Contracts and Firms' Inflation Expectations

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Introduction

- Little is known about the use of contracts in firms
  - Barro (1977), Carlton (1983, 1986, 1991)
    - ⋆ Long-term relationships can reduce the allocative role of prices
  - Price and wage setting (Taylor, 1979a; Calvo, 1983)
    - ⋆ Heterogeneity in contract (duration) (Taylor 1979b; Carvalho, 2006; Kara, 2015) and endogenous contract length (Ball, 1987; Romer, 1990)
  - Empirical: Stigler and Kindahl (1970), Hubbard and Weiner (1989), **Blinder** (1991, 1994), Lyons (1994), Hall (1997, 2000), Apel et al. (2005), Amirault et al. (2006), Fabiani et al. (2006)
- Research questions
  - How do firms use contracts?
  - What are the determinants of firm's contract use?
  - What is the relation to firms' inflation expectations?

Introduction (cont'd)

"Information on the price expectations of businesses [...] is particularly scarce."
Bernanke (2007)

- Fill a gap in our understanding of contracts and expectations
- Relates to price stickiness and allows calibration of DSGE models
- Link micro and macro
- Survey Evidence
  - A *quantitative* survey of firms (Kumar et al., 2015; Coibion et al., 2018, 2021)
  - Study the determinants using firm-level controls
  - Include measures of uncertainty at firm and sectoral level

Introduction (cont'd)

Take Away

- Firms purchase and sell inventory through contracts
  - Fixed P&Q (largest), fixed P, and fixed Q
- Drivers: age (-), firm size (-), rel. price (-), average profit margin (-), competitors (+)
- Firms forecast *much* higher levels of inflation (3.8 % vs. 1.6 %)
- Higher inflation expectations $\Rightarrow$*lower* use of contracts
  - Types of contracts have strong links to beliefs
  - Higher inflation expectations $\Rightarrow$*shorter* contracts (esp. sale)

The Survey

- Random sample
  - Timing of survey: Jan 2016 - March 2016
  - $\approx$ 5,500 firms randomly chosen (Equifax NZ)
    - ★ All are private companies, listed in Companies Office
    - ★ Main GDP sectors
    - ★ Exclude very small firms (< 6 employees)
  - Classification according to ANZSIC 2006
    - ★ Manufacturing, professional and financial services, trade, and construction and transportation
  - Response rate ≈ 11 % (615 firms)
- Execution
  - Send questionnaire in advance (1 week)
  - Phone interview with manager/director
  - Responses verified by another person

The Survey (cont'd)

- Representative Survey
  - Proportion of firms in each employment size group for each sector
  - Ensure similar proportions
- Quality control
  - Entry and cross-checks
  - Check responses using publicly available data and online profile (e.g. age of firm, employment, trade)
  - Cross-check information with another manager (e.g. sales Q&P)
  - Ask for contribution in decision making for various variables (price setting, hiring, investment, purchase and sale contracts)
    - ⋆ Input in decisions is $\geq 90\%$

Survey Questions

Descriptive Statistics

Firm Characteristics

Variable	Mean	Std. Dev.
Age	42.56	32.75
Employment	28.13	25.03
Rel. Price to Competitors	2.74	1.50
Labor Costs	43.57	9.47
Share of Trade	6.15	16.43
Number of Competitors	8.13	6.01
Avg. Margin	21.15	10.87
Exp. Inflation next 12m	3.84	2.2
Exp. Inflation last 12m	3.69	2.1
Inattention	3.28	2.1

Notes: Average margin is the margin the price exceeds operating costs. Inattention is defined as $\left|\pi_t - F_{i,t}\pi_{t-12}\right|$.

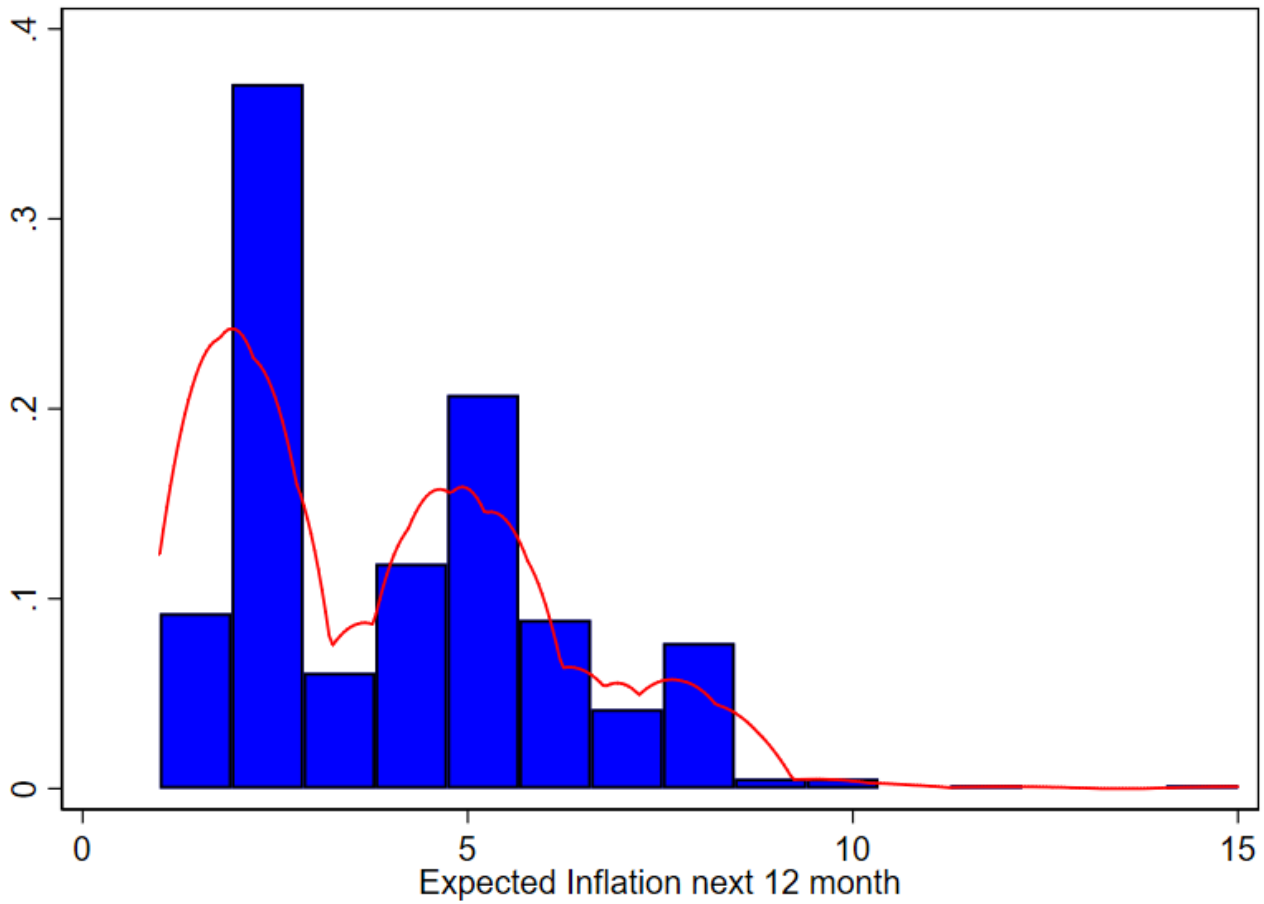
Descriptive Statistics (cont'd)

Contract Characteristics

Variable	Mean	Std. Dev.
Purchases		
Fixed Quantity	4.05	7.03
Fixed Price	20.67	23.95
Fixed Price & Quantity	32.56	26.47
Spot	42.69	41.33
Time of P&Q	17.49	15.24
Sales		
Fixed Quantity	9.95	8.16
Fixed Price	15.32	12.61
Fixed Price & Quantity	23.58	21.14
Spot	51.15	40.28
Time of P&Q	19.03	16.13

