Covid-19 vaccine supply chain bottlenecks and international policy cooperation

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Respected @POTUS, if we are to truly unite in beating this virus, on behalf of the vaccine industry outside the U.S., I humbly request you to lift the embargo of raw material exports out of the U.S. so that vaccine production can ramp up. Your administration has the details. 🙏🏻

4:46 AM · Apr 16, 2021 · Twitter Web App

27.3K Retweets  2,544 Quote Tweets  107.8K Likes

US export ban on vaccine supplies?

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FINANCIAL TIMES  MARCH 14 2021

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US export ban on vaccine supplies? No

Still, economic problem: shortages of specialized inputs

Source: Bown, Chad P. and Chris Rogers, The US did not ban exports of vaccine supplies. But more help is needed. PIIE Trade and Investment Policy Watch, 7 June 2021.
Why are there input shortages?

- 10 companies (plants) making the drug product
  - 9 companies (plants) doing the fill and finish
- They may all be going to the same input providers
Novavax’s global vaccine manufacturing network

Stages and partners involved in Novavax vaccine production

**Drug substance and drug product**

**US supply chain**
- FUJIFILM Diosynth Biotechnologies (FDB), North Carolina, US
- FDB, Texas, US

**UK supply chain**
- FDB, Stockton-on-Tees, UK

**European supply chain**
- Novavax, Bohumil, Czech Republic
- Biofabri, Spain

**Korean supply chain**
- SK Bioscience, Andong L-house, South Korea

**Indian supply chain**
- Serum Institute of India (SII), Pune, India

**Japanese supply chain**
- Takeda Pharmaceutical, Hikari, Japan

**Fill and finish**

- Par Sterile Products (Endo), Michigan, US
- Jubilant HollisterStier, Washington, US
- GlaxoSmithKline, Barnard Castle, UK
- Baxter, Halle, Germany
- Siegfried, Hameln, Germany

**Distribution**

- To be determined

- Vaccine distribution centers
Policy Interventions and Vaccine Supply Chains during the Pandemic

- United States: Operation Warp Speed and Defense Production Act
  - United Kingdom
  - European Union, Germany and others
  - CEPI and foundations
## US: Operation Warp Speed and Defense Production Act

### US Federal Subsidies or Contracts to COVID-19 Vaccine Supply Chain, 2020 through March 12, 2021

<table>
<thead>
<tr>
<th>Company</th>
<th>Amount</th>
<th>Date</th>
<th>Task</th>
<th>Contract manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vaccine sponsors</strong></td>
<td></td>
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<tr>
<td>Johnson &amp; Johnson (Janssen)</td>
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<tr>
<td>$21 million</td>
<td>February 11, 2020</td>
<td>Support nonclinical studies and a Phase 3 clinical trial</td>
<td>Eli Lilly &amp; Co. $68.75 million</td>
<td>May 30, 2020</td>
</tr>
<tr>
<td>$448 million</td>
<td>March 21, 2020</td>
<td>Amendment</td>
<td>Dulbecco Biosolutions (Texas A&amp;M University) $20 million</td>
<td>August 6, 2020</td>
</tr>
<tr>
<td>$1 billion</td>
<td>August 5, 2020</td>
<td>Demonstrate large-scale manufacturing, 100 million doses</td>
<td>Fulfill Diagnostics (Tulsa A&amp;M University) $265 million</td>
<td>July 24, 2020</td>
</tr>
<tr>
<td>$65 million</td>
<td>August 21, 2020</td>
<td>(Unknown)</td>
<td>Grand River Aseptic Manufacturing (GRAM) $181 million</td>
<td>August 6, 2020</td>
</tr>
<tr>
<td>$404 million</td>
<td>November 11, 2020</td>
<td>Amendment, funding for Phase 3 clinical trial</td>
<td>Cobiq Bio $106 million</td>
<td>August 17, 2020</td>
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<tr>
<td><strong>Contract manufacturers</strong></td>
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<tr>
<td>Merck and RIVI</td>
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<tr>
<td>$20 million</td>
<td>April 15, 2020</td>
<td>Accelerate development of vaccine candidate</td>
<td>Merck $280 million</td>
<td>March 2, 2021</td>
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<tr>
<td>Moderna</td>
<td></td>
<td></td>
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<tr>
<td>$250 million</td>
<td>April 16, 2020</td>
<td>Accelerate development of vaccine candidate</td>
<td>Moderna $30 million</td>
<td>May 14, 2021</td>
</tr>
<tr>
<td>$54 million</td>
<td>May 24, 2020</td>
<td>Expand manufacturing capacity</td>
<td>Moderna $30 million</td>
<td>May 14, 2021</td>
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<tr>
<td>$4.2 million</td>
<td>July 26, 2020</td>
<td>Support Phase 3 clinical trial</td>
<td>Moderna $30 million</td>
<td>May 14, 2021</td>
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<td>$1.9 billion</td>
<td>August 11, 2020</td>
<td>Support Lonza’s manufacturing; 100 million doses</td>
<td>Johnson &amp; Johnson $1.9 billion</td>
<td>December 31, 2020</td>
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<tr>
<td>$167.1 million</td>
<td>December 11, 2020</td>
<td>100 million doses</td>
<td>Moderna $30 million</td>
<td>May 14, 2021</td>
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<td>$17.5 million</td>
<td>February 11, 2021</td>
<td>100 million doses</td>
<td>Moderna $30 million</td>
<td>May 14, 2021</td>
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<tr>
<td><strong>Equipment and other input suppliers</strong></td>
<td></td>
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<tr>
<td>SIO2 Materials Science</td>
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<tr>
<td>$143 million</td>
<td>June 5, 2020</td>
<td>Glass tubing and vials</td>
<td>Sio2 Materials Science $143 million</td>
<td>June 5, 2020</td>
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<tr>
<td><strong>Corning</strong></td>
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<tr>
<td>$204 million</td>
<td>June 5, 2020</td>
<td>Glass tubing and vials</td>
<td>Corning $204 million</td>
<td>June 5, 2020</td>
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<td><strong>Erector, Dickinson and Co.</strong></td>
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<tr>
<td>$42 million</td>
<td>July 1, 2020</td>
<td>Syringes and needles</td>
<td>CORning $204 million</td>
<td>June 5, 2020</td>
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<td><strong>Retractable Technologies</strong></td>
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<tr>
<td>$54 million</td>
<td>July 1, 2020</td>
<td>Syringes and needles</td>
<td>ReTip Technologies $54 million</td>
<td>July 1, 2020</td>
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<td><strong>Smiths Medical</strong></td>
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<tr>
<td>$71 million</td>
<td>July 11, 2020</td>
<td>Syringes and needles</td>
<td>Smiths Medical $71 million</td>
<td>July 11, 2020</td>
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<tr>
<td><strong>Cytiva</strong></td>
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<tr>
<td>$51 million</td>
<td>October 16, 2020</td>
<td>Cellular material, filter bags, and bioreactors</td>
<td>Cytiva $51 million</td>
<td>October 16, 2020</td>
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<tr>
<td><strong>Applikon Systems</strong></td>
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<tr>
<td>$530 million</td>
<td>November 19, 2020</td>
<td>Prefilled, single-dose injectors</td>
<td>Applikon Systems $530 million</td>
<td>November 19, 2020</td>
</tr>
</tbody>
</table>

