Competition's effect on productivity: Treatment or selection?

Evidence from BLADE

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Research Questions

1. How has market competition been growing over time?
- HHI, mean and median size of firms: Grullon, Larkin and Michaely (2018)
- Markups: De Loecker and Eeckhout (2017); Edmonds et al. (2019)

2. Does changes in competition contribute to firm-level productivity?

3. Can markets benefit from institutional changes to competition in Australia, and if so, how?

Research Questions

1. How has market competition been growing over time?

2. Does changes in competition contribute to firm-level productivity?
- Relationship using micro-level data in other jurisdictions: Nickell (1996); Disney, Haskel and Heden (2003)
- Exogenous policy changes: Hoque and Moll (2001); Wagner (2002)

3. Can markets benefit from institutional changes to competition in Australia, and if so, how?

Research Questions

1. How has market competition been growing over time?

2. Does changes in competition contribute to firm-level productivity?

3. Can markets benefit from institutional changes to competition in Australia, and if so, how?

Treatment effect: Competition has a direct causal effect on productivity

- Innovation (Aghion et al., 2008);
- Threat of bankruptcy (Schmidt, 1997);
- Informational externalities of managerial/worker performance (Holstrom, 1982)

Selection effect: In more competitive markets, less productive firms are forced to exit, leading to a reallocation of resources to more productive firms (Syverson, 2004; Hopenhayn, 1992)

- Since observation is contingent upon survival, on average, we only observe more productive firms

Business Longitudinal Analysis Data Environment (BLADE)

New firm-level data of all active businesses from 2001-02 to 2015-16

Government Administrative Data

Business Activity Statements

Business Income Tax Filings

Pay As You Go Summaries

ABS Survey Data

Business Characteristics Survey

Economic Activity Survey

Business Expenditure on Research and Development

I estimate:

- Productivity: Wooldridge (2009); Diewert and Fox (2010)
    - Olley and Pakes; Levinsohn and Petrin; Labour Productivity
- Competition: Herfindahl-Hirschmann Index; Change in Market Share
    - Markups; Concentration Ratios

Industries of study

Four criteria that make identification possible:

1. **Domestic markets**: BLADE does not have adequate measures of import competition.

2. **Localised markets**: Assigning clear markets.

3. **High level of entry and exit**: Is market exit correlated with competition (selection effect)?

4. **Not characterised by large conglomerates**: BLADE contains firm-level, not establishment-level data.

Industries of study

Four criteria that make identification possible:

1. Domestic markets
2. Localised markets
3. High level of entry and exit
4. Not characterised by large conglomerates

- Retail Trade
- Accommodation and Food Services

Policy relevance: Two of the highest employing divisions in Australia

Empirical strategy

Backus (2019)

1. Estimate the effect of competition on firm-level productivity

2. Estimate the effect of competition on market-level productivity

3. Grouped IV quantile model

4. Semi-parametric GMM approach

Model 1: Firm-level IV Regression

$$\omega_{it} = \beta_t + \beta_c c_{m(i)t} + \beta_X X_{it} + \gamma_i + \zeta_i + \delta_t + \epsilon_{it}$$

Where: ω_{it} is total factor productivity;

$c_{m(i)t}$ is my measure of competition;

X_{it} are my set of firm-level controls; and

γ_i , ζ_i and δ_t are unit, industry class, and time fixed effects.

	ω_{it}		$\Delta\omega_{it}$	
Log(HHI)	-0.0242*** (-8.57)		-0.0478* (-1.67)	
Log(mktsh diff$_{t-2}$)		-0.0294*** (-13.53)		-0.0641** (-2.70)
Observations (rounded)	2638700	983600	2311100	980400
Clusters (rounded)	16000	14000	16000	14000

Model 2: Market-level Productivity Decomposition

Diewert and Fox (2007) decompose aggregate productivity growth into the contributions of different components:

$$\Delta\omega_{mt} = \underbrace{\sum \frac{1}{2}(s_{Ci}^{0} + s_{Ci}^{1})(\omega_{Ci}^{1} - \omega_{Ci}^{0})}_{Surviving\ firms\ (\sigma_{mt})} + \underbrace{\sum \frac{1}{2}(\omega_{Ci}^{0} + \omega_{Ci}^{1})(s_{Ci}^{1} - s_{Ci}^{0})}_{Reallocation\ (\rho_{mt})} + \underbrace{S_{N}^{1}\sum s_{Ni}^{1}(\omega_{Ni}^{1} - \omega_{C}^{1})}_{Entering\ firms\ (\nu_{mt})} + \underbrace{S_{X}^{0}\sum s_{Xi}^{0}(\omega_{Xi}^{0} - \omega_{C}^{0})}_{Exiting\ firms\ (\chi_{mt})}$$

$$y_{mt} = \beta_t + \beta_c c_{m(i)t} + \beta_X X_{it} + \gamma_m + \zeta_m + \delta_t + v_{mt}$$