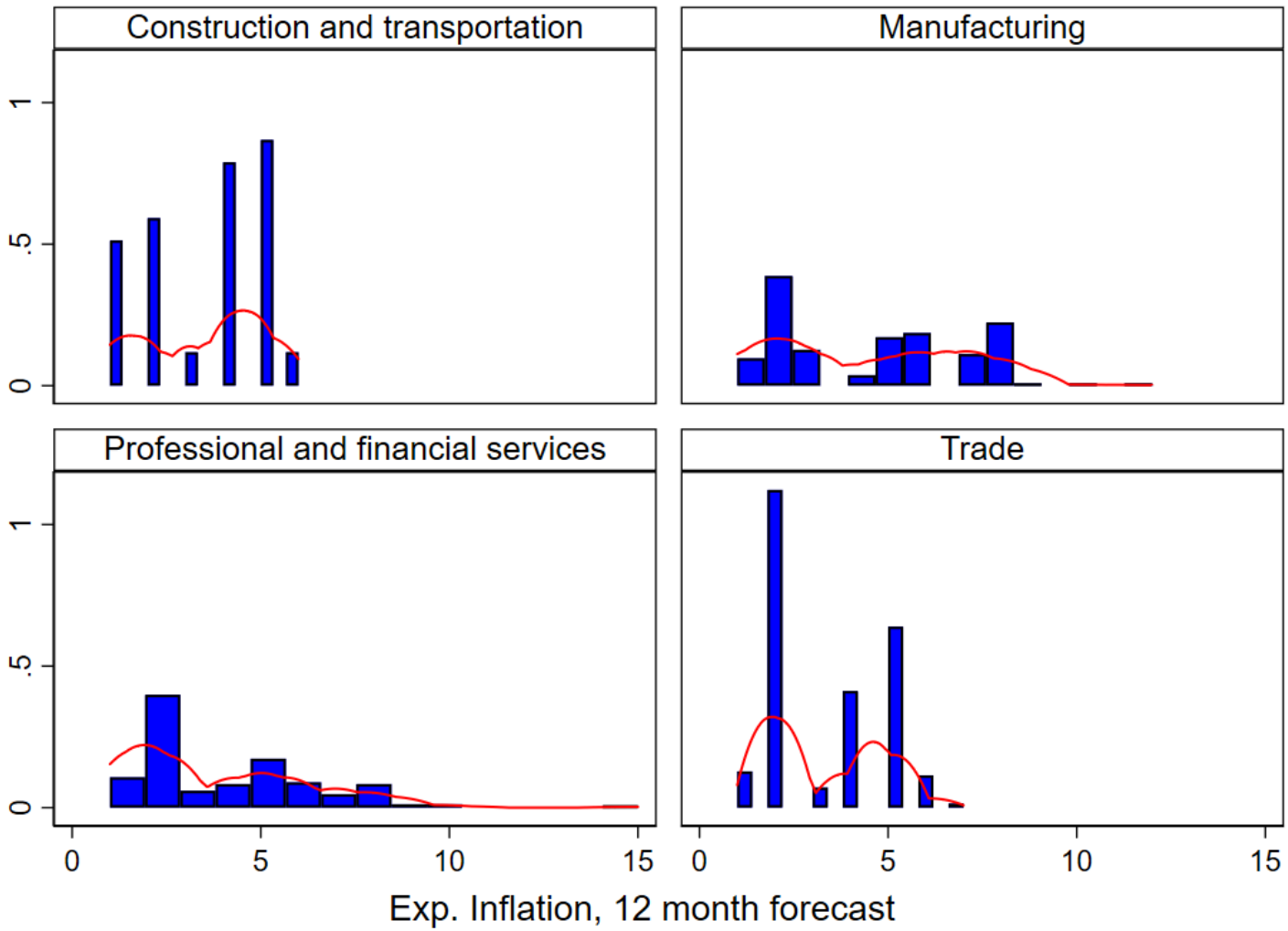
Descriptive Statistics (cont'd)

Forecast



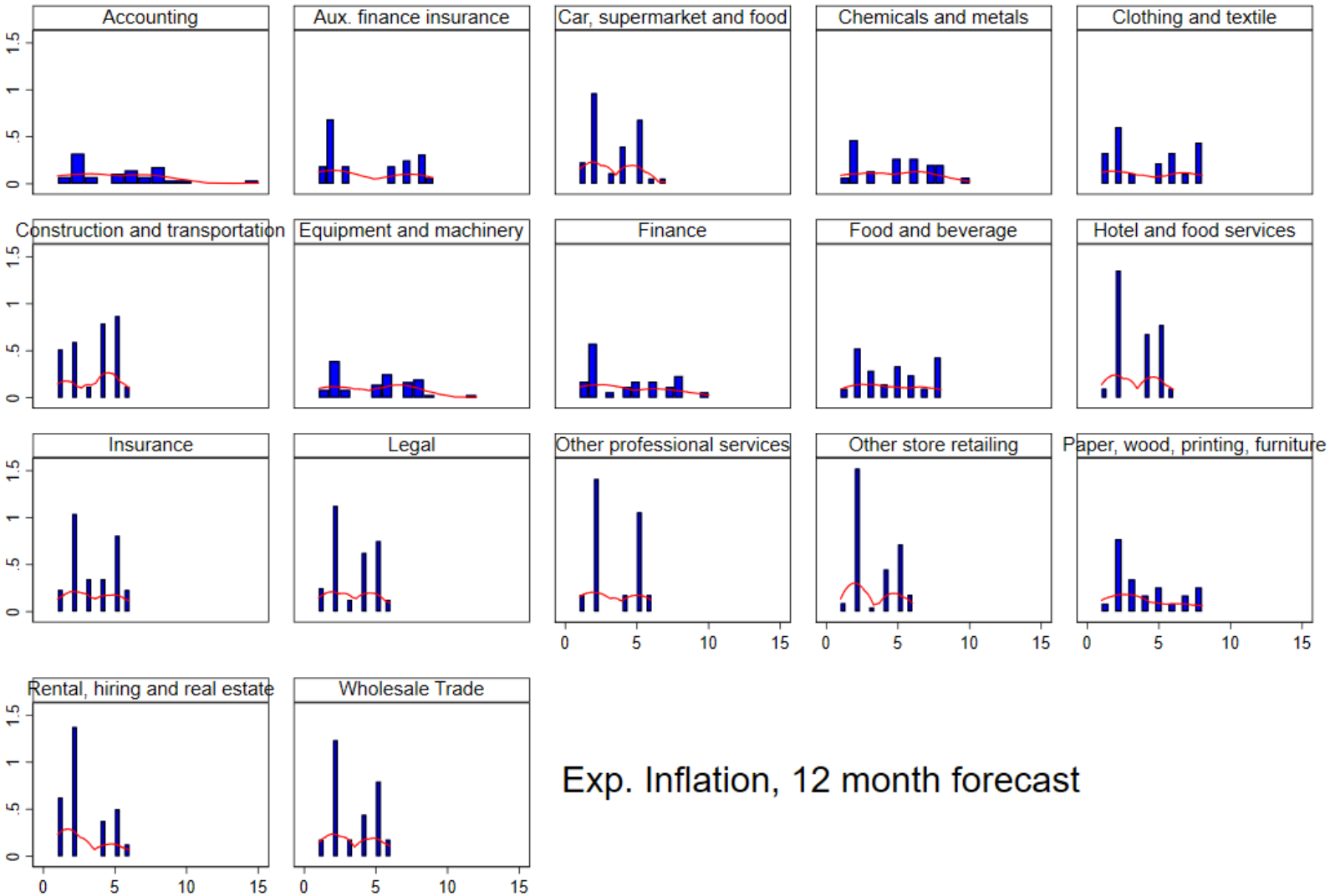
Descriptive Statistics (cont'd)

Forecast - Sector



Descriptive Statistics (cont'd)

Forecast - Subsector



Exp. Inflation, 12 month forecast

Descriptive Statistics (cont'd)

