Dutch Disease? Firm-level evidence from Indonesia

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What’s Dutch Disease and why would it matter?

- Does oil and gas extraction make manufacturing less competitive by increasing wages?
- This is important as manufacturing may be special in terms of productivity spillovers (Matsuyama, 1992)
How does one catch the Dutch Disease?

- Corden and Neary (1982): Extra wealth $\rightarrow$ appreciation of real exchange rate $\rightarrow$ contraction of traded sector
- Allcott and Keniston (2014): Whether manufacturing contracts during a resource boom depends on whether:
  - local manufacturing wages rise
  - prices are exogenous, i.e. don’t rise
Is Dutch Disease real?

- Smith (2014): Wages and employment increase in oil-dependent countries during the oil price boom in the 1970s
- Little on firm-level Dutch Disease effects
  → Allcott and Keniston (2014) is one recent exception
This paper

- What is the effect of oil and gas extraction on wages across Indonesian firms?
- Our contribution:
  - Firm-level evidence from an emerging economy
  - An improved identification strategy
Recent and relevant papers to keep in mind

- Cavalcanti et al. (2015): Compare Brazil municipalities where oil was discovered to municipalities with drilling but no discovery
  → Oil discoveries significantly increase GDP per capita
  → Positive spillovers to services and manufacturing GDP
Recent and relevant papers to keep in mind

- De Haas and Poelhekke (201X): Look at firms in emerging economies
  - Firms report more constraints to doing business if they are located within 20km of active mines
  - These constraints include access to educated workers
What about papers on Indonesia?

- Cust and Rusli (2014) look at fiscal transfers related to oil production in Indonesia → They boost local GDP
- Cust (2014) examines the labor market effects of mines in Indonesia → Shift of employment from the traded manufacturing sector to the non-traded services sector
Indonesia is a resource-rich country

Source: World Development Indicators, World Bank.
Indonesia is a resource-rich country

Source: The Observatory of Economic Complexity
Indonesia is a resource-rich country

Source: Wood Mackenzie
Indonesia is a resource-rich country

Oil and gas total production 1990–2008

Note: Around 85% of districts have no oil or gas production in any period. 35% of production fields are offshore but can be linked to a closest district. Source: Wood Mackenzie.
Ups and downs in oil and gas production among non-dry districts
Data

- Indonesian Manufacturing Census 1990-2008
- All plants with more than 20 employees (>30,000 plants)
- We look at wages, exit rates, and prices using core products’ unit values
- As in Amiti and Davis (2012), wages are the log of the average firm-level wage, defined as the total wage bill divided by the number of workers
### Table: "Two-digit industries, ISIC rev. 3"