Where: $y_{mt} \in \{\Delta\omega_{mt}, \sigma_{mt}, \rho_{mt}, \nu_{mt}, \chi_{mt}\}$

Model 2: Market-level Productivity Decomposition

$$y_{mt} = \beta_t + \beta_c c_{m(i)t} + \beta_X X_{it} + \gamma_m + \zeta_m + \delta_t + v_{mt}$$

Where: $y_{mt} \in \{\Delta\omega_{mt}, \sigma_{mt}, \rho_{mt}, \nu_{mt}, \chi_{mt}\}$

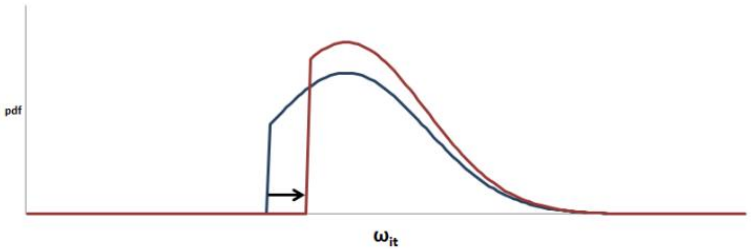
	Market prod. growth $\Delta\omega_{mt}$	*Surviving firms* σ_{mt}	*Reallocation* ρ_{mt}	*Entering firms* ν_{mt}	*Exiting firms* χ_{mt}
Log(HHI)	-0.0278*** (-6.74)	-0.00862*** (-6.58)	-0.0234*** (-14.01)	0.0326*** (17.83)	-0.0284*** (-16.11)
Observations (rounded)	192200	188500	188500	188500	114113
Clusters (rounded)	300	300	300	300	300

Model 3: Grouped IV Quantile Model

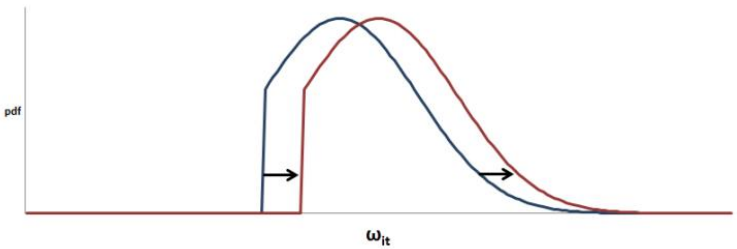
I exploit the unique predictions that the treatment and selection effects have on the productivity distribution in a market as competition increases.

$$\omega_{it}^{k} = \beta_{t}^{k} + \beta_{c}^{k} c_{mt} + \beta_{X}^{k} X_{it}^{k} + \gamma_{i}^{k} + \zeta_{i}^{k} + \delta_{t}^{k} + \epsilon_{it}$$

From this model, the existence of a selection effect is identified by a marginal effect of competition declining in the decile of market-level productivity distribution.



