Where Do Jobs Go When Oil Prices Drop?

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Introduction

- Growth in U.S. employment in 2014 had been concentrated in mining (BLS, 2015)
- Development of technologies in oil extraction (e.g. shale)
- Falling oil prices since July 2014 ⇒ Where do jobs go when oil prices fall?
"The U.S. economy and the stock market will not even notice the fall in oil prices" (Ro, 2014)

Our results indicate that lower oil prices have disproportionate effects on different economic sectors (energy, manufacturing, services)

We show that an unexpected drop in oil prices stimulate net employment growth in sectors that are energy intensive
We employ data on job flows from BED for the total private sector and 87 three-digit NAICS industries in agriculture, mining, construction, manufacturing, and services covering the period between 1992:Q2 and 2014:Q4.
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  SUM_{i,t} &= POS_{i,t} + NEG_{i,t} \\
  EXC_{i,t} &= SUM_{i,t} - |NET_{i,t}|
  \end{align*} \]
Figure 1: Oil prices and job flows
Consider the joint dynamics of $Y_t$ and $F_t$ to be given by a FAVAR: Observation equation:

$$X_t = \Lambda^y Y_t + \Lambda^f F_t + u_t$$

(1)

Transition equation:

$$\begin{bmatrix} Y_t \\ F_t \end{bmatrix} = A(L) \begin{bmatrix} Y_{t-1} \\ F_{t-1} \end{bmatrix} + e_t$$

where $Y_t = [o_t, TNEG_t, TPOS_t, i_t]'$ is a $4 \times 1$ vector of observable macroeconomic variables. $F_t$ is a vector of unobserved common factors that drive the vector $X_t$. 

Model Specification

- $N = 174$ observable variables. $T = 90$ observations.
- Number of factors are chosen using Bai and Ng (2002) information criterion ($IC_{p2}(k)$).
- The information criterion leads us to select a total of 7 factors (4 observed and 3 unobserved).
FAVAR is estimated using a two-step procedure similar to Bernanke, Boivin, and Eliasz (2005) and Boivin Giannoni and Mihov (2009).

- **Step 1**: Extract common factors
  
  Estimate factors ($F_t$) by Principal Components ($PC_{\text{X}_t}$) of $X_t$.
  
  The 3 identified factors are denoted by $b_{F_t} = f_1 f_2 f_3$.

- **Step 2**: Estimate transition equation in observable variables $Y_t$, and estimated factors $F_t$ in a standard VAR framework.
  
  We choose $p = 4$ lags in estimating equation (2).

  We identify the structural shocks by standard recursive method using Cholesky decomposition where we assume:
  
  - Neither aggregate job flows nor the quality spread have a contemporaneous effect on the real oil price.
  - The quality spread responds contemporaneously to innovations in all the other aggregate variables.

  We estimate the response of the aggregate and industry-level variables to a 1% decrease in the real oil price.
Estimation

- FAVAR is estimated using a two-step procedure similar to Bernanke, Boivin, and Eliasz (2005) and Boivin Giannoni and Mihov (2009).
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Figure 2: Responses of job creation and job destruction to a negative oil price shock of 1 s.d.

Notes: Squares, diamonds and circles represent significance at the 5%, 10% and 32%, respectively.
## The cumulative effects of negative oil price shock on job flows