Sales Contracts

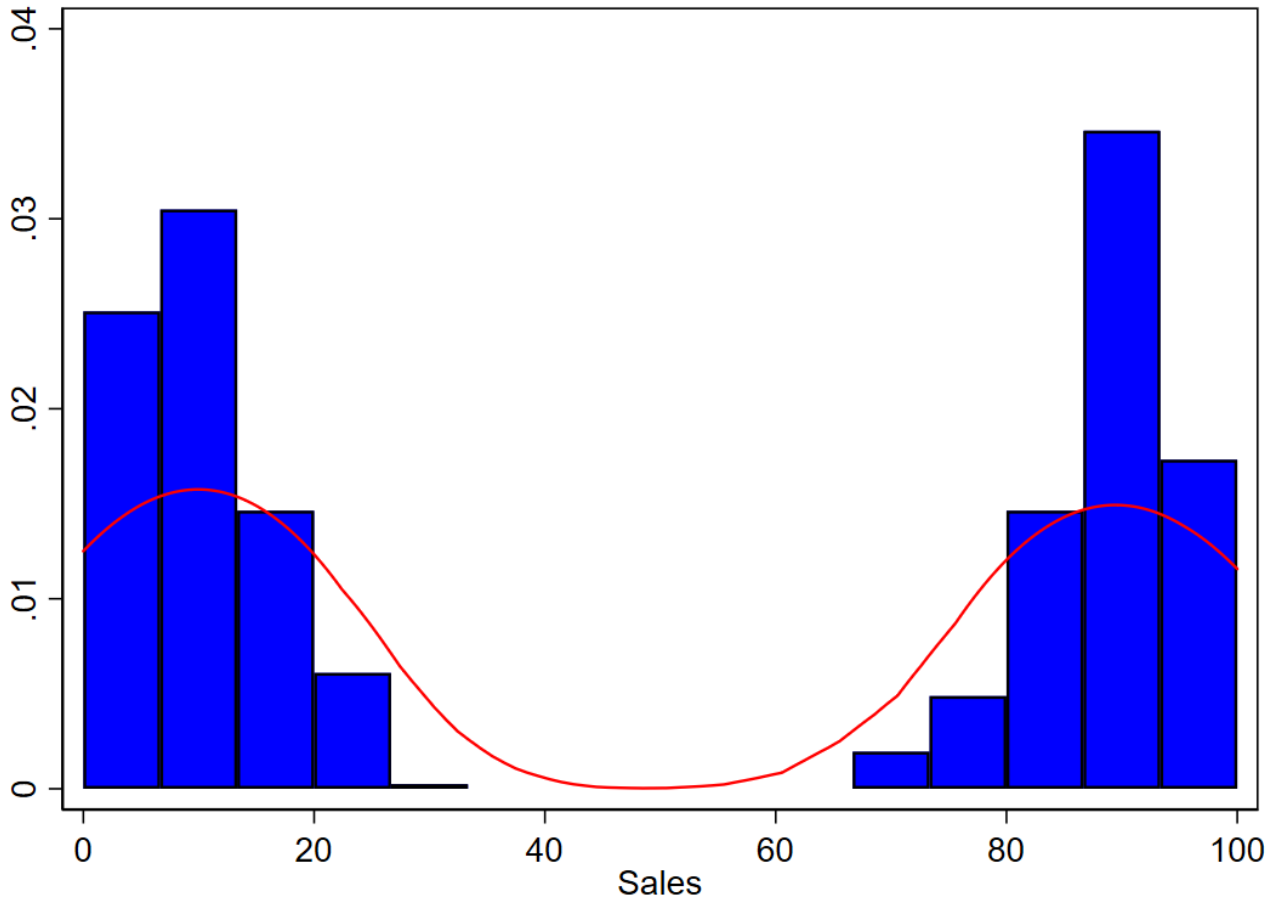
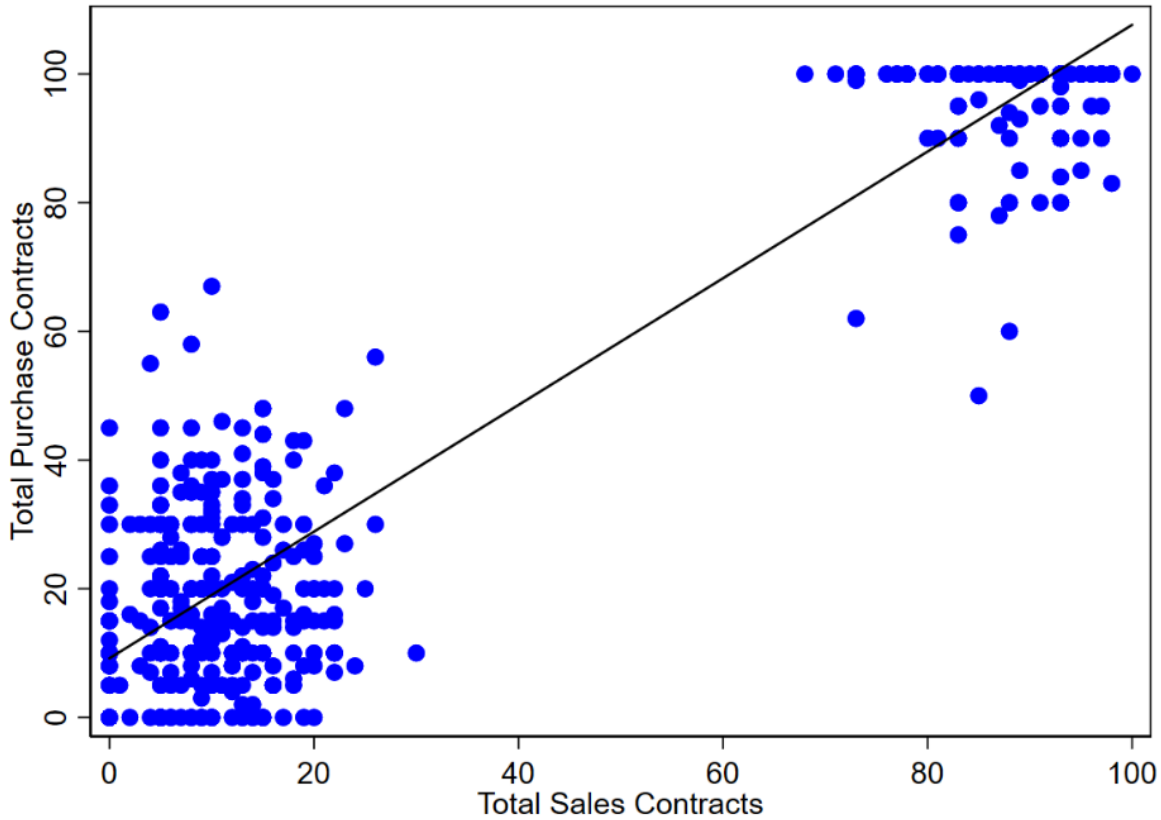


Figure Purchase | Figure Sales Sector | Figure Sales Subsector | Figure Purchase Sector | Figure Purchase Subsector

Descriptive Statistics (cont'd)

Sales v Purchase Contracts



Descriptive Statistics (cont'd)

