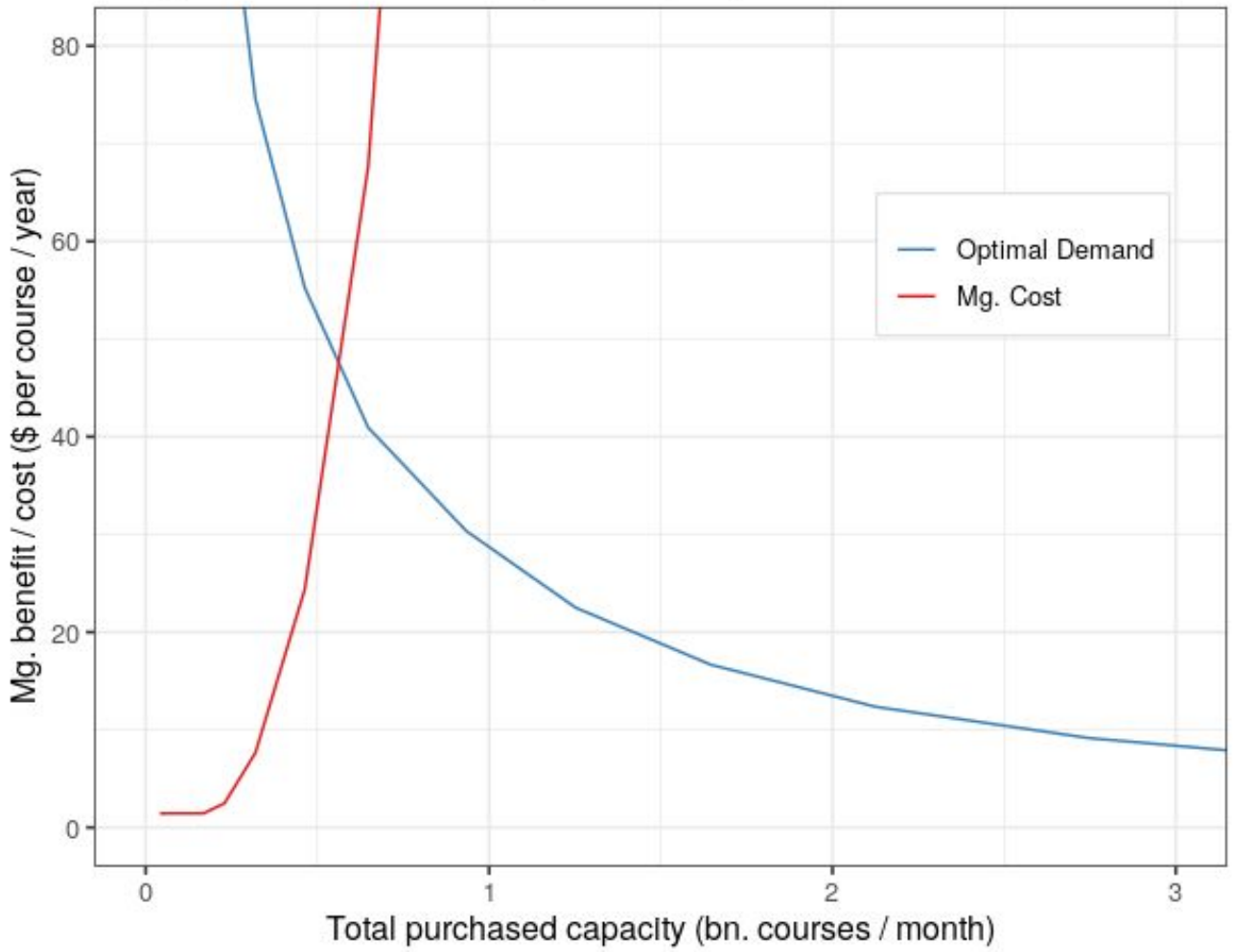


Total optimal purchases at current prices exceed feasible capacity

Country	Mean Candidates with significant Investment	Total Capacity (mn. courses / mth)	Total Capacity (courses / mth per thousand pop.)	Expected Benefits ($ per cap.)	Total Cost (bn. $)	Total Cost ($ per cap.)
High Income	27	2,767	227	685.3	133	112
Middle Income Developing	9	2,493	56	24.3	120	22
Low Income Developing	5	71	11	0.3	3	3