<table>
<thead>
<tr>
<th>isic_2d</th>
<th>isic_2d_name</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Manu. of food products and beverages</td>
<td>7617</td>
</tr>
<tr>
<td>16</td>
<td>Manu. of tobacco products</td>
<td>1544</td>
</tr>
<tr>
<td>17</td>
<td>Manu. of textiles</td>
<td>3646</td>
</tr>
<tr>
<td>18</td>
<td>Manu. of wearing apparel; dressing and dyeing of fur</td>
<td>3112</td>
</tr>
<tr>
<td>19</td>
<td>Tanning and dressing of leather; Manu. of luggage, handbags, saddlery, harness and footwear</td>
<td>922</td>
</tr>
<tr>
<td>20</td>
<td>Manu. of wood and of products of wood and cork, except furn.; articles of straw and plaiting mat.</td>
<td>2186</td>
</tr>
<tr>
<td>21</td>
<td>Manu. of paper and paper products</td>
<td>709</td>
</tr>
<tr>
<td>22</td>
<td>Publishing, printing and reproduction of recorded media</td>
<td>990</td>
</tr>
<tr>
<td>23</td>
<td>Manu. of coke, refined petroleum products and nuclear fuel</td>
<td>232</td>
</tr>
<tr>
<td>24</td>
<td>Manu. of chemicals and chemical products</td>
<td>1384</td>
</tr>
<tr>
<td>25</td>
<td>Manu. of rubber and plastics products</td>
<td>1869</td>
</tr>
<tr>
<td>26</td>
<td>Manu. of other non-metallic mineral products</td>
<td>2579</td>
</tr>
<tr>
<td>27</td>
<td>Manu. of basic metals</td>
<td>406</td>
</tr>
<tr>
<td>28</td>
<td>Manu. of fabricated metal products, except machinery and equipment</td>
<td>1218</td>
</tr>
<tr>
<td>29</td>
<td>Manu. of machinery and equipment n.e.c.</td>
<td>650</td>
</tr>
<tr>
<td>30</td>
<td>Manu. of office, accounting and computing machinery</td>
<td>266</td>
</tr>
<tr>
<td>31</td>
<td>Manu. of electrical machinery and apparatus n.e.c.</td>
<td>427</td>
</tr>
<tr>
<td>32</td>
<td>Manu. of radio, television and communication equipment and apparatus</td>
<td>380</td>
</tr>
<tr>
<td>33</td>
<td>Manu. of medical, precision and optical instruments, watches and clocks</td>
<td>240</td>
</tr>
<tr>
<td>34</td>
<td>Manu. of motor vehicles, trailers and semi-trailers</td>
<td>425</td>
</tr>
<tr>
<td>35</td>
<td>Manu. of other transport equipment</td>
<td>453</td>
</tr>
<tr>
<td>36</td>
<td>Manu. of furniture; manufacturing n.e.c.</td>
<td>3122</td>
</tr>
<tr>
<td>37</td>
<td>Recycling</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>34463</td>
</tr>
</tbody>
</table>
Identification

- Oil and gas extraction may take place where institutions and infrastructure are best, and this also favors manufacturing.
- We need exogenous variation in the location and timing of oil and gas windfalls.
- This comes from luck in oil and gas discovery’s interaction with the real oil price.
Identification

- This means we focus only on districts where exploration took place
  → Cavalcanti et al. (2015) suggest districts with exploration but no discovery are a valid counterfactual

- We exploit both randomness in success of oil exploration and yearly variation in oil prices in our identification
  → Cotet and Tsui (2013) also exploit randomness in success of oil exploration to look at effect of oil wealth on conflict
Production is influenced by luck but luck does not increase with exploration drilling.

\[ \text{Exploration wells (log)} \]

Regression coeff: .011. Std. error clustered by year and Kab: .017

\[ \text{Oil and gas production} \]

Regression coeff: 3.24. Robust s.e.: 1.20
Wages

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**Average wage**


- Luck in exploration
- No luck

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**Average wage**


- Oil and Gas
- No Oil and Gas

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*Cust et al.*

*Dutch Disease*

March 28, 2016
Exit rates

![Graph of exit rates showing two lines: one labeled 'Luck in exploration' and another labeled 'No luck'. The x-axis represents years from 1990 to 2005, and the y-axis represents exit rates from 0 to 0.15.]

![Graph of exit rates showing two lines: one labeled 'Oil and Gas' and another labeled 'No Oil and Gas'. The x-axis represents years from 1990 to 2005, and the y-axis represents exit rates from 0 to 0.15.]

Cust et al.
Number of firms

- Luck in exploration
- No luck

- Oil and Gas
- No Oil and Gas
Manufacturing output

- Luck in exploration
- No luck

- Oil and Gas
- No Oil and Gas
## Cross section of firms

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery rate</td>
<td>0.033*</td>
<td>0.027*</td>
<td>0.037*</td>
<td>0.033*</td>
<td>-0.030</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.014)</td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.036)</td>
<td>(0.036)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.111***</td>
<td>0.120***</td>
<td>0.259***</td>
<td>0.259***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.026)</td>
<td>(0.026)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>14763</td>
<td>14763</td>
<td>11731</td>
<td>11731</td>
<td>16025</td>
<td>16023</td>
</tr>
<tr>
<td>R2</td>
<td>0.001</td>
<td>0.008</td>
<td>0.001</td>
<td>0.008</td>
<td>0.001</td>
<td>0.012</td>
</tr>
<tr>
<td>Industry FE</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