<table>
<thead>
<tr>
<th>Sectors</th>
<th>POS 1 year</th>
<th>POS 2 year</th>
<th>NEG 1 year</th>
<th>NEG 2 year</th>
<th>NET 1 year</th>
<th>NET 2 year</th>
<th>SUM 1 year</th>
<th>SUM 2 year</th>
<th>EXC 1 year</th>
<th>EXC 2 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Private</td>
<td>-0.02</td>
<td>0.09</td>
<td>0.16</td>
<td>0.03</td>
<td>-0.18</td>
<td>0.06</td>
<td>0.14</td>
<td>0.13</td>
<td>-0.16</td>
<td>-0.42</td>
</tr>
<tr>
<td>Crop Production</td>
<td>0.38</td>
<td>0.67</td>
<td>0.38</td>
<td>0.52</td>
<td>0.00</td>
<td>0.15</td>
<td>0.77</td>
<td>1.19</td>
<td>0.03</td>
<td>0.31</td>
</tr>
<tr>
<td>Oil &amp; Gas Extraction</td>
<td>-0.24</td>
<td>-0.23</td>
<td>-0.07</td>
<td>-0.06</td>
<td>-0.18</td>
<td>-0.17</td>
<td>-0.32</td>
<td>-0.28</td>
<td>-0.94</td>
<td>-0.94</td>
</tr>
<tr>
<td>Mining (exc. O. &amp; G.)</td>
<td>0.11</td>
<td>0.18</td>
<td>0.34</td>
<td>0.21</td>
<td>-0.22</td>
<td>-0.03</td>
<td>0.45</td>
<td>0.38</td>
<td>-0.47</td>
<td>-0.73</td>
</tr>
<tr>
<td>Support Act. for Min.</td>
<td>-0.30</td>
<td>0.03</td>
<td>0.61</td>
<td>0.32</td>
<td>-0.92</td>
<td>-0.29</td>
<td>0.31</td>
<td>0.35</td>
<td>-2.43</td>
<td>-3.02</td>
</tr>
<tr>
<td>Construction of Build.</td>
<td>0.12</td>
<td>0.52</td>
<td>0.28</td>
<td>0.19</td>
<td>-0.15</td>
<td>0.32</td>
<td>0.40</td>
<td>0.71</td>
<td>-0.23</td>
<td>-0.39</td>
</tr>
<tr>
<td>Plas. &amp; Rubb. Manuf.</td>
<td>-0.07</td>
<td>0.11</td>
<td>0.39</td>
<td>0.07</td>
<td>-0.45</td>
<td>0.04</td>
<td>0.32</td>
<td>0.18</td>
<td>-0.41</td>
<td>-1.04</td>
</tr>
<tr>
<td>Transp. Equip Manuf.</td>
<td>-0.11</td>
<td>0.02</td>
<td>0.40</td>
<td>0.03</td>
<td>-0.51</td>
<td>-0.01</td>
<td>0.29</td>
<td>0.05</td>
<td>-0.54</td>
<td>-1.28</td>
</tr>
<tr>
<td>Credit Intermediation</td>
<td>0.10</td>
<td>0.06</td>
<td>-0.19</td>
<td>-0.23</td>
<td>0.30</td>
<td>0.29</td>
<td>-0.09</td>
<td>-0.17</td>
<td>-0.39</td>
<td>-0.48</td>
</tr>
</tbody>
</table>
Entry/Exit Versus Existing Establishments

- Do changes in job creation (destruction) stem mainly from the response of expanding (contracting) establishments or opening (closing) establishments?
- Modify the FAVAR by separately including in the vector of industry-level variables $X_t$ the job destruction rates of contracting and exiting establishments and the job creation rates of expanding and entering establishments.
- Estimate the FAVAR and use the same identification restriction.
Figure A.2a: Responses of job creation from expanding and opening establishments to a negative oil price shock of 1 s.d.

Notes: Squares, diamonds and circles represent significance at the 5%, 10% and 32%, respectively.
Figure A.3a: Responses of job destruction from contracting and closing establishments to a negative oil price shock of 1 s.d.

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Cumulative change in job flows due to a 1 s.d. negative oil price shock