Sources: Compiled by the authors from Biomedical Advanced Research and Development Authority, 2021; BARDA’s Rapidly Expanding COVID-19 Medical Countermeasure Portfolio® and BARDA’s COVID-19 Domestic Manufacturing & Infrastructure Investments ©; Novavax ©, Merck ©, GRAM ©, and US International Development Finance Corporation ©.

Note: Loan to finance 75 percent of the project’s capital costs.
How to use supply chain transparency to minimize COVID-19 vaccine input shortages

Five policy steps

1. **Survey vaccine production facilities** about their inputs to establish what they need, where they source from, and on what schedule.

2. **Aggregate the information** by input-supplying firm to determine the volume that each firm needs to provide.

3. **Survey each input** supplier to cross-check the data and determine if their existing capacity can meet demand.

4. **Identify input shortages.**

5. **For shortages of customized inputs**
   - **Short-term solution:** Increase production at existing facilities, e.g., incentivize addition of second, third, and weekend shifts.
   - **Long-term solution:** Incentivize investment to expand capacity. Use subsidies when there is insufficient private (market) incentives.

   **For general inputs**
   - Use data accumulated in step 3 to identify alternate suppliers with spare capacity.

   If input shortfalls still arise, policymakers can help ration limited supplies.

**Source:** Authors’ recommendations (Chad P. Bown, PIIE, and Chris Rogers, S&P Global Market Intelligence Panjiva).
How to scale out globally when fragmentation also crosses borders?

Implications
1. Everyone needs to subsidize their part of the supply chain to address the global externality
2. Without coordination/cooperation, everyone subsidizes too little

Practical challenges
1. Fear of noncooperation (export restrictions) on vaccine output leads to too little subsidization of vaccine inputs
2. Some vaccine input countries may be fiscally constrained and unable to subsidize
Proposal: COVID-19 Vaccine Investment and Trade Agreement (CVITA)

Five principles

1. **Leverage COVAX** – distribute based on global public health (attack externality at its source)

2. **Investment**: coordinate (and fund) subsidies across the full supply chain

3. **Enforcement**: make explicit that export restrictions on vaccine output will be met with (joint) limits on vaccine inputs

4. **Transparency**: AMIS-like information on availability of vaccine inputs and outputs

5. **Administrator**: one part general contractor (DPA/OWS), one part ombudsperson (resolve frictions)
References