Sales v Inflation Expectations

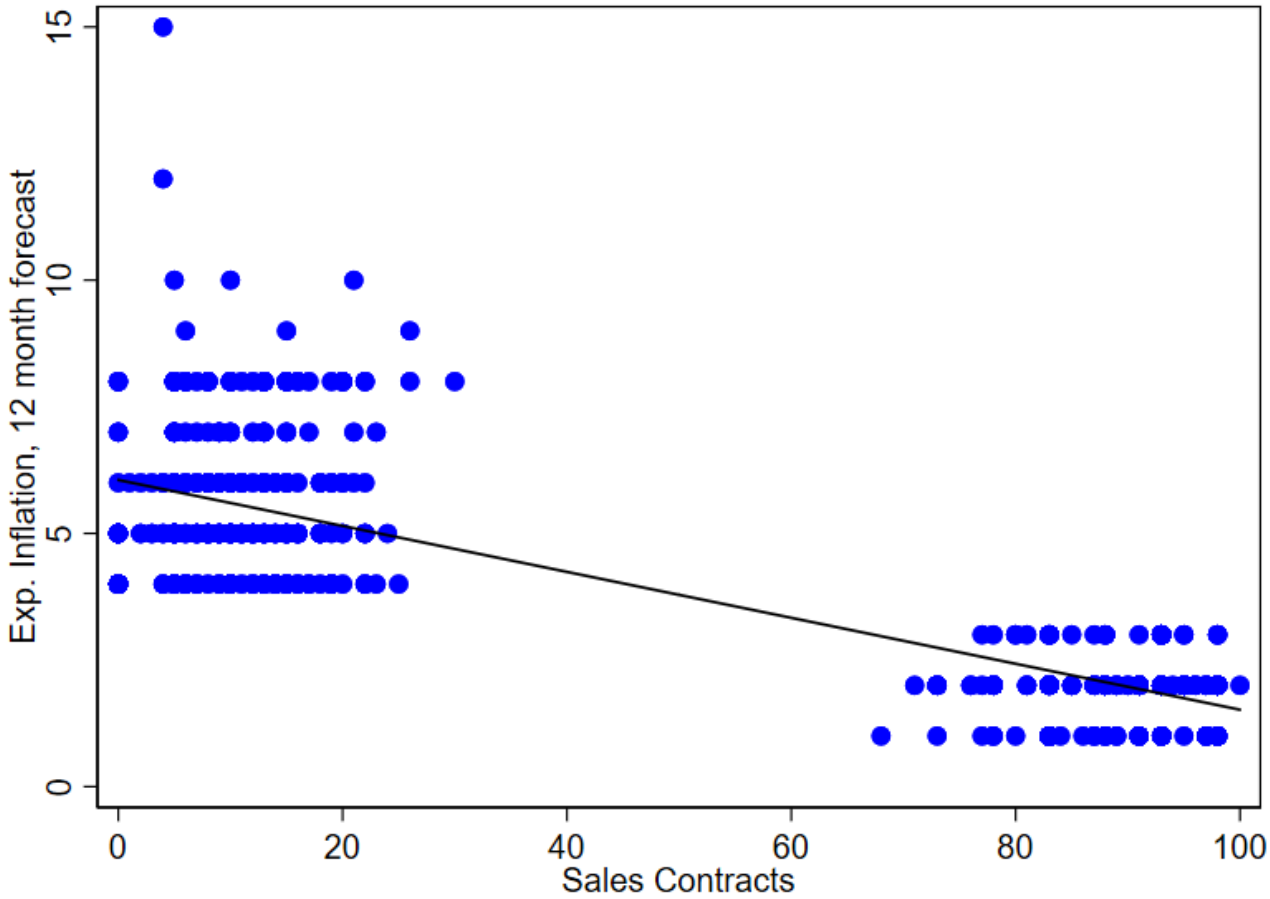


Figure Purchase

Descriptive Statistics (cont'd)

Sales Duration v Inflation Expectations

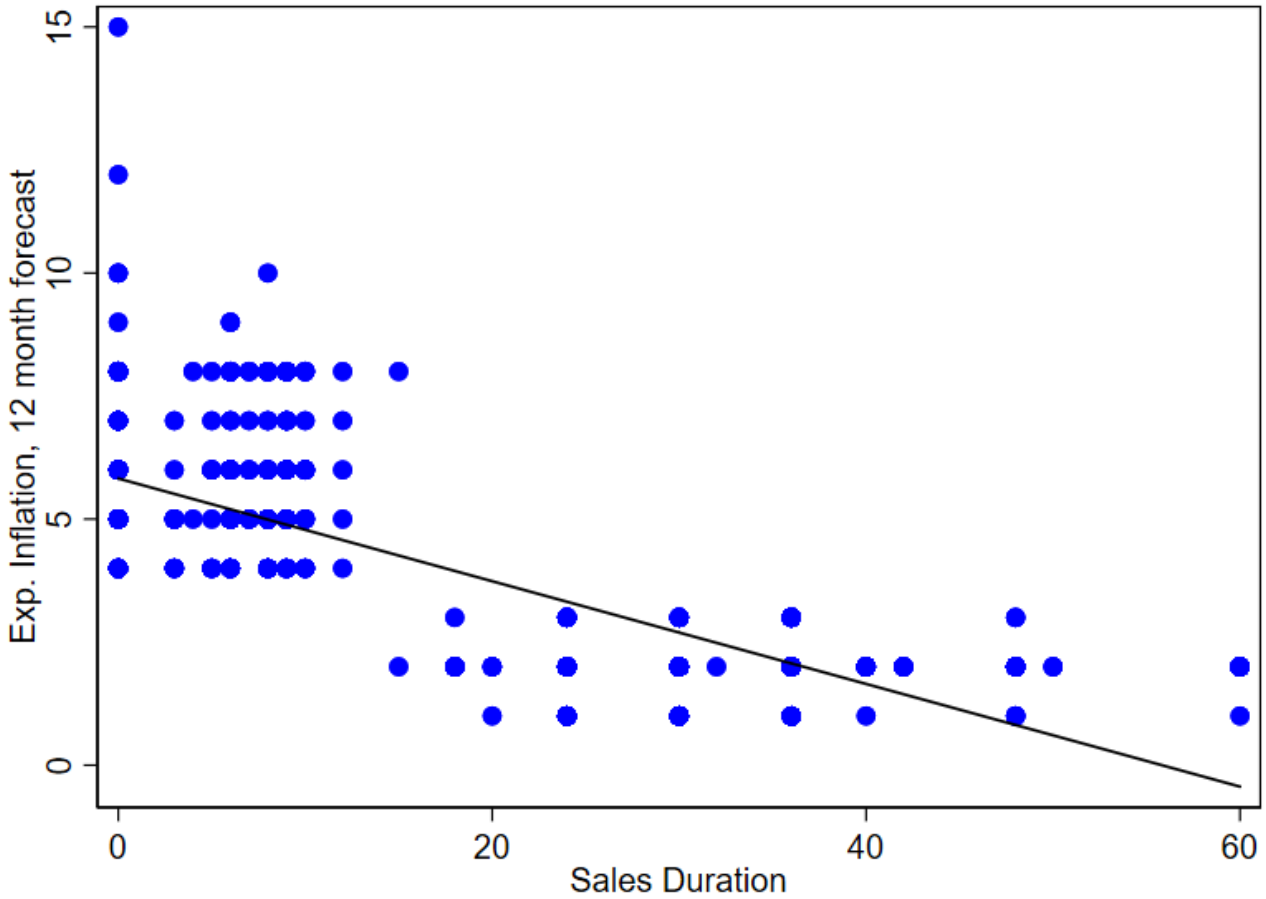


Figure Purchase

Estimation

- Cross-section, fixed-effects regressions

$$Contract_i = \alpha + \phi \mathbf{X}_i + \gamma \mathbb{E}\pi_i + \delta_j + \delta_k + \varepsilon_i,$$

- where
  - $\mathbf{X}_i$ captures firm-specific characteristics
  - $\mathbb{E}\pi_i$ is the expected inflation rate
  - δ_j, δ_k are sector, subsector fixed effects
- All regression use clustered SE at the firm level
- Robustness: Managerial controls

Estimation - Inflation Expectations

Variable	Purchase (Overall)			Sales (Overall)		
Log Age	-13.37^{***}	-12.14^{***}	-13.77	-13.93^{***}	-12.48^{***}	-14.58^{***}
	(1.46)	(1.52)	(1.43)	(1.17)	(1.21)	(1.20)
Log Employment	-9.56^{***}	-9.54^{***}	-9.88^{***}	-8.30^{***}	-8.34^{***}	-8.80^{***}
	(1.20)	(1.20)	(1.22)	(0.96)	(0.92)	(0.94)
Labor Costs	-0.13^{**}	-0.13^{*}	-0.15^{**}	-0.19^{***}	-0.19^{***}	-0.21^{***}
	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)
Trade	0.02	0.01	0.02	0.02	0.02	0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Competitors	1.17^{***}	1.11^{**}	1.23^{***}	1.19^{***}	1.12^{***}	1.28^{***}
	(0.16)	(0.16)	(0.16)	(0.14)	(0.14)	(0.15)
Rel. Price	-5.11^{***}	-4.80^{***}	-5.35^{***}	-4.94^{***}	-4.59^{***}	-5.30^{***}
	(0.74)	(0.72)	(0.76)	(0.67)	(0.67)	(0.69)
Average Margin	-0.59^{***}	-0.62^{***}	-0.63^{***}	-0.46^{***}	-0.51^{***}	-0.53^{***}
	(0.10)	(0.10)	(0.10)	(0.08)	(0.08)	(0.08)
$\mathbb{E}\pi_{t-12m}$	-2.17^{***}			-2.84^{***}		
	(0.56)			(0.52)		
$\mathbb{E}\pi_{t+12m}$		-2.88^{***}			-3.59^{***}	
		(0.63)			(0.50)	
$\mathbb{E}\pi_{t+5y}$			-1.65^{***}			-1.91^{***}
			(0.61)			(0.47)
Obs.	615	615	615	615	615	615
R^2_{adj}	0.89	0.89	0.88	0.92	0.92	0.91

Regression (OLS) is performed with sector and subsector fixed effects. Standard errors are clustered at the firm level.
Significance levels: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Estimation - Inflation Expectations (Purchase)