<table>
<thead>
<tr>
<th>Sectors</th>
<th>POS expanding</th>
<th>POS opening</th>
<th>NEG contracting</th>
<th>NEG closing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year 2 year</td>
<td>1 year 2 year</td>
<td>1 year 2 year</td>
<td>1 year 2 year</td>
</tr>
<tr>
<td>Total Private</td>
<td>-0.046 0.054</td>
<td>0.070 0.100</td>
<td>0.054 -0.125</td>
<td>0.091 0.076</td>
</tr>
<tr>
<td>Crop Production</td>
<td>-0.118 -0.165</td>
<td>0.170 0.217</td>
<td>-0.113 -0.300</td>
<td>0.049 0.028</td>
</tr>
<tr>
<td>Oil &amp; Gas Extraction</td>
<td>0.033 0.081</td>
<td>0.079 0.113</td>
<td>0.199 0.252</td>
<td>0.096 0.107</td>
</tr>
<tr>
<td>Mining (except Oil &amp; Gas)</td>
<td>-0.047 -0.107</td>
<td>0.009 -0.009</td>
<td>-0.187 -0.418</td>
<td>0.005 -0.005</td>
</tr>
<tr>
<td>Support Act. for Mining</td>
<td>-0.483 -0.306</td>
<td>-0.026 -0.024</td>
<td>0.241 -0.205</td>
<td>-0.020 -0.027</td>
</tr>
<tr>
<td>Construction of Buildings</td>
<td>0.013 0.272</td>
<td>0.036 0.096</td>
<td>-0.102 -0.502</td>
<td>0.027 -0.068</td>
</tr>
<tr>
<td>Plastics &amp; Rubber Manuf.</td>
<td>-0.074 0.053</td>
<td>0.045 0.056</td>
<td>-0.012 -0.451</td>
<td>0.095 0.082</td>
</tr>
<tr>
<td>Transp. Equipment Manuf.</td>
<td>0.014 0.098</td>
<td>0.018 0.039</td>
<td>-0.218 -0.849</td>
<td>0.016 0.003</td>
</tr>
<tr>
<td>Credit Intermed. &amp; Related Act.</td>
<td>0.292 0.316</td>
<td>0.079 0.094</td>
<td>-0.195 -0.286</td>
<td>0.079 0.051</td>
</tr>
</tbody>
</table>
Historical decomposition

The cumulative effects of a negative oil price shock on job flows are given by

$$\begin{bmatrix} \hat{Y}_t \\ \hat{F}_t \end{bmatrix} \approx \sum_{i=0}^{t-1} \hat{\Theta}_i \hat{v}_{t-i}$$

where

- $\hat{Y}_t$ and $\hat{F}_t$ denote, respectively, the $4 \times 1$ and $3 \times 1$ vectors of fitted aggregate variables and estimated factors of the FAVAR,
- $\hat{\Theta}_i$ denotes the matrix of estimated structural impulse responses at lags $i = 0, 1, 2, ...$
- $\hat{v}_{t-i}$ is a vector of estimated structural shocks.

We focus on the second and third elements of $\hat{Y}_t$, $\hat{TNEG}_t$ and $\hat{TPOS}_t$.
Figure 3: Contribution to Cumulative Change in Job Creation and Job Destruction

Notes: 1 = Oil Price Shock; 2 = Total Private Job Destruction Shock; 3 = Total Private Job Creation Shock; 4 = Quality Spread Shock; 5 = Factor Shock.
Two years after the shock, an unexpected decrease in real oil prices results in higher private employment.
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Conclusion

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1. The first year after an oil price decline, jobs flow out from mining towards other sectors of the economy such as construction manufacturing and services.

2. The negative effect of a decline in oil prices on the mining sector (oil and gas, and support activities for mining) is rather short lived.
Conclusion

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1. The first year after an oil price decline, jobs flow out from mining towards other sectors of the economy such as construction manufacturing and services.
2. The negative effect of a decline in oil prices on the mining sector (oil and gas, and support activities for mining) is rather short lived.
3. The unexpected drop in oil prices has a positive effect on employment that is not limited to the manufacturing sector examined in previous studies. Instead, it extends to the construction and service sectors.
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3. The unexpected drop in oil prices has a positive effect on employment that is not limited to the manufacturing sector examined in previous studies. Instead, it extends to the construction and service sectors.
4. The impact on job flows in agriculture and forestry, instead, is rather small.
Conclusion

- Where do jobs go when oil prices drop?
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Using a modified version of the FAVAR we found that during the first year, most of the increase in private job destruction stems from changes in job flows from closing firms in services and manufacturing most of the decline in job creation during the first year stems from changes in job flows from expanding establishments in manufacturing and services. However, we found that oil price shocks explained only a small fraction of the cumulative change in net employment both during the rapid shale oil expansion (2004:I-2014:II) and during the oil price collapse (2014:II-2014:IV).
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