Kabubpaten-clustered s.e. in parenthesis. * 0.10 ** 0.05 *** 0.01.
Cross section of firms

Effect of exploration luck on wage growth

Dutch Disease

March 28, 2016
Panel identification

\[ Y_{it} = \alpha_i + \delta_{jt} + \beta L_i \times P_t + u_{it} \] (1)

- \( L_i \) is luck, i.e. the number of non-dry wells above total wells dug in the kabupaten of firm \( i \)
- \( P_t \) is the oil price in year \( t \) in 2010 USD
- \( \alpha_i \) and \( \delta_{jt} \) are firm and industry-year fixed effects
- Standard errors are clustered two ways:
  - By firms to take into account potential serial correlation
  - By kabupaten-year to adjust for any Moulton bias, as the treatment is more aggregated than the outcome.
### Panel (Reduced-form) - Only explored Kabupatens

<table>
<thead>
<tr>
<th>(1) Wage</th>
<th>(2) Wage production</th>
<th>(3) Wage non-production</th>
<th>(4) Unit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg success rate x Oil price</td>
<td>0.190*** (0.043)</td>
<td>0.255*** (0.050)</td>
<td>0.116 (0.231)</td>
</tr>
<tr>
<td>N</td>
<td>48194</td>
<td>48194</td>
<td>48194</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.80</td>
<td>0.91</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Notes: Panel regressions with firm and industry-year fixed effects. Standard errors clustered by firm and kabupaten-year in parentheses. ***p < 0.01, **p < 0.05, *p < 0.10.
## Panel (Reduced-form) - Only explored Kabupatens

<table>
<thead>
<tr>
<th></th>
<th>(1) Exit</th>
<th>(2) Entry</th>
<th>(3) Product drop</th>
<th>(4) Product intro</th>
<th>(5) Output</th>
<th>(6) Empl</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avg success rate x Oil price</strong></td>
<td>-0.018 (0.032)</td>
<td>-0.006 (0.004)</td>
<td>0.018 (0.028)</td>
<td>-0.001 (0.029)</td>
<td>0.156*** (0.057)</td>
<td>0.073*** (0.025)</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>48194</td>
<td>48194</td>
<td>48194</td>
<td>48194</td>
<td>48193</td>
<td>48194</td>
</tr>
<tr>
<td><strong>R-sq</strong></td>
<td>0.33</td>
<td>0.28</td>
<td>0.54</td>
<td>0.55</td>
<td>0.94</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Notes: Panel regressions with firm and industry-year fixed effects. Standard errors clustered by firm and kabupaten-year in parentheses. ***p < 0.01, **p < 0.05, *p < 0.10.
Panel (Reduced-form) - Only explored Kabupatens

<table>
<thead>
<tr>
<th></th>
<th>(1) Labor Prod.</th>
<th>(2) % exported</th>
<th>(3) Share imported inputs</th>
<th>(4) Intermediate inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg success rate x Oil price</td>
<td>0.186***</td>
<td>-3.447*</td>
<td>0.012</td>
<td>0.123**</td>
</tr>
<tr>
<td></td>
<td>(0.063)</td>
<td>(1.820)</td>
<td>(0.008)</td>
<td>(0.062)</td>
</tr>
<tr>
<td>N</td>
<td>48193</td>
<td>48194</td>
<td>47876</td>
<td>48192</td>
</tr>
<tr>
<td>R-sq</td>
<td>0.81</td>
<td>0.69</td>
<td>0.87</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Notes: Panel regressions with firm and industry-year fixed effects. Standard errors clustered by firm and kabupaten-year in parentheses. ***p<0.01, **p<0.05, *p<0.10.
Conclusions

- We find some evidence of Dutch Disease *symptoms* in Indonesia
  ⇔ Firms face higher wages in oil and gas districts
- But firms are not more likely to exit
  ⇔ Firms adapt by raising productivity


Smith, B. (2014). Dutch Disease and the Oil and Boom and Bust. Technical report.