Variable	Fixed P&Q		Fixed Q		Fixed P	
Log Age	-6.99^{***}	-6.35^{***}	0.35	0.3	-6.73^{***}	-6.09^{***}
	(1.33)	(1.37)	(0.67)	(0.68)	(1.15)	(1.19)
Log Employment	-5.19^{***}	-5.29^{***}	0.13^{***}	0.14	-4.50^{***}	-4.40^{***}
	(1.15)	(1.16)	(0.56)	(0.56)	(1)	(0.98)
Labor Costs	-0.05	-0.05	-0.01	-0.01	-0.08	-0.08
	(0.07)	(0.07)	(0.04)	(0.04)	(0.07)	(0.07)
Trade	-0.03	-0.03	-0.02	-0.02	0.06	0.06
	(0.04)	(0.04)	(0.02)	(0.02)	(0.05)	(0.05)
Competitors	0.41^{**}	0.39^{*}	-0.08	-0.07	0.84	0.84^{***}
	(0.21)	(0.21)	(0.10)	(0.10)	(0.22)	(0.22)
Rel. Price	-3.65^{***}	-3.52^{***}	0.22	0.21	-1.69^{**}	-1.69^{**}
	(0.74)	(0.75)	(0.31)	(0.30)	(0.67)	(0.66)
Average Margin	-0.32^{***}	-0.35^{***}	0.02	-0.02	-0.25^{***}	-0.25^{***}
	(0.09)	(0.09)	(0.04)	(0.04)	(0.08)	(0.08)
$\mathbb{E}\pi_{t-12m}$	-1.66^{***}		0.14		-0.66	
	(0.50)		(0.24)		(0.43)	
$\mathbb{E}\pi_{t+12m}$		-1.85^{***}		0.16		-1.19^{***}
		(0.53)		(0.24)		(0.44)
Obs.	615	615	615	615	615	615
R^2_{adj}	0.69	0.69	0.7	0.07	0.63	0.63

Regression (OLS) is performed with sector and subsector fixed effects. Standard errors are clustered at the firm level.
Significance levels: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Estimation - Inflation Expectations (Sales)

Variable	Fixed P&Q		Fixed Q		Fixed P	
Log Age	-6.58^{***}	-6.05^{***}	-2.71	-2.39^{***}	-4.65^{***}	-4.04^{***}
	(0.74)	(0.76)	(0.35)	(0.36)	(0.44)	(0.45)
Log Employment	-3.83^{***}	-3.91^{***}	-1.70^{***}	-1.70^{***}	-2.77^{***}	-2.72^{***}
	(0.63)	(0.61)	(0.29)	(0.29)	(0.38)	(0.36)
Labor Costs	-0.10^{**}	-0.11^{*}	-0.04^{**}	-0.04^{**}	-0.05^{***}	-0.05^{**}
	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Trade	0.01	0.01	0.004	0.004	0.01	0.01
	(0.02)	(0.02)	(0.008)	(0.008)	(0.01)	(0.01)
Competitors	0.62^{***}	0.59^{***}	0.24^{***}	0.22^{***}	0.34^{***}	0.30^{***}
	(0.11)	(0.11)	(0.04)	(0.04)	(0.05)	(0.05)
Rel. Price	-2.54^{***}	-2.43^{***}	-1.02^{***}	-0.94^{***}	-1.38^{***}	-1.22^{***}
	(0.42)	(0.42)	(0.18)	(0.18)	(0.24)	(0.24)
Average Margin	-0.28^{***}	-0.30^{***}	-0.05^{***}	-0.06^{***}	-0.14^{***}	-0.15^{***}
	(0.05)	(0.05)	(0.02)	(0.02)	(0.03)	(0.03)
$\mathbb{E}\pi_{t-12m}$	-1.40^{***}		-0.57^{***}		-0.87^{***}	
	(0.31)		(0.14)		(0.18)	
$\mathbb{E}\pi_{t+12m}$		-1.56^{***}		-0.75^{***}		-1.29^{***}
		(0.30)		(0.15)		(0.17)
Obs.	615	615	615	615	615	615
R^2_{adj}	0.85	0.85	0.82	0.83	0.88	0.88

Regression (OLS) is performed with sector and subsector fixed effects. Standard errors are clustered at the firm level. Significance levels: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Estimation - Inflation Expectations (Duration)

Variable	Purchase		Sales	
Log Age	-4.67^{***}	-4.23^{***}	-4.70^{***}	-4.04^{***}
	(0.66)	(0.68)	(0.65)	(0.65)
Log Employment	-3.28^{***}	-3.27^{***}	-2.55^{***}	-2.58^{***}
	(0.61)	(0.60)	(0.52)	(0.50)
Labor Costs	-0.05	-0.05	-0.004	-0.01
	(0.04)	(0.04)	(0.04)	(0.04)
Trade	0.01	0.01	0.01	0.01
	(0.03)	(0.03)	(0.02)	(0.02)
Competitors	0.36^{***}	0.34^{***}	0.52^{***}	0.49^{***}
	(0.11)	(0.11)	(0.10)	(0.10)
Rel. Price	-1.83^{***}	-1.72^{***}	-1.67^{***}	-1.52^{***}
	(0.37)	(0.37)	(0.39)	(0.39)
Average Margin	-0.16^{***}	-0.17^{***}	-0.16^{***}	-0.19^{***}
	(0.05)	(0.05)	(0.05)	(0.05)
$\mathbb{E}\pi_{t-12m}$	-0.78^{***}		-1.34^{***}	
	(0.27)		(0.26)	
$\mathbb{E}\pi_{t+12m}$		-1.04^{***}		-1.66^{***}
		(0.29)		(0.25)
Obs.	615	615	615	615
R^2_{adj}	0.74	0.74	0.78	0.78

Regression (OLS) is performed with sector and subsector fixed effects. Standard errors are clustered at the firm level.
Significance levels: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Uncertainty

- Measure is standard deviation of...
  - 12 months-ahead inflation forecast of the firm (by assigning probability for various ranges of inflation rate)
  - Employment growth of the firm
  - Sectoral producer price index (PPI)
- Higher uncertainty $\Rightarrow$ negative relation with contract use
- Relation to Literature
  - Vavra (2014), Baley and Bianco (2019), and Bachmann et al. (2019)
  - Two effects: (i) option value (less price adjustments) and (ii) volatility effect (more price adjustments)
  - Our results $\rightarrow$ volatility effect dominates

Macroeconomic Modelling

- Inattention
  - Sticky information (Mankiw and Reis, 2002)
  - Noisy information (Woodford, 2001; Sims, 2003)
  - Rational inattention (Reis, 2006; Mackowiak and Wiederholt, 2009)
- State-dependence (models of menu and observation costs)
  - Gorodnichenko (2008): better informed firms do not want to reveal information (longer contracts)
  - Alvarez et al. (2011): higher inflation rates $\rightarrow$ frequency of price adjustments $\uparrow$ while the ratio of the frequency of price reviews to adjustments $\downarrow$ (firms with long-term sale contracts have better inflation expectations)

Conclusion

- Contracts
  - Firms purchase and sell inventory through various contractual arrangements (Fixed P&Q (largest))
  - Drivers: age (-), fim size (-), rel. price (-), average profit margin (-), competitors (+)
- Purchase and sale contracts correlate with inflation expectations
  - Higher inflation expectations $\Rightarrow$ lower use of contracts *and* shorter contracts (esp. sale)
- Calibration
  - Bayesian DSGE (Smets and Wouters, 2007): 1.6 quarters
  - Micro data (Nakamura and Steinsson, 2008): 2.5-3 quarters
  - Our survey: 6 quarters (RBNZ DSGE: 5 quarters)