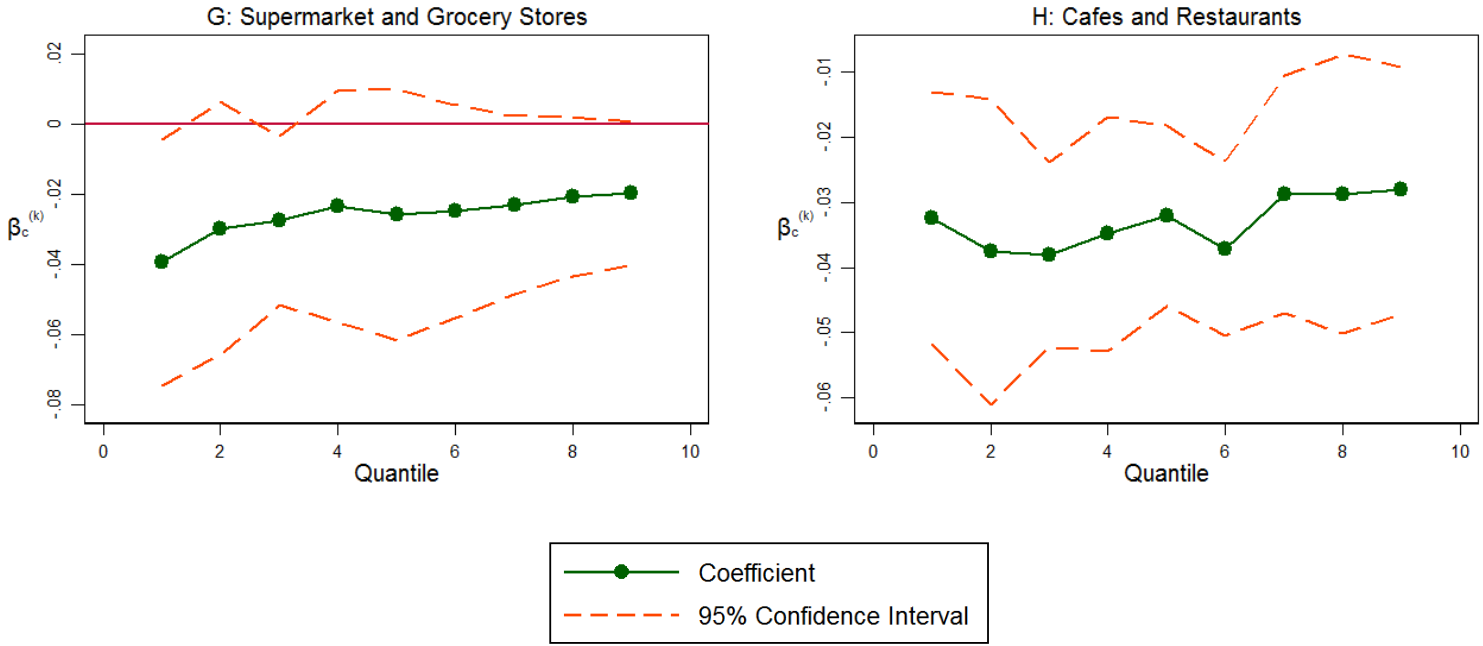
Selection effect



Treatment effect

Source: Backus (2019)

Model 3: Grouped IV Quantile Model



Model 4: Semi-Parametric Model

$$\omega_{it} = \beta_t + \beta_{(tr)} c_{m(i)t} + \phi_{it}$$

Where: ϕ_{it} is the underlying productivity type of the firm, assumed to be residual of first IV estimation

$\beta_{(tr)}$ is the treatment effect of competition on productivity.

Biased by correlation between ϕ_{it} and ω_{it}, and ϕ_{it} and $c_{m(i)t}$: Selection effect

Model 4: Semi-Parametric Model

Assumption 1: Timing of play: $\Phi_{it}\ evolves \rightarrow \pi_{it}\ received \rightarrow\ entry, exit, or\ investment\ decisions\ chosen$

Assumption 2: Exogeneity of innovations: $p(\phi_{it+1}|S_t) = p(\phi_{it+1}|\phi_{it})$

1) $\omega_{it} = \beta_t + \beta_{(tr)} c_{m(i)t} + g_t(\phi_{it-1}) + \eta_{it}$

Where: $\eta_{it} \equiv \phi_{it} - E[\phi_{it}|\phi_{it-1}]$

$g_t(.)$ is a control function: third-order polynomial series of ϕ_{it-1}

$$E[\eta_{it}|Z_{it}] = 0$$

2) $\underbrace{\omega_{it} - \hat{\beta}_{(tr)} c_{m(i)t}}_{\phi_{m(i)t}} = \alpha_t + \alpha_{(sel)} c_{m(i)t} + \epsilon_{it}$

$$E[\epsilon_{it}|Z_{it}] = 0$$

Model 4: Semi-Parametric Model

1) $$\omega_{it} = \beta_t + \beta_{(tr)} c_{m(i)t} + g_t(\phi_{it-1}) + \eta_{it}$$

2) $$\Rightarrow \underbrace{\omega_{it} - \hat{\beta}_{(tr)} c_{m(i)t}}_{\phi_{m(i)t}} = \alpha_t + \alpha_{(sel)} c_{m(i)t} + \epsilon_{it}$$

		Retail Trade: ω_{it}		Accommodation and Food Services: ω_{it}	
Treatment effect	*Log(HHI)*	-0.01813** (-2.36)		-0.0336*** (-1.03)	
	Log(mktsh diff$_{t-2}$)		-0.01501* (-2.21)		-0.04171*** (-4.30)
Selection effect		-0.01044*** (-14.07)	-0.00913*** (-19.70)	-0.00181*** (-3.48)	-0.00101** (-2.50)
Observations (rounded)		1073400	403200	661200	238500
Clusters (rounded)		11400	9900	3200	2500

Appendix 1: Instrumental Variable Approach

Without some control, single-dimensional competition indices mis-measure competition; a market may have few firms because it is extremely competitive, or may have few firms because barriers to entry stifle competition.