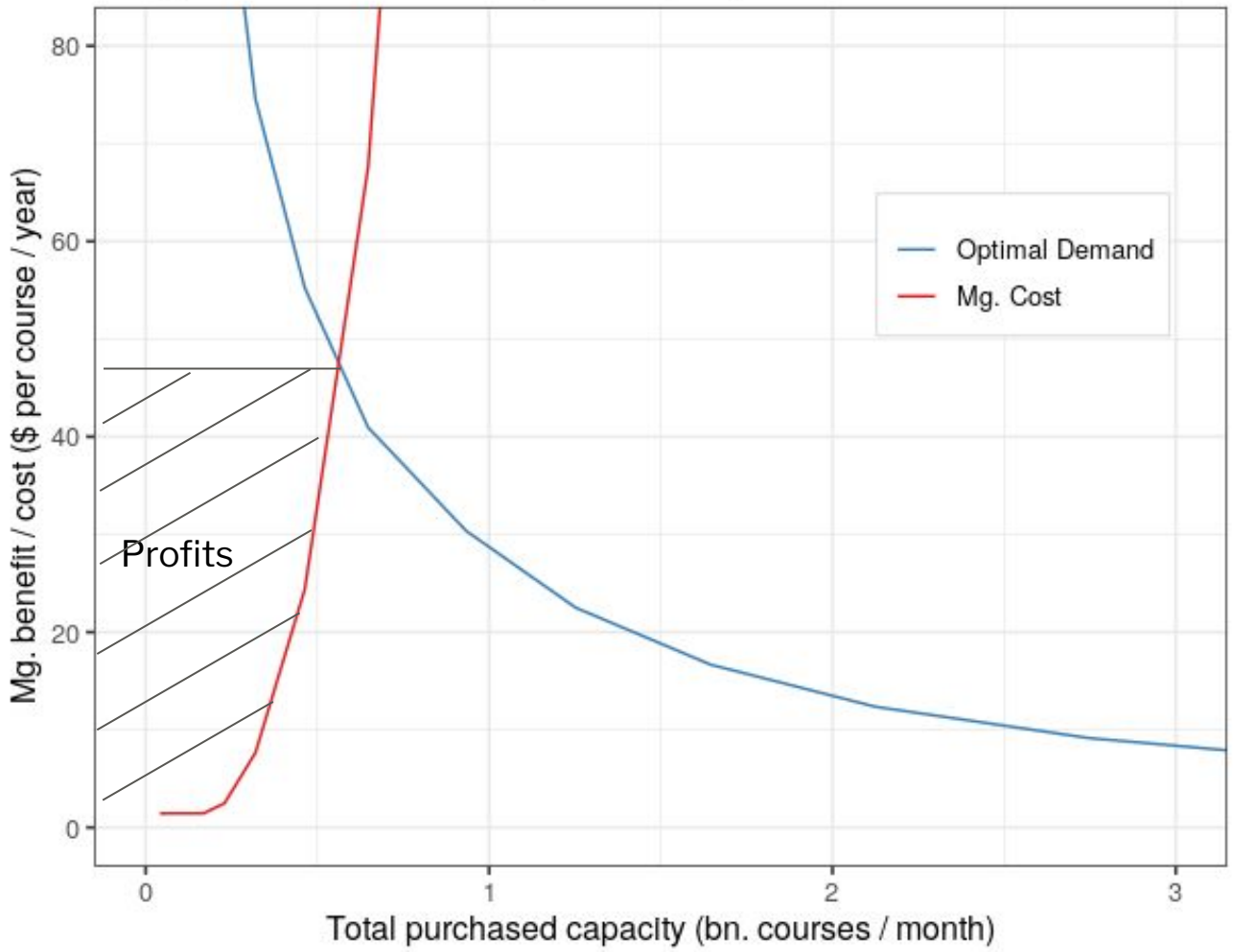
International equilibrium and role of international cooperation