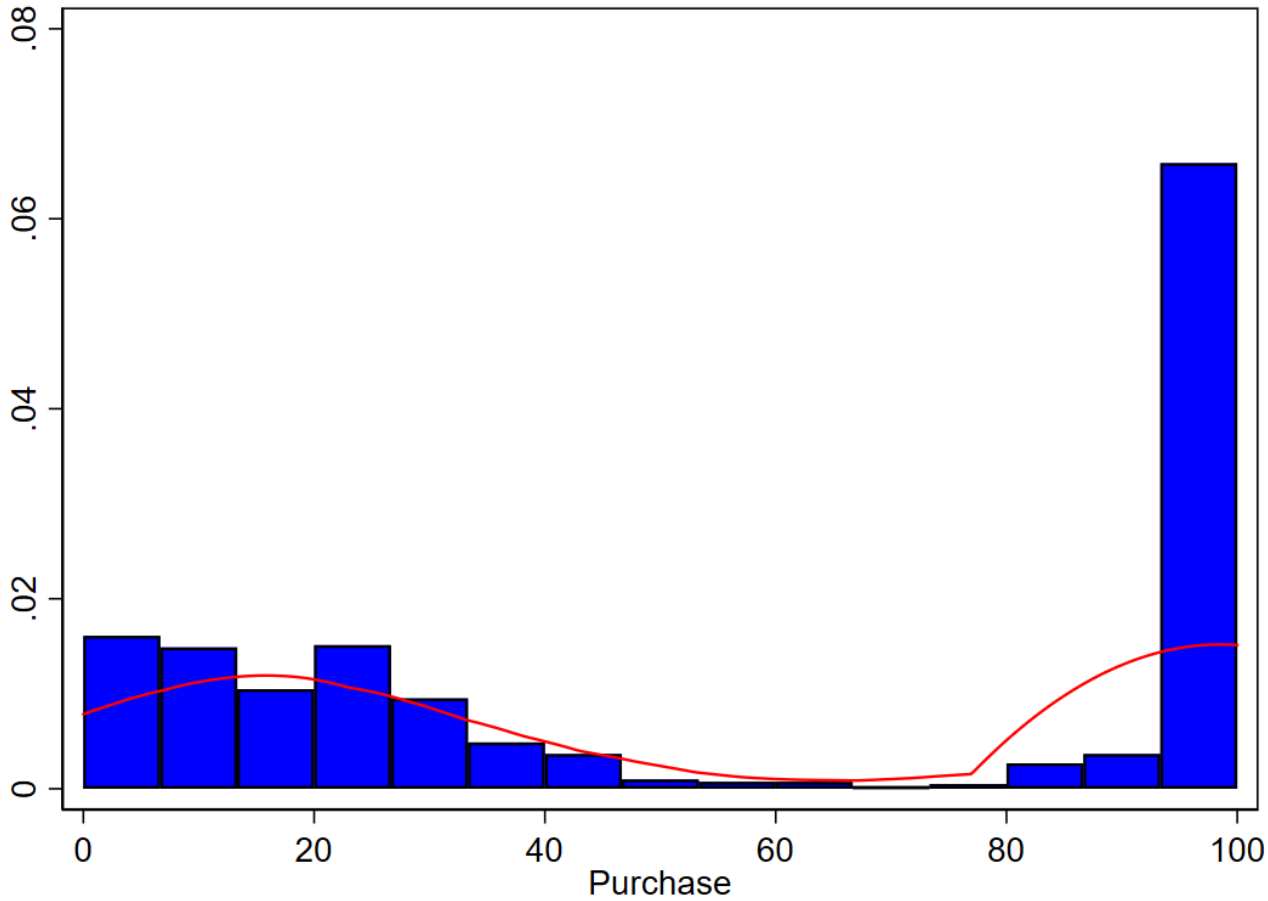
Survey Questions

- During the *next* twelve months, by how much do you think prices will change overall in the economy?
- When purchasing the inventory of your main product line, are buying fixed quantities, or at fixed prices, that are specified in advance in contracts with your supplies, or do you purchase in the spot market, according to your needs at any moment in time? For each of the following please specify the proportion bought under each type of arrangement:
  - Supply contract specifies quantity and price: %
  - Supply contract specifies price, but not quantity: %
  - Supply contract specifies quantity, with a price determined by the spot market: %
  - No contract / spot market: %
- What is the *average length* of time of purchase contracts that specify quantity and price?

Back

Descriptive Statistics

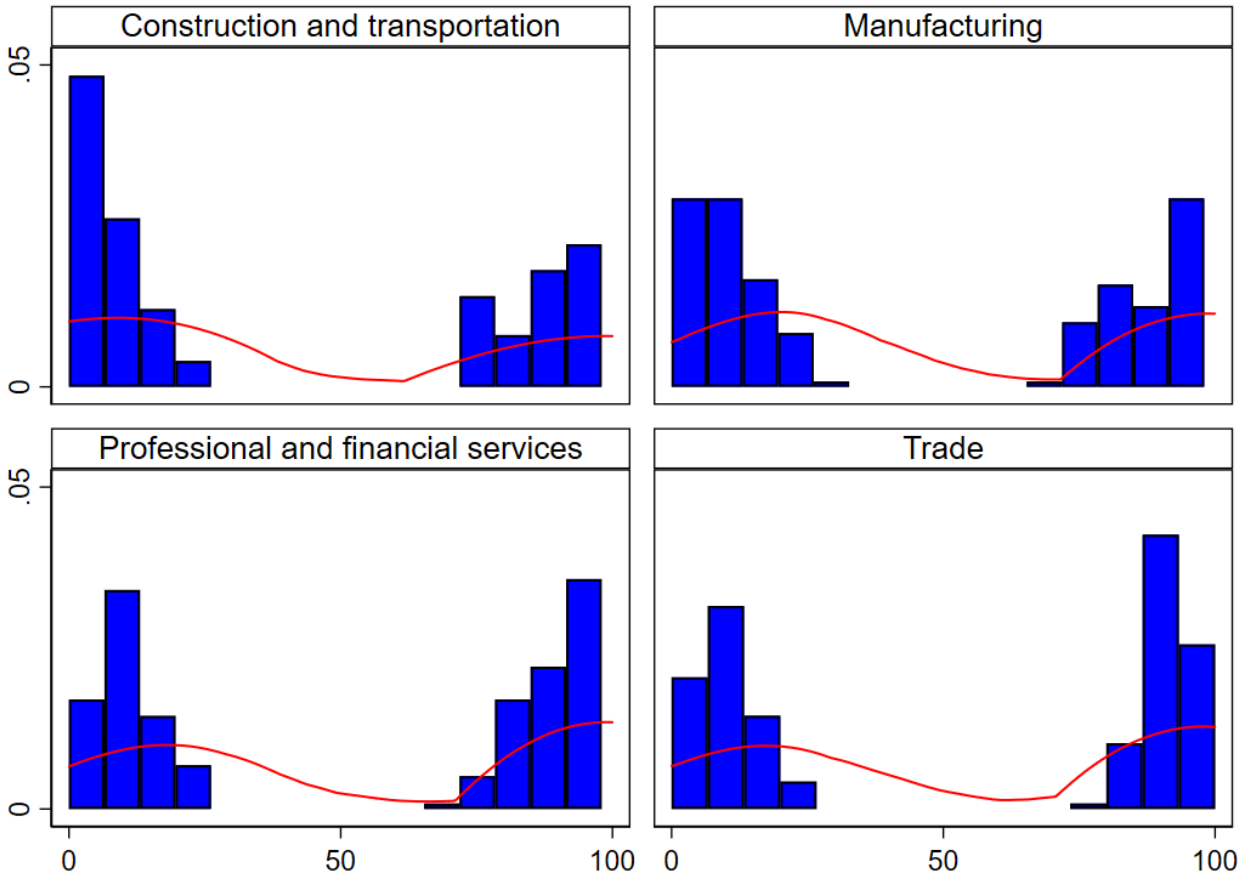
Purchase Contracts



Back

Descriptive Statistics

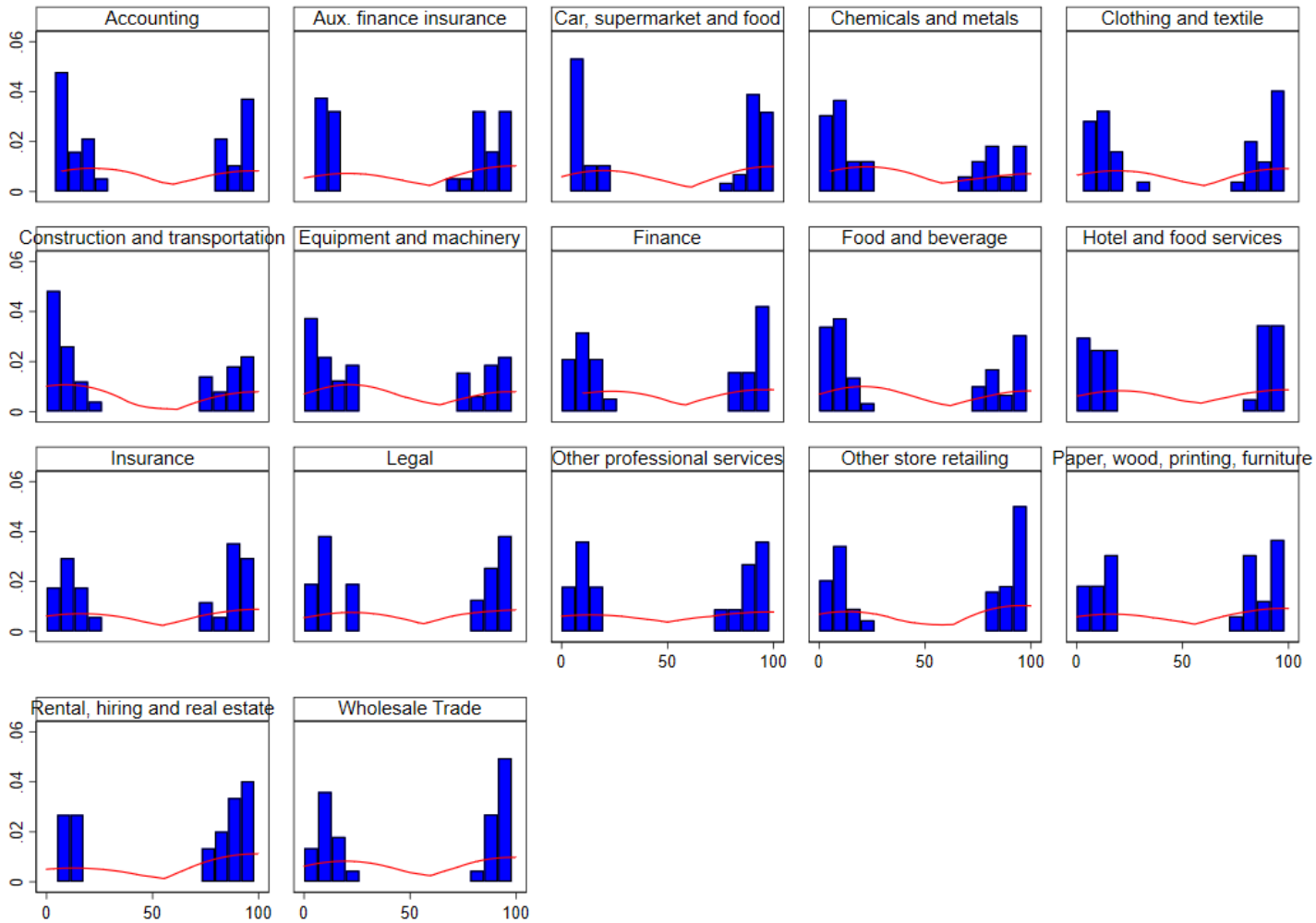
Sales Sector



Back

Descriptive Statistics

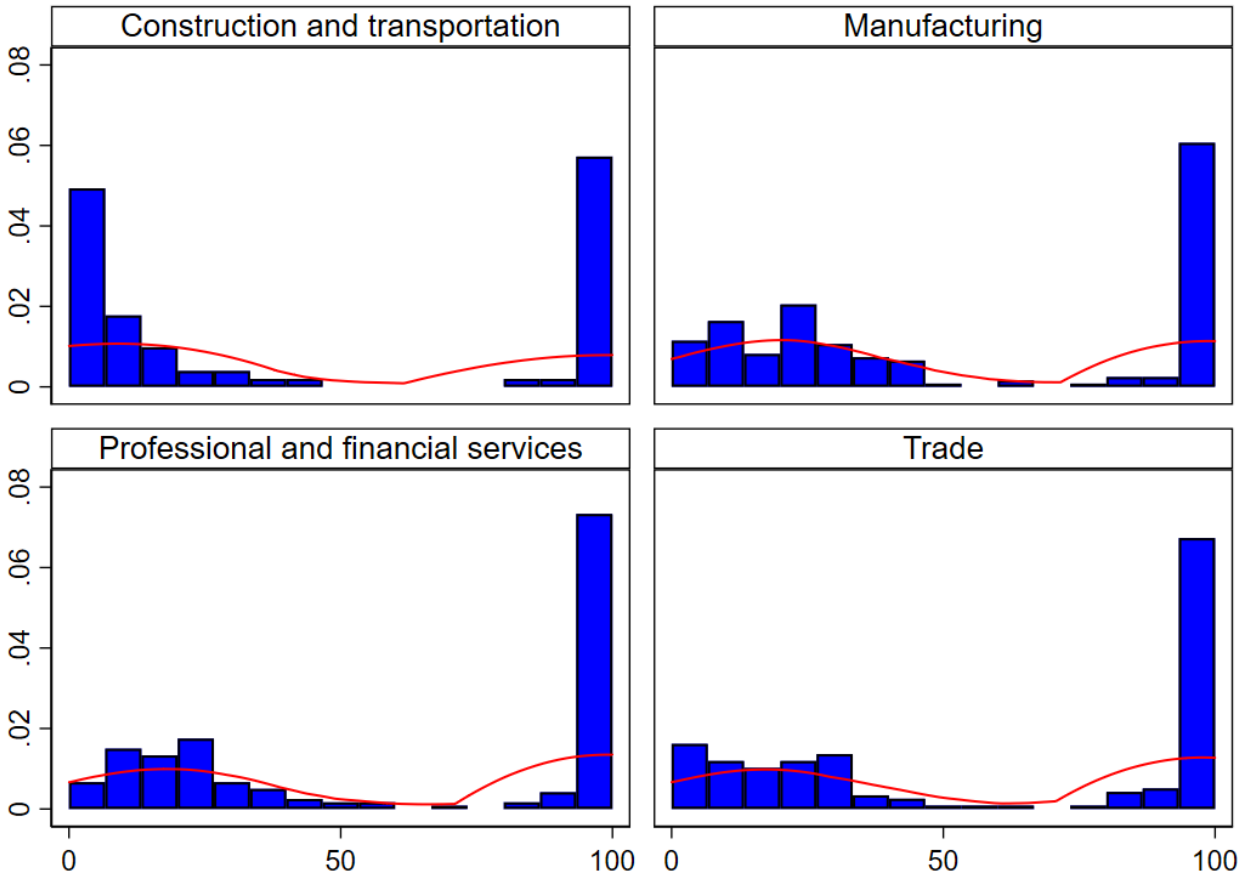
Sales Subsector



Back

Descriptive Statistics

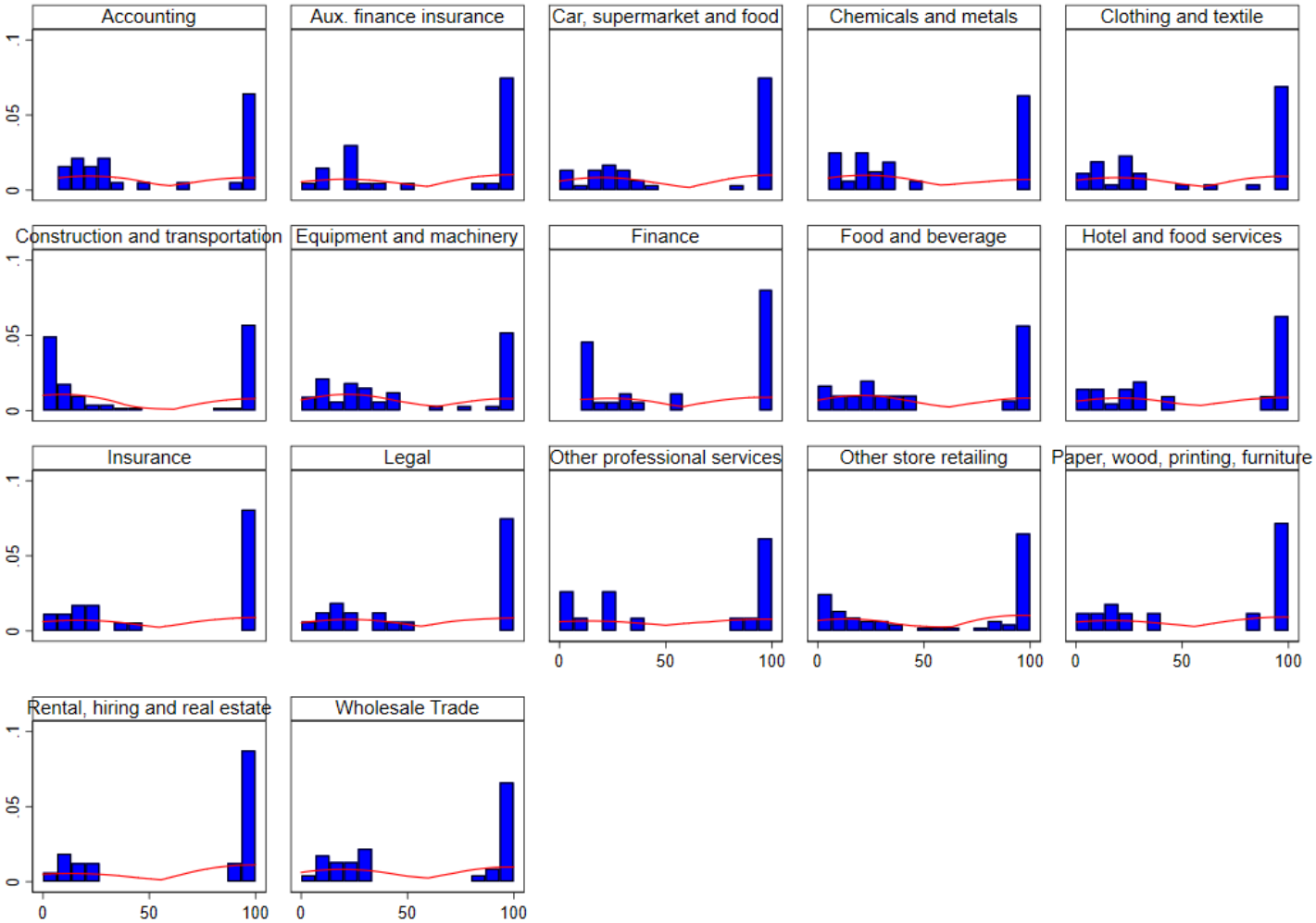
Purchase Sector



Back

Descriptive Statistics

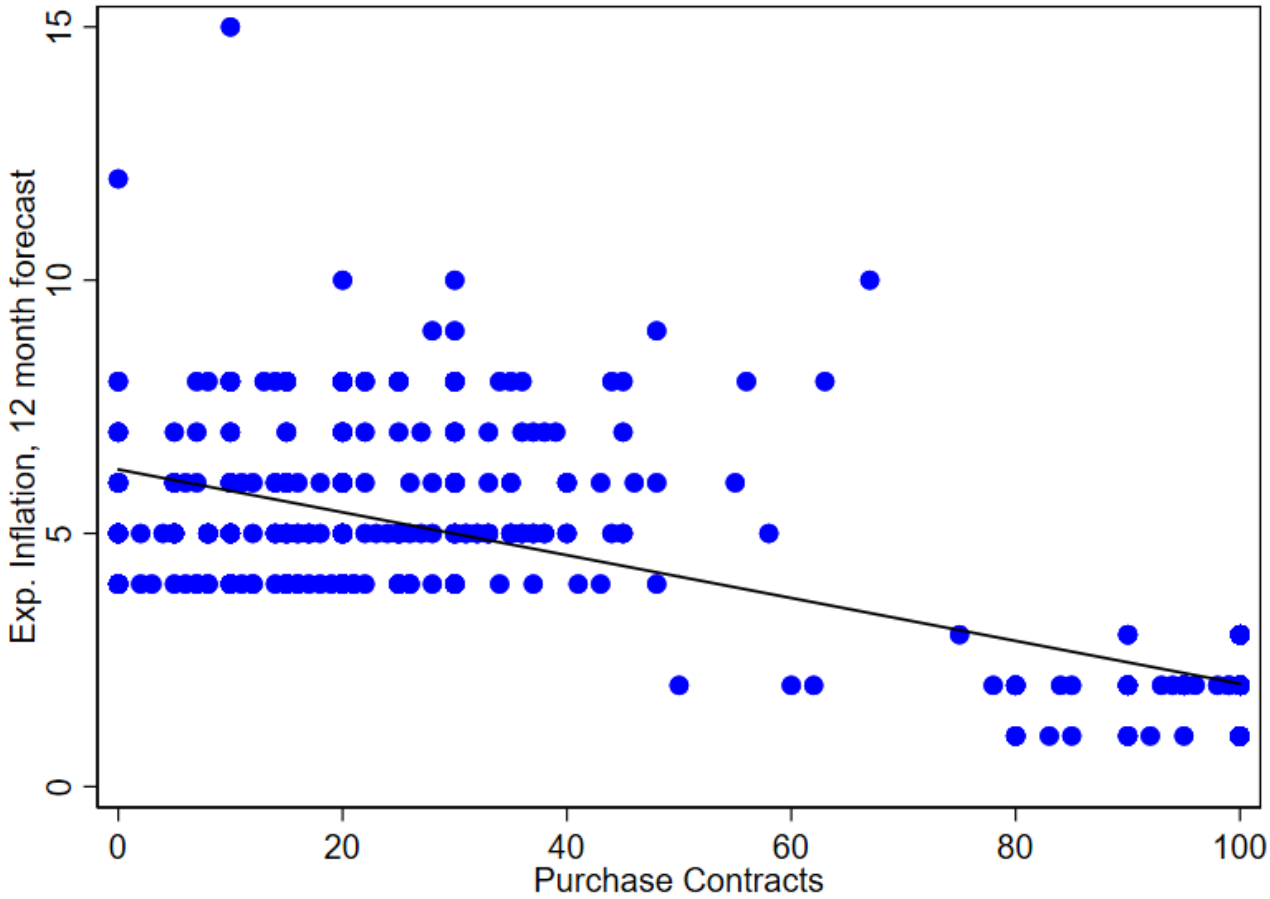
Purchase Subsector



Back

Descriptive Statistics

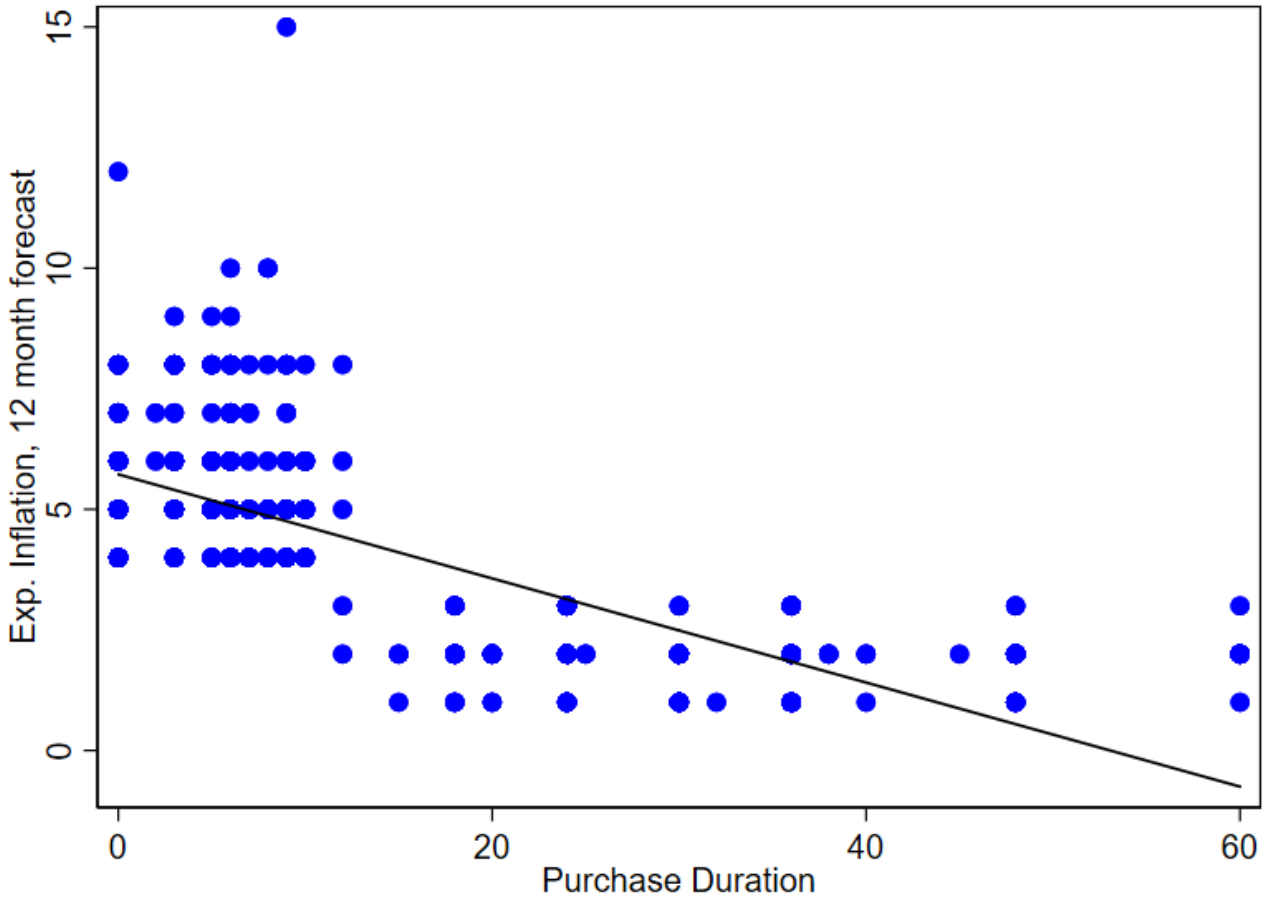
Purchase v Inflation Expectations



Back

Descriptive Statistics

Purchase Duration v Inflation Expectations



Back