E.g. Two firms operating in market X;
Each has 50% market share:
$\rightarrow HHI_X = 50^2 + 50^2 = 5000$

Two firms operating because price competition is high, allowing these two high-productivity firms to absorb entire market share:

Highly competitive environment

Two firms operating because barriers to entry are high, deterring more productive potential entrants:

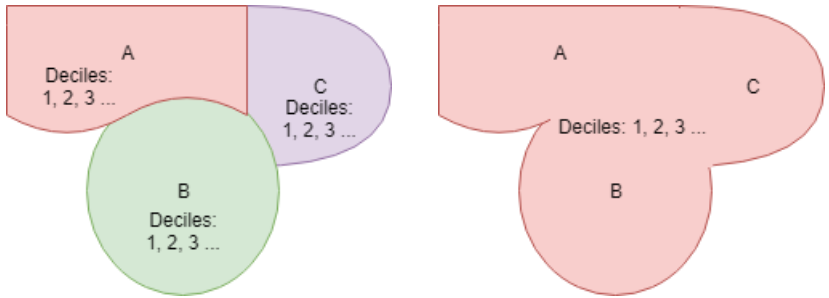
Low competition

Appendix 2: Grouped IV Quantile Model Approach

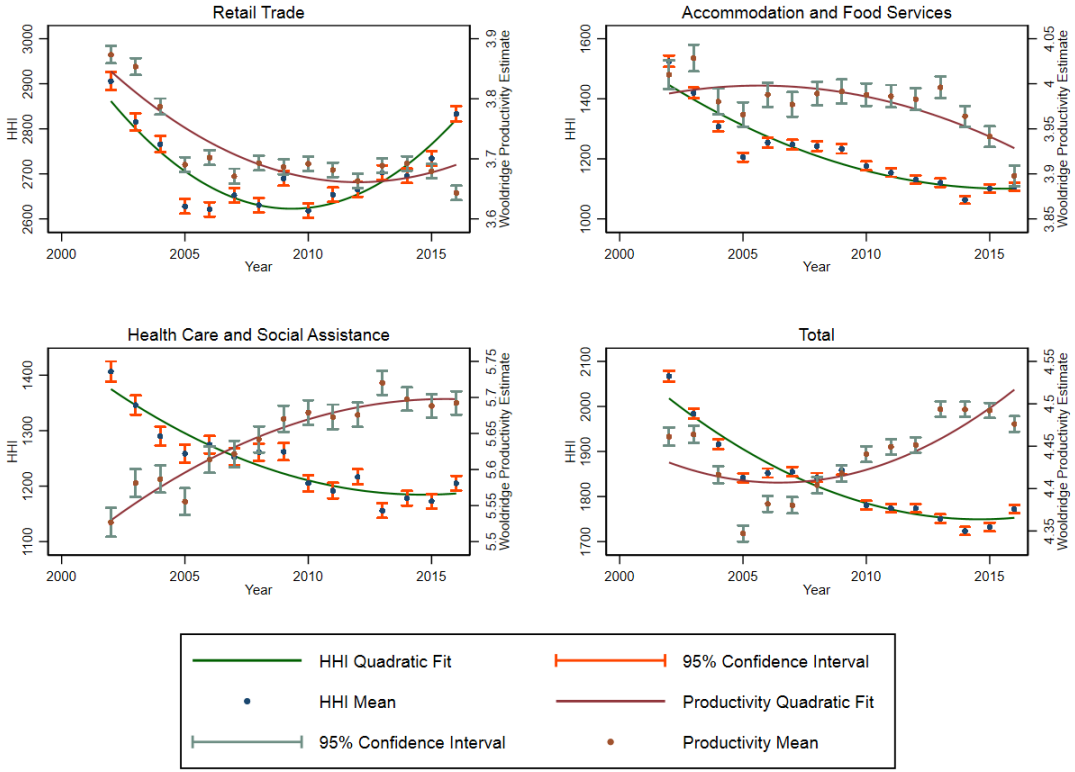
$$\omega_{it}^{k} = \beta_{t}^{k} + \beta_{c}^{k} c_{mt} + \beta_{X}^{k} X_{it}^{k} + \gamma_{i}^{k} + \zeta_{i}^{k} + \delta_{t}^{k} + \epsilon_{it}$$

Aggregating to the market-level and comparing the effect of market competition on within-market productivity deciles:

The other approach would be to aggregate across markets.