Equilibrium in a market with national purchases



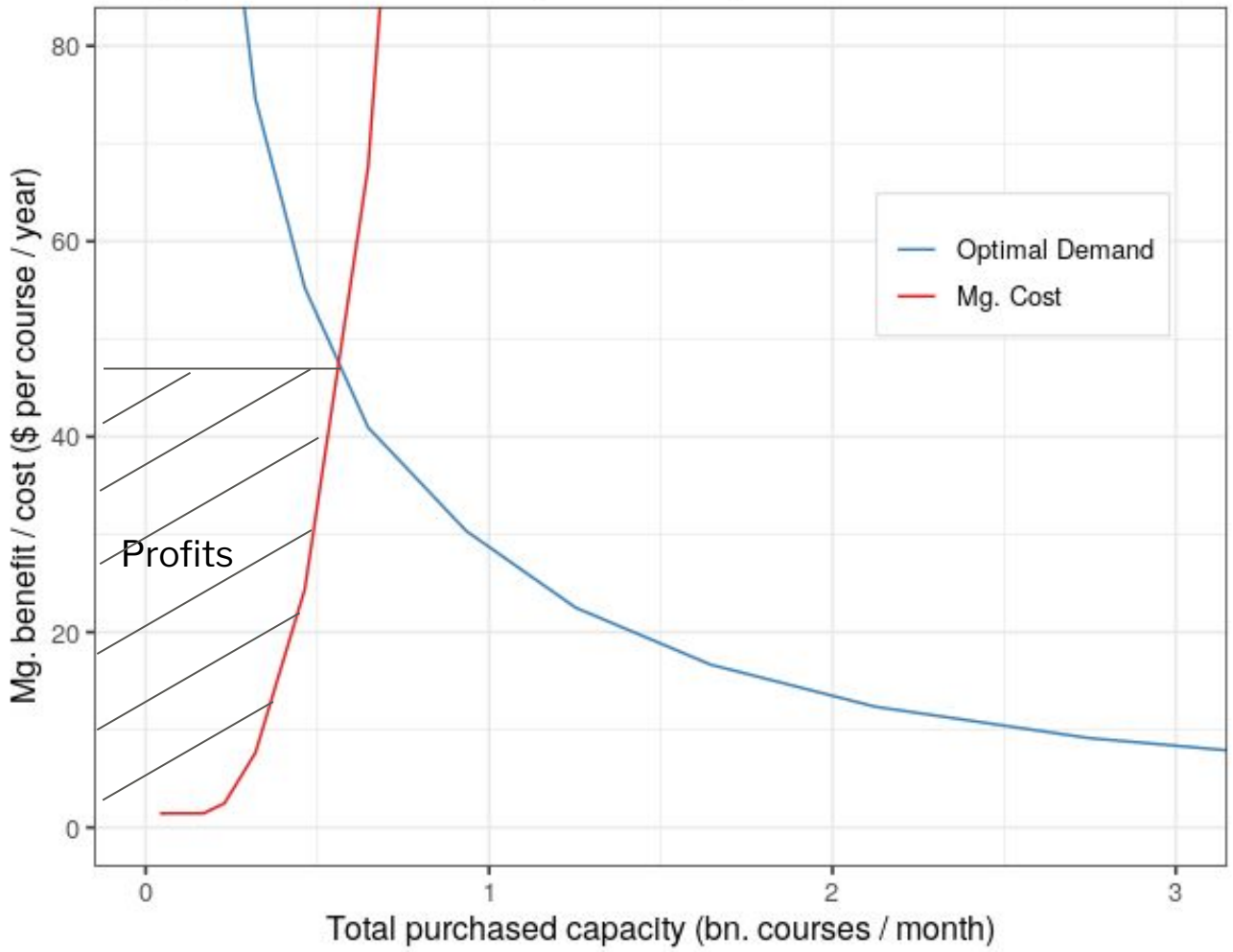
- Under standard economic analysis, price = marginal cost = marginal benefit

Equilibrium in a market with national purchases



- Under standard economic analysis, price = marginal cost = marginal benefit
- With an inelastic short-run supply curve , standard analysis suggests
  - Jump to high prices immediately
  - Rents for low cost suppliers
  - LICS and LMICs priced out of the market?

