Commodity Prices and Productivity: A sectoral view

Claudia De La Huerta & Javier García-Cicco

Central Bank of Chile, Universidad Católica Argentina

August, 2016
Motivation: Dutch Disease
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- A boom in commodities (e.g. persistent change in international prices) leads to a contraction in the industrial/manufacturing sector, due to the relocation of resources to other sectors (commodities and non-tradables).
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- Problem with this argument:
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More generally, it is not clear how changes in sectoral productivity will affect aggregate productivity.
Our paper:

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- We study the effects of shocks to commodity prices in sectoral TFP, as well as other related sectoral variables; trying to distinguish between the effects of temporary vs. permanent shocks.
- We decompose the effects of TFP of groups of sectors in “true” TFP changes vs movements due to relocation of resources or relative prices between sectors.
Preview of Results

- At the aggregate level there is mild effect of commodity price shocks on TFP, but the sectoral responses are quite heterogeneous.
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- In particular, TFP in the industrial sector seems to be negatively affected by the shock, while the opposite happens in the main non-traded sectors.

- When we apply the decomposition of TFP, we find that the estimated effect on Aggregate TFP is mainly due to relocation of resources or changes in relative prices. But once we exclude Mining and Utilities, TFP seems to increase after the shocks and it does not appear to be influenced by relocation effects or relative prices.
Rest of the presentation:

- Related literature.
- Constructing TFPs.
- VARs and VECs based analysis.
- Conclusions.
Most of the empirical literature studies aggregate effects:


Little sectoral analysis:

- No analysis of sectoral TFP (sometimes labor productivity).
We compute aggregate and sectorial TFPs for Chile for the period 1996-2013, using Solow residuals:

\[ GDP_t = A_t k_t^\alpha l_t^{1-\alpha} \]
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- We adjust employment by hours worked (sectoral) and by quality (an index that reflects the differences in productivity across workers with different levels of education; just aggregate).
- We use different labor income shares to calculate aggregate and sectoral TFPs.
- Still, there many caveats in interpreting \( A_t \) as technology (e.g. Hopenhayn, 2014).
Constructing TFPs

TFP

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We estimate 3 alternative VAR/VEC models.
Empirical Strategy

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The typical VAR has 14 variables.

Identification I: Block exogeneity

GDP for commercial partners and Price of copper are block exogenous (small-open-economy assumption).

Cholesky order between these two (trying to isolate the copper shock from global demand).
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  - Permanent: VEC, including a constant, with and without restrictions in the error-correction adjustment for external variables.

- Estimation: OLS/MLE, Lag selection using BIC. Inference: Bootstrap. All IRFs are in levels.
VAR Models
IRFs VAR in levels with trends and break
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IRFs VAR in levels with trends and break

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IRFs VAR in levels with trends and break

De La Huerta & García-Cicco (CBCh, UCA)
Definitions:

\[
T FP_{it} = \frac{GDP_{it}}{(L_{it})^{\alpha_i}(K_{it})^{1-\alpha_i}}, \text{ for } i=1,...,N, \quad T FP_t = \frac{GDP_t}{(L_t)^{\alpha}(K_t)^{1-\alpha}}
\]

where \( GDP_t = \sum_{i=1}^{N} GDP_{it}\beta_{it}, \) where \( \beta_{it} = \frac{P_{it}}{P_t} \) (chain weighted).
TFP Decomposition

- **Definitions:**

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\]

where \( GDP_t = \sum_{i=1}^{N} GDP_{it} \beta_{it} \), where \( \beta_{it} = P_{it}/P_t \) (chain weighted).

- **Thus,**

\[
TFP_t = \frac{\sum_{i=1}^{N} GDP_{it} \beta_{it}}{(L_t)^{\alpha}(K_t)^{1-\alpha}} = \sum_{i=1}^{N} TFP_{it} \omega_{it}
\]

where \( \omega_{it} = \beta_{it} \frac{(L_{it})^{\alpha_i}(K_{it})^{1-\alpha_i}}{(L_t)^{\alpha}(K_t)^{1-\alpha}} \).
The change in TFP can be decomposed as

\[ TFP_t - TFP_0 = \sum_{i=1}^{N} TFP_{it} \omega_{it} - \sum_{i=1}^{N} TFP_{i0} \omega_{i0} \]

\[ = \sum_{i=1}^{N} TFP_{it} \omega_{it} - \sum_{i=1}^{N} TFP_{i0} \omega_{i0} - \ldots \]

\[ + \sum_{i=1}^{N} TFP_{it} \omega_{i0} + \sum_{i=1}^{N} TFP_{it} \omega_{i0} \]

\[ = \sum_{i=1}^{N} (TFP_{it} - TFP_{i0}) \omega_{i0} + \ldots \]

\[ + \sum_{i=1}^{N} TFP_{it} (\omega_{it} - \omega_{i0}) \]
## TFP Decomposition with VAR results

### Decomposition of TFP effects for selected groups after a temporary shock

<table>
<thead>
<tr>
<th>Qtr.</th>
<th>TFP only</th>
<th>Reloc.</th>
<th>Sum</th>
<th>TFP only</th>
<th>Reloc.</th>
<th>Sum</th>
<th>TFP only</th>
<th>Reloc.</th>
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<td>0.69</td>
<td>-0.09</td>
<td>0.60</td>
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<td>8</td>
<td>-0.03</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.36</td>
<td>0.02</td>
<td>0.39</td>
<td>0.27</td>
<td>0.09</td>
<td>0.36</td>
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<tr>
<td>12</td>
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<tr>
<td>16</td>
<td>-0.16</td>
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<td>20</td>
<td>-0.08</td>
<td>0.28</td>
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<td>-0.11</td>
<td>-0.07</td>
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VEC Models
IRFs VEC