Appendix 3: Competition, Productivity and Controls



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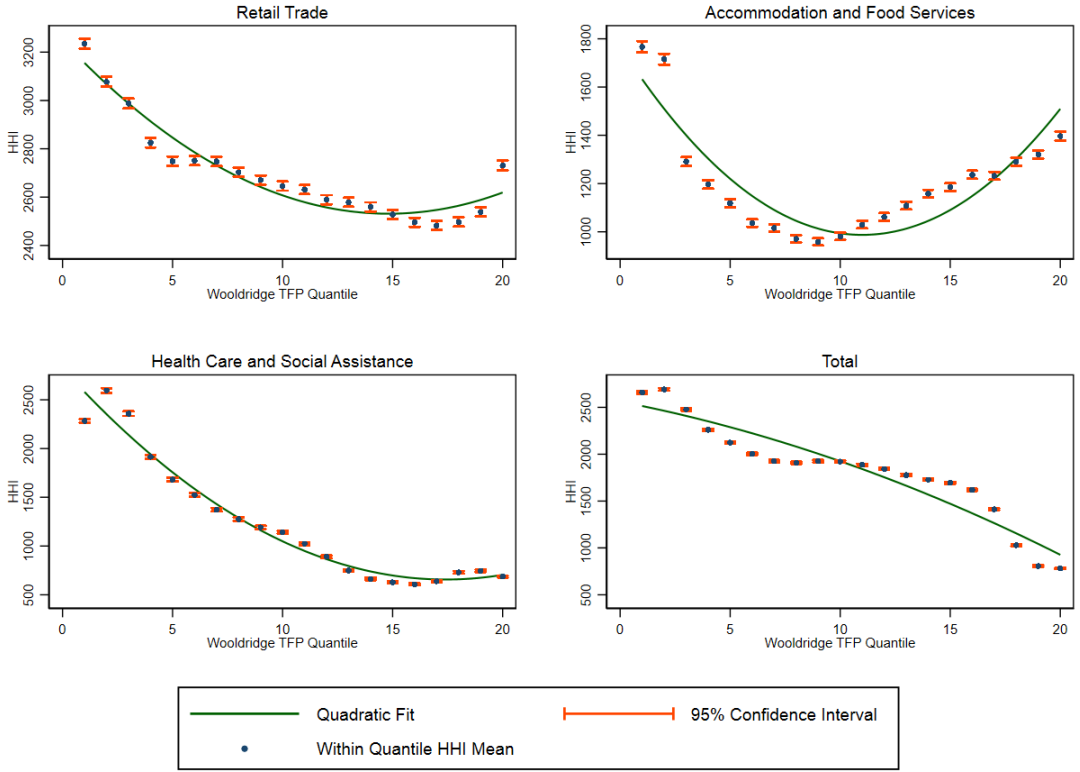