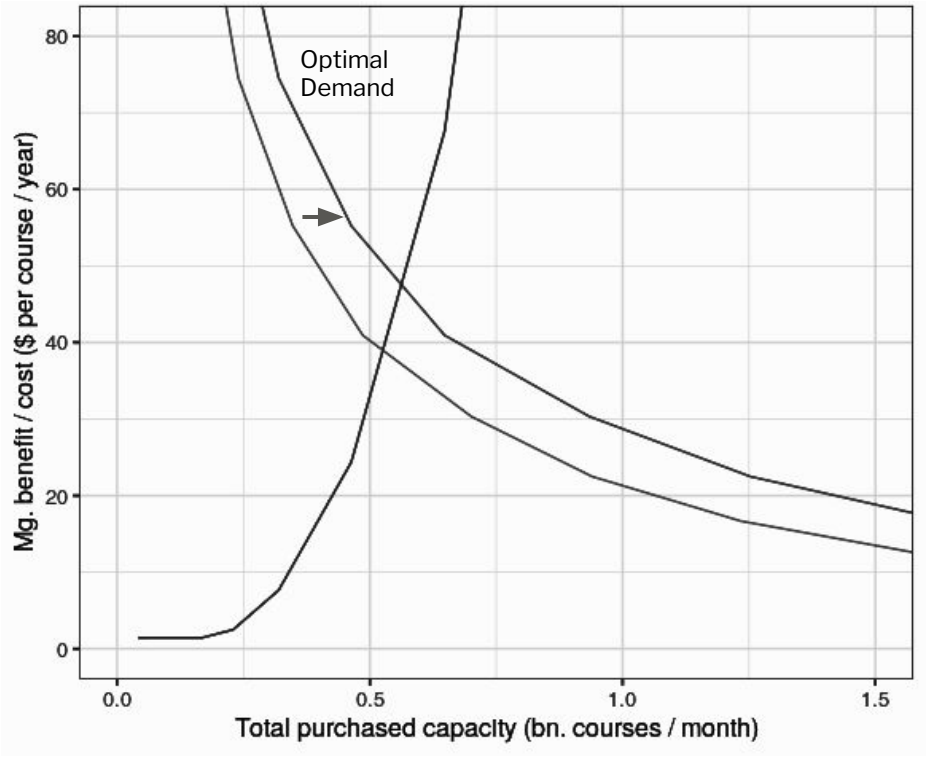
Equilibrium in a market with national purchases



- So far, prices have not jumped to this level.
  - Perhaps market participants expect lower demand, more elastic supply?
  - Perhaps each supplier prices at their cost + margin due to ethical/political concerns not to be seen as profiteering?
    - Suggest may work way up supply cost curve over time
    - Would generate race among buyers to lock in low prices

