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Responses to reviewers for "Colluding Against Workers"

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We thank the referees and the editor for their valuable and constructive insights. This document responds to the points raised by the reviewers.

Reviewer 1

- *The no-collusion scenario holds marginal revenue products fixed. Shouldn't these endogenously adjust when quantities of output (and thus employment) change?*.
  Answer:
- *There are various other dynamics that the authors ignore in their counterfactual, for instanve entry and exit.*.
  Answer:
- *I would like to see additional robustness tests when the production function and labor supply elasticities are estimated for multiple time periods. Particularly a strong assumption for the production function* .
  Answer:
  - In Appendix X, we estimate the production function when splitting the panel into 2 and 3 time blocks. Still works. Report this as robustness check.
  - In Appendix X, we estimate the production function with time trend interacted with labor coefficient. Still works. Report this as robustness check.
  - Do the same for labor supply elasticities (still to do)
- *Surprised by the low markup levels. Can the authors produce the markup estimates from their translog P.F.?* .
  Answer: Report translog markup estimates. Are very similar to CD.
- *Can the authors compare their estimates with cost-share-based estimates for the production function?*.
  Answer: As we work out in Appendix X, the cost-shares approach requires to take a stance on the size of the labor wage markdown. To see this, solve the markup expressions $\mu = \frac{\beta^l}{\alpha^l \mu^l}$ and $\mu \frac{\beta^m}{\alpha^m}$ for the output elasticity of labor β^l. Denoting returns to scale parameter as $\nu \equiv \beta^l + \beta^m + \beta^k$, and assuming variable capital with $w^k K$ being capital investment, the output elasticity of labor is equal to the *weighted* cost share of labor, weighting the wage bill by the markdown μ^l.

$$\beta^l = \nu\Big(\frac{w^l L \mu^l}{w^m M + w^k K + w^l L \mu^l}\Big)$$

  As a robustness check, we estimate bounds on the output elasticity of labor β^l as the median markdown-weighted cost share using the non-collusive and fully collusive wage markdown values from the

labor supply model. This results in output elasticity bounds of $\beta^l \in (0.67, 0.75)$ and $\beta^m \in (0.20, 0.25)$. The resulting average markup lies in the interval $\mu \in (0.61, 0.81)$. The estimated output elasticities and markups in the main model lie within the bounds of the cost share-based estimates.

- *We should see a response of markups to the collusion. Is this correct?.*
  Answer: report DiD result of markup change in response to cartel. Indeed increase in the markup.

- *Are unobserved input prices/input quality differences a concern here?.*
  Answer:

  Can estimate model following DLGKP adding price in control function. gives slightly higher markups, indeed. other results very similar.

- *The statement the "coal price markup was low and close to one" is wrong..*
  Answer: agree. (correct this)

- *Market power in intermediate input markets could bias the results. Can you discuss the direction of this bias?*
  Answer: Suppose firms have market power over intermediate inputs. This implies $\mu^m > 1$. Wage markdown formula becomes:

$$\mu^l = \frac{\theta^l \alpha^m}{\theta^m \alpha^l \mu^m}$$

  Hence, market power over intermediate inputs leads to overestimating the wage markdown (explain intuition).

  Collusion increase after cartel could partly be due to increased collusion on intermediate inputs. Counter this using anecdotal evidence (evidence for wage collusion, not for intermediate input collusion, no cartel d'acheteurs (cite de leener), etc;)

- *What is the cost share of lamp oil? .*
  Answer: ?

- *Another potential idea is to estimate a revenue production function.*
  Answer: Did this, gives sensible results, broad conclusion remains intact. Explain why revenue production functions are a bad idea.

- *Grammar on p1.*
  Answer: agree (correct it)

- *Can authors explain how approach can be extended to settings with differentiated goods and multi-product firms?.*
  Answer: explain in appendix.

- *Typo p39.*
  Answer: agree (correct it)
- *How did material share respons to capital investment?.*
  Answer: show this.
- *First pages have too many footnotes.*
  Answer: agree (correct it)
- *What is the exact final sample How many firms and observations in it? How many obs before dropping and why the dropping?.*
  Answer: mention this.
- *Shouldn't markdown be weighted by wage bill? Can you explain and motivate the choice of weighting?.*
  Answer: ? (think makes no sense because you would weight markdown twice: wages contain markdown info. ask natalie bau and david baqaee and read up on markdown/markup aggregation).

Reviewer 2

- *What share of local employment was in the mines?*
  Vince:
- *Was there much mobility between mining and other sectors?*
  Vince:
- *Employment data in labor supply curve: is this mining data or employment more generally?*
  Mining. could do total population instead.
- *Test for employer differentiation by estimating a firm level wage equation with market-time fixed effect and suitably instrumented firm employment on the RHS.*
  Did this. Gives precisely estimated zero.
- *One might also want to add in the market elasticity, e.g. take market-time fixed effects and regress on market-level employment and other relevant controls.*
- *More discussion of labor supply model and of cross-firm variation in markdown estimates, etc.*
- *Why is focus exclusively on Liege/Namur? If data availability, say so.*
- *Figure 1 comes before data, which is odd. Is time series for investment needed here?*
- *Why section 2.2 before data section?*
- *mention labor supply model in discucssion on p21. Introduce Cournot model earlier.*

- *On p23 there should be more discusion of the role of the agricultural wage. Is there data on harvests etc?*
- *Is there documentary evidence on employers colluding on wages rather than on employment?*

Referee 3

- *The data section should show a Table of panel summary statistics and explain the dimensions of the data being used.*
- *How many concessions are in the data? How many exit early? How many years of data are present for the average concession? What is average concession size? What are typical labor cost shares.*
- *Table 1 should report the rho estimate and standard error. Please also report a test of overidentifying restrictions. .*

  Add to table. Test is OK.
- *What would happen if rho = 1?*

  Add to robustness checks
- *Would the GMM estimates change substantially if a linear time trend is added to the model of productivity*

  Add to robustness checks. Looks good.
- *The productivity innovations ν should be serially uncorrelated. Is that true of the estimated $\hat{\nu}$?*

  Add to robustness checks. Seems like there is a moderate negative correlation. Check with bootstrapped standard errors whether significant. R-squared is small.
- *Please report the J-stat for the labor supply estimates in Table 3*

  Report it. Rejects overid rest..
- *Add a note explaining more in detail the set of instruments used. Is the demand shock instrument just a dummy for 1871-1874? If so, how sensitive are the labor supply estimates to inclusion of a linear time trend?*
- *One worries about unmodeled cross-sectional dependence in the errors. Can you assess this by computing driscoll-kraay standard errors?*
- *Why does the number of observations change across Tables 1-3? Please carfeully explain each sample.*
- *Footnotes should be removed, esp. in the introduction.*
- *Labor supply elaticity of 1 is low compared to Sokolova Sorensen (2021) and Staiger et al (2010). Should be noted.*
- *It is more conventional to discuss wage markdowns in percentage terms.*

- *The derivation of FOCs 4a and 4b should be spelled out, as does the Cournot markdown condition on p32.*
- *The object $\hat{\mu}_{ft}^{l}$ appears on p34 without definition.*
- *There is a paranthesis missing from the conditioning set in equation (6)*