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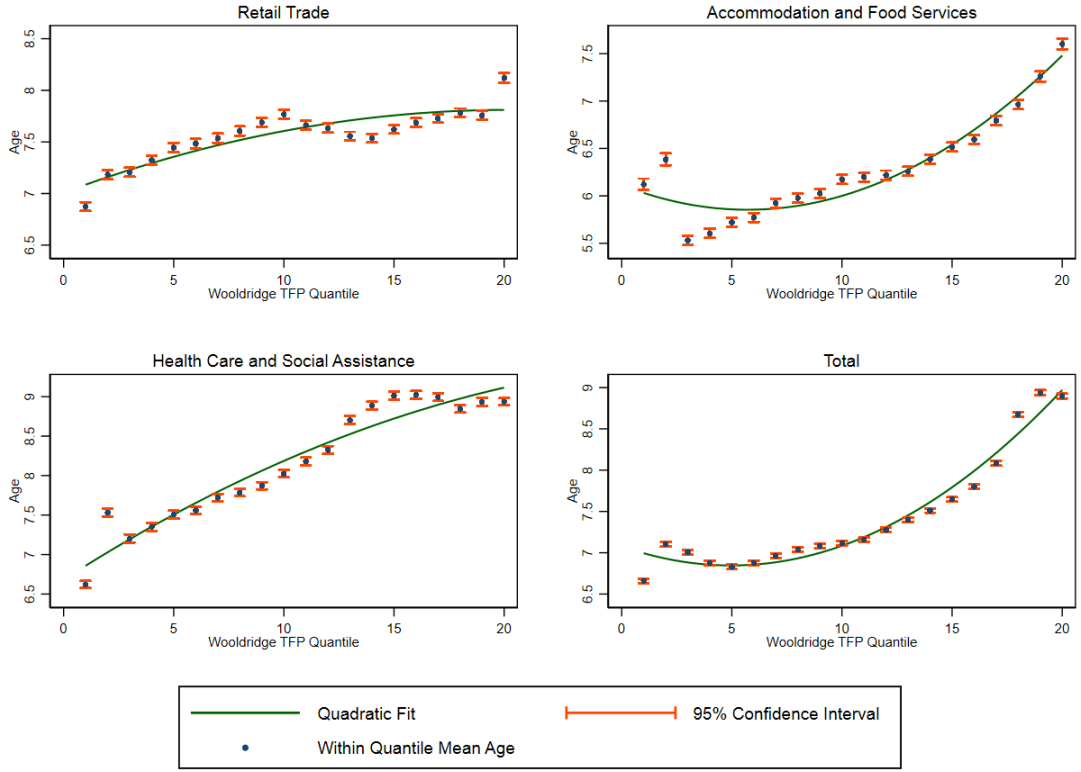

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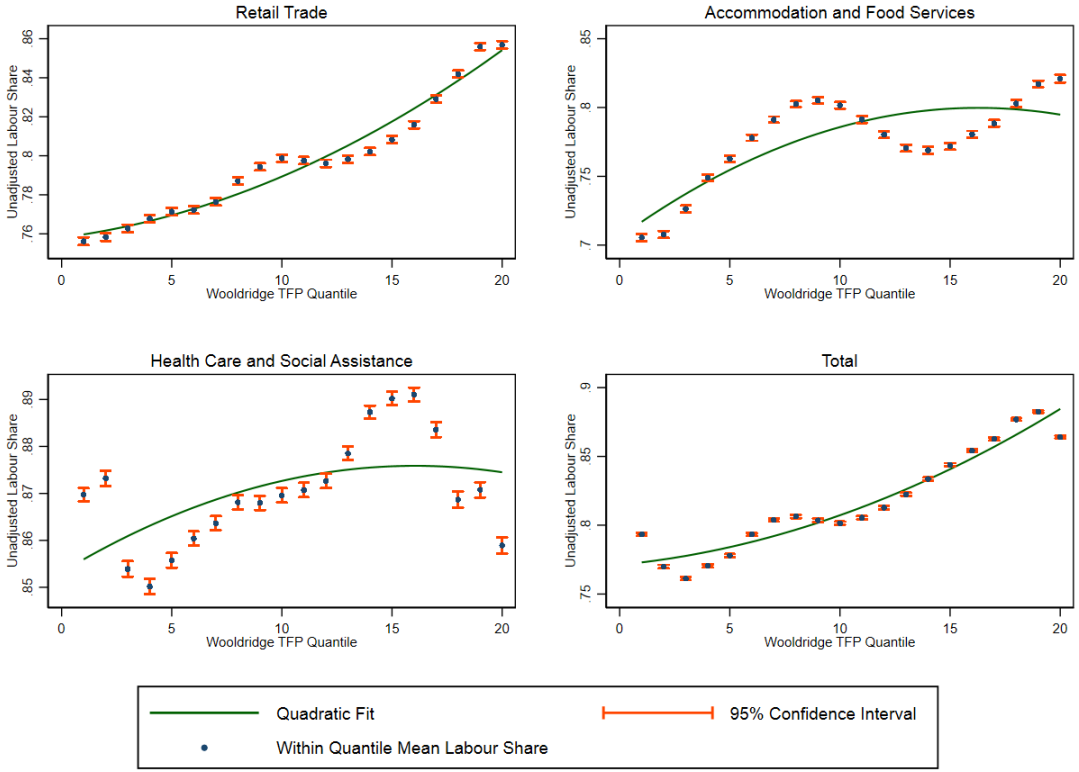