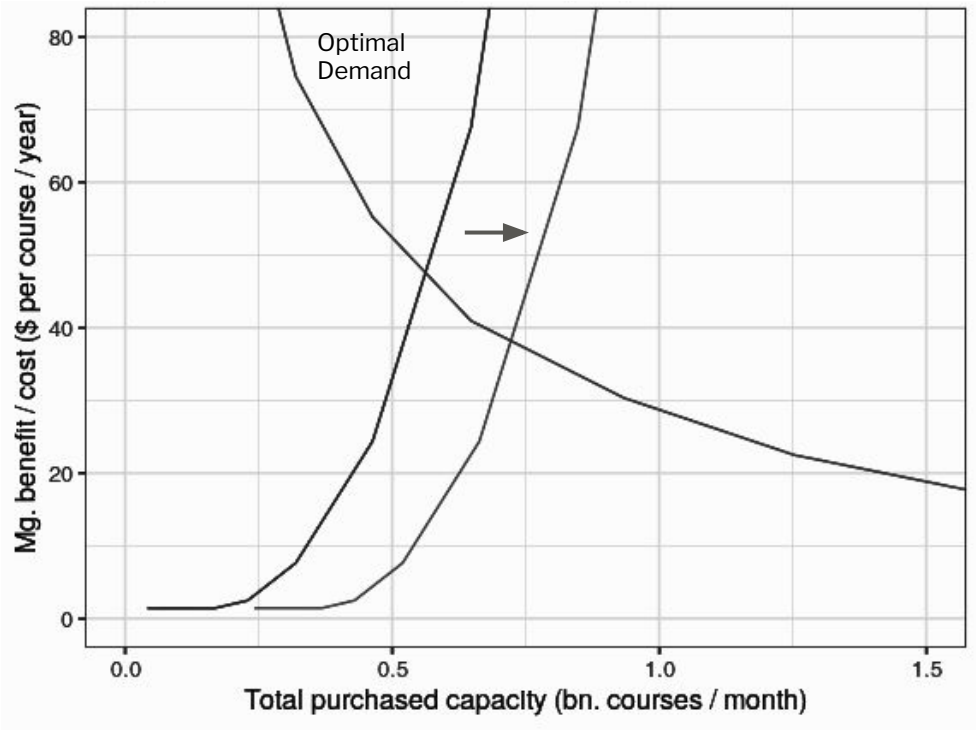
Buying capacity creates negative short-run but positive long-run pecuniary externalities for other buyers

Short Run



Short run demand curve shifts outward and price increases.

Long Run



Long run supply curve shifts outward and price decrease.

Policy Implications

National policy makers: buy now at current price

From a global perspective:

- Clear win from supporting low and middle-income countries to vaccinate priority populations early
- Buying additional early doses beyond that may have trade-offs, depending on elasticities, time perspective

NGO/Philanthropy role:

- Lend at least for countries to supply high priority populations
- Seek contracts that expand capacity

Global coordination in purchasing?

Coordinated global purchasing could potentially:

- Hold down prices for given demand through procurement design to capture rents that would go to inframarginal candidates, capacity suppliers
  - Optimal procurement design depends on information structure, ability to differentiate among producers
  - Will assume capacity installation costs roughly observable; more difficult to vary payment to producers based on probability of success
- Limit demand from high-income countries, allowing lower prices, earlier vaccine access for poorer countries (allocation according to health need not GDP)

Pull alone is more expensive, gives rents to inframarginal candidates

Could pay for capacity costs up front (push) or only for successful vaccines (pull)

Example:

- Each unit of capacity costs $4 to install.
- 3 candidates with 20%, 10% and 5% independent chance of success
  - Implies ~32% overall chance of success

	Prob success	Push	Pull
Candidate A	20%	$4	$4/0.2 ~ $20
Candidate B	10%	$4	$4/0.1 ~ $40
Candidate C	5%	$4	$4/0.05 ~ $80
Expected program cost		**$4+ $4 +$4 = $12**	**$80 * 32% ~ $26**

Combining Push and Pull Funding

- Model suggests forces in example are quantitatively important
- Some pull element desirable to incentivize speed, capacity; weed out manufacturers with private information that their candidate unlikely to succeed
- Suggests substantially different structure than pneumococcus AMC

Equalizing dose allocation across countries

- Optimal program for global health planner
  - Distribute by health need, independent of GDP
  - Larger short-run health benefits. Smaller economic benefits, as rich countries get less access
  - Much smaller program than sum of plans for individual countries, so holds down short-run demand, prices
    - Long-run impact unclear since fewer candidates, less total capacity
- Unlikely to be incentive compatible for high-income countries

Conclusion

- Given the enormous benefits of accelerating vaccine availability, worth investing in vaccine capacity in parallel with testing
  - Diversified pool of candidates
  - Large capacity
  - It is in the interests of low and middle income countries to invest now
- Optimal incentives include large “push” component, with up front payments for capacity installation in exchange for option to purchase vaccine