Commodity Prices and Productivity: A sectoral view

De La Huerta & García-Cicco (CBCh, UCA)
IRFs VEC

GDP – Agg

GDP – Agric

GDP – Min

GDP – Indu

GDP – Util

GDP – Constr

GDP – Retail

GDP – Trans

GDP – FinServ

GDP – PersServ

GDP – No Co–Ut

GDP – NT

De La Huerta & García-Cicco (CBCh, UCA)
IRFs VEC

Share – Agric

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<thead>
<tr>
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<th>TFP aggregate</th>
<th>No Co-Ut</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TFP only</td>
<td>Other</td>
<td>Sum</td>
</tr>
<tr>
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<td>0.04</td>
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  - Endogenous TFP: Learning-by-doing?
Extras
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition and Methodology</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>Number of workers in the labor force.</td>
<td>INE, old and new Employment Surveys. Series joined formerly by the Central Bank of Chile.</td>
</tr>
<tr>
<td>Aggregate labor share</td>
<td>Share of capital in national income for period 1960-2005 with correction for income share of independent workers.</td>
<td>Taken from Fuentes et al. (2006) with data from National Accounts, Central Bank of Chile.</td>
</tr>
<tr>
<td>Sectorial labor share</td>
<td>Total labor remunerations to value added of each sector Corbo and Gonzalez (2012).</td>
<td>Data from the Income Accounts from the old National Accounts, Central Bank of Chile, Compilación de Referencia 2003.</td>
</tr>
<tr>
<td>Hours worked</td>
<td>Sum of hours worked in a year. Average weekly hours worked multiplied by the number of weeks in a year.</td>
<td>INE old and new Employment Surveys. Series joined formerly by the Central Bank of Chile.</td>
</tr>
<tr>
<td>Labor quality index</td>
<td>Average wage of workers with educational attainment $i$ relative to average wage of workers with no education multiplied by the share of workers of a certain educational attainment $i$ to the total amount of workers.</td>
<td>CASEN Survey, Ministry of Planification and Cooperation.</td>
</tr>
<tr>
<td>Capital utilization</td>
<td>Deviations of energy consumption from its trend. The cycle is obtained with a HP filter with $\lambda = 6.25$ for annual data and $\lambda = 1600$ for quarterly data. Data on final energy consumption includes: hydro-electricity, coal, natural gas, oil and wood (teracalories).</td>
<td>National Energy Balances, Ministry of Energy.</td>
</tr>
</tbody>
</table>
Constructing TFPs

<table>
<thead>
<tr>
<th>Sector</th>
<th>Labor Income Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Economy</td>
<td>60.0</td>
</tr>
<tr>
<td>Agriculture</td>
<td>37.1</td>
</tr>
<tr>
<td>Mining</td>
<td>18.8</td>
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<tr>
<td>Manufacturing</td>
<td>30.2</td>
</tr>
<tr>
<td>Public Utilities</td>
<td>13.5</td>
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<tr>
<td>Construction</td>
<td>65.0</td>
</tr>
<tr>
<td>Retail</td>
<td>63.2</td>
</tr>
<tr>
<td>Transport</td>
<td>35.1</td>
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<tr>
<td>Financial Services</td>
<td>45.3</td>
</tr>
<tr>
<td>Social Services</td>
<td>71.3</td>
</tr>
</tbody>
</table>

Constructing TFPs

K. Adj.

De La Huerta & García-Cicco (CBCh, UCA)
Constructing TFPs

L. Adj.

[Graphs showing time series data for various sectors such as Agg, Agric, Min, Indu, Util, Constr, Retail, Trans, FinServ, PersServ, No Co–Ut, NT, with years 2000, 2005, and 2010 along the x-axis and values from 20 to 24.4 along the y-axis.]
Nominal shares relative to Resto (ex. mining and energy)
## Constructing TFPs

Input contribution to economic growth by sector (in %)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Period</th>
<th>PIB</th>
<th>TFP</th>
<th>Capital</th>
<th>Labor</th>
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<tr>
<td>Aggregate Economy</td>
<td>1997-2003</td>
<td>3.0</td>
<td>0.5</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>2004-2008</td>
<td>5.3</td>
<td>1.5</td>
<td>2.7</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>2009-2013</td>
<td>3.9</td>
<td>1.0</td>
<td>2.0</td>
<td>0.9</td>
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<tr>
<td>Agriculture</td>
<td>1997-2003</td>
<td>3.9</td>
<td>2.2</td>
<td>1.5</td>
<td>0.2</td>
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<td></td>
<td>2004-2008</td>
<td>8.5</td>
<td>6.3</td>
<td>2.8</td>
<td>−0.6</td>
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<tr>
<td></td>
<td>2009-2013</td>
<td>0.6</td>
<td>0.2</td>
<td>1.0</td>
<td>−0.6</td>
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<tr>
<td>Mining</td>
<td>1997-2003</td>
<td>4.8</td>
<td>−1.7</td>
<td>6.5</td>
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<td></td>
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