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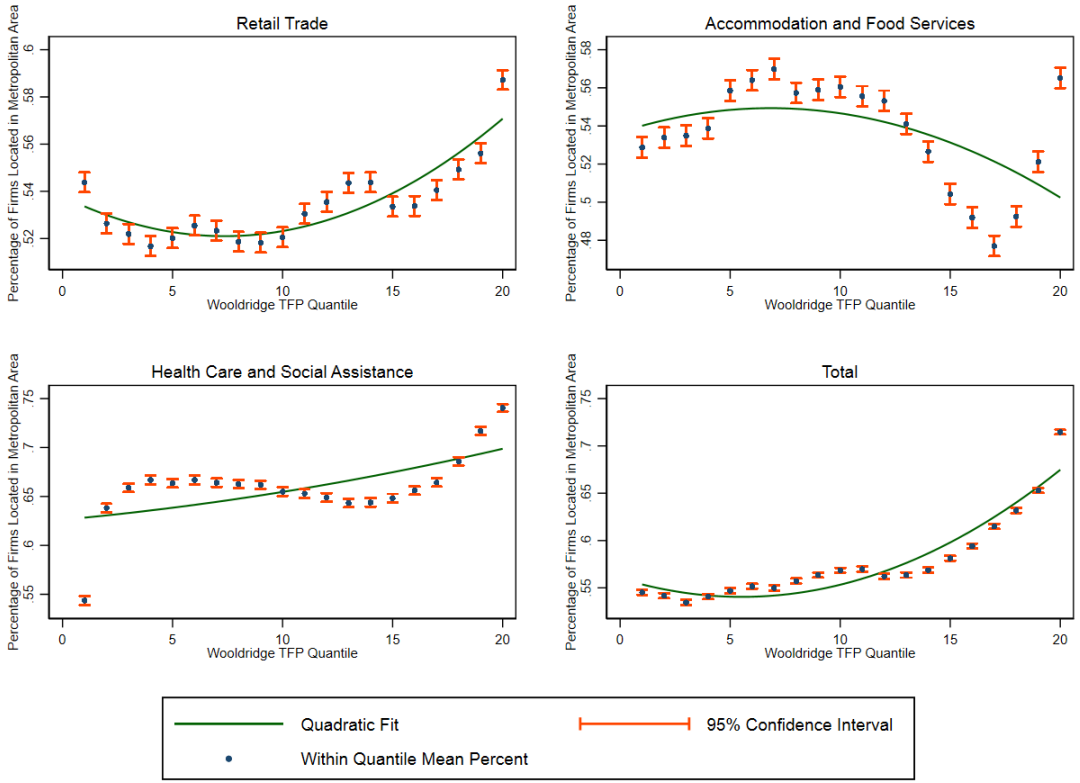
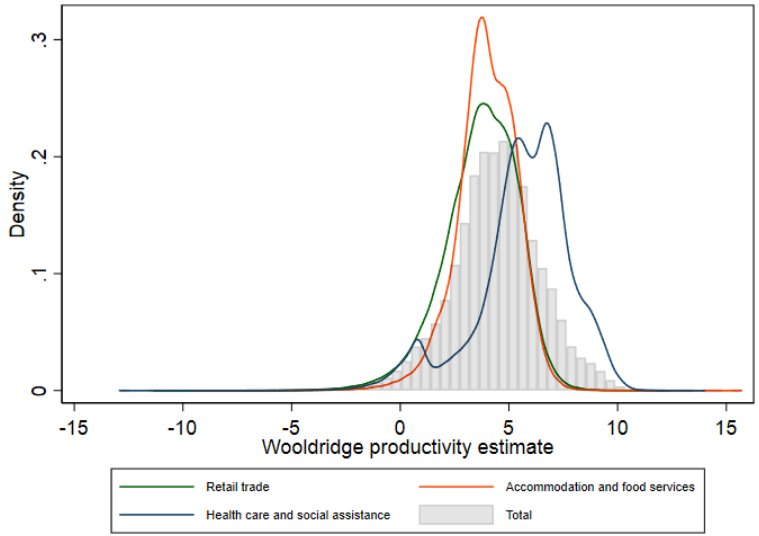


