Relational Contracting Inside the Firm

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Motivation

- Incomplete contracts create value in repeated interactions both within and across firms (MacLeod & Malcomson 1989; Baker, Gibbons, & Murphy 1994, 2001, 2002; Levin 2003)
  - "Firms are riddled with relational contracts" (Baker, Gibbons, & Murphy 2002)
  - Many organizational capabilities rely on managerial practices that in turn rest on relational contracts (Gibbons & Henderson 2012; Blader, Gartenberg, Henderson, & Prat 2015; Halac & Prat 2016)
- Relational contracts may be particularly important in low-income country contexts, where 1) weak institutions often render enforcement difficult, and 2) large shocks are often uninsured
  - Informal risk-sharing is a key feature of low-income economies (Coate & Ravallion 1993; Townsend 1994, 1995; Besley 1995)

Motivation

- Evidence on existence and properties of relational contracts *across* firms is abundant (Banerjee & Duflo 2000; Johnson, McMillan, & Woodruff 2002; Machiavello & Morjaria 2015; Machiavello & Miquel-Florensa 2017)
- Little rigorous empirical documentation of the nature of these intra-firm interactions and their importance for firm growth
  - Only formal evidence we are aware of comes from lab setting (Brown, Falk, & Fehr 2004)

Research objectives

- We study the informal risk sharing behavior of managers at an Indian readymade garments firm
    - Absenteeism shocks are frequent and often very large; how do managers smooth production in the face of this uncertainty?
    - Is managers' behavior consistent with the canonical theory of relational contracting?
    - How efficient is risk sharing?
    - What is the value of relational contracting in this setting?

Context

- Ready-made garment factories in Bengaluru, India
- 2.5 years (06/2013 - 11/2015) of daily worker-manager matched data from 123 production lines across 6 plants
- Lines consist of 65-70 workers, usually one worker to machine, each garment order lasts 20-30 days
- Managers assign workers to machines/tasks every morning conditional on who is present; they can "lend" and "borrow" workers with each other

Production Data

- Worker id's, "home" line id, and daily manager/team match
- Worker level daily absenteeism
- managers' ids, behavior with regard to day-to-day "lending" and "borrowing" of workers across teams
- **Absenteeism**: percentage of home line absenteeism measured in (unit-level) SD units

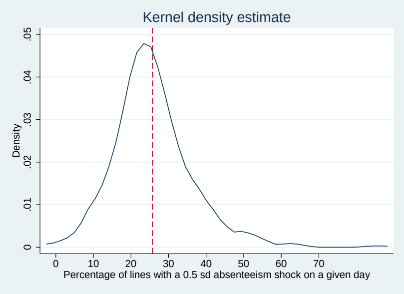
Summary statistics (production line level)

Variables	Mean/(S.D.)
Number of home-line workers	66.24
	(16.04)
Number of workers present	60.85
(incl. transfers)	(15.33)
Number of home-line workers	56.46
present	(15.71)
Percentage of home-line workers	86.04%
present	(8.12)
Number of home-line workers	6.93
with a festival	(3.27)
Number of adjacent lines	2.88
	(0.84)
Distance in feet from	11.73
other lines	(8.01)

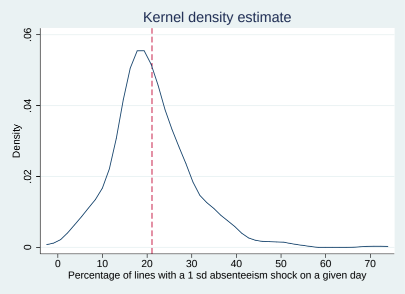