Appendix 4: Stylised Facts of Australian Businesses in 3 Industries

1. Wide productivity dispersion (Syverson, 2003; 2004)



2. High rates of entry and exit

3. Relatively localised markets

Appendix 4: Stylised Facts of Australian Businesses in 3 Industries

1. Wide productivity dispersion (Syverson, 2003; 2004)

2. High rates of entry and exit

	Average Annual Market Entries			*Average Annual Market Exits*		
	G	**H**	**Q**	**G**	**H**	**Q**
Bottom productivity decile	2983.6	1257.1	1137.9	2716.1	999.4	905.5
Top productivity decile	81.3	27.1	1147.7	105.1	58.2	761.3

3. Relatively localised markets

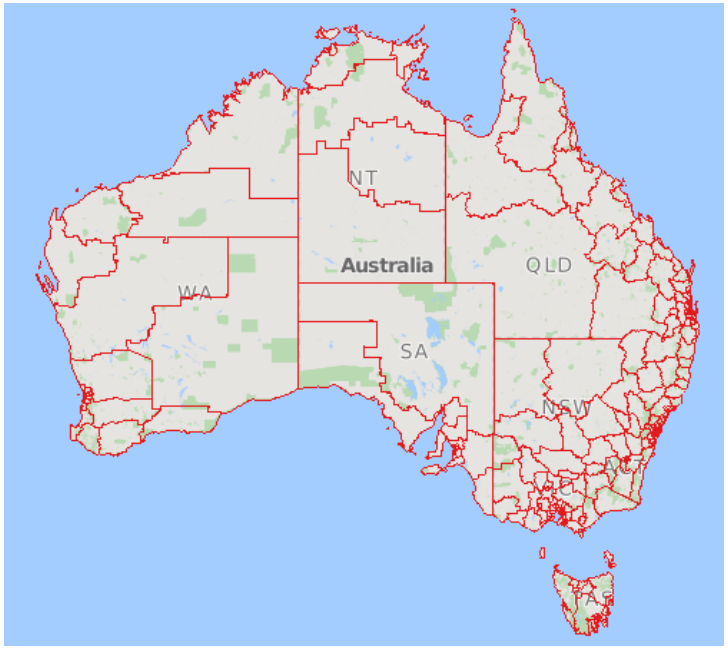
Appendix 4: Stylised Facts of Australian Businesses in 3 Industries

1. Wide productivity dispersion (Syverson, 2003; 2004)

2. High rates of entry and exit

3. Relatively localised markets

Identification for my empirical strategy relies on variation in market competition both cross-sectionally, and over time. I exploit postcode data in BLADE to create market definitions according to ABS Australian Statistical Geography Standard's Statistical Area Level 3 (SA3).



Appendix 5: Background Literature

Competition and concentration over time	• Since 1995, over 75% of U.S. Industries have experienced an increase in concentration levels (Herfindahl-Hirschmann Index, mean and median size of US public firms). Firms in industries with the largest increases in product market concentration have enjoyed the highest profit margins (Grullon, Larkin and Michaely, 2018). • Rise in aggregate markups from 1980s to 2016 (De Loecker and Eeckhout, 2017; Edmonds et al., 2019).
Relationship between competition and productivity	• Positive relationship has been identified both at the firm-level and using industry-level data, both cross-sectionally and using panel data, in the US, Europe, various developing countries and using cross-country data. • Has been analysed through trade liberalisation (Wagner, 2002; Greenaway and Kneller 2004) and the deregulation of state-owned enterprises (McMillan and Naughton, 1992; Hoque and Moll, 2001). • The importance of the relationship has been highlighted by the benefits it has on generating quality and technical improvements in product markets (Das et al. 2007) and on innovation (Aghion et al., 2008); and the welfare improvements for economies overall (Edmond et al. 2019).
Channels through which competition affects productivity	**Treatment effect**: Competition has a direct causal effect on productivity • Positive informational externalities of competition on managerial / worker performance (Holstrom, 1982; Mookherjee, 1984; Scharfstein, 1988). • Greater threat of bankruptcy and sensitivity to profits (Schmidt, 1997; Willig, 1987; Smirlock and Marshall, 1983). • Greater incentives to innovate or invest in productivity enhancements (Aghion et al., 2008; Griffith et al., 2006). **Selection effect**: The relationship is driven by selective attrition of low productivity firms in more competitive markets • Demand is reallocated to productive firms, making low-productivity firms exit (Syverson, 2004; Olley and Pakes, 1996). • Since observation is contingent upon survival, we observe the most productive firms operating in the most competitive environments (Hopenhayn, 1992; Aw et al., 2003; Asplund and Nocke 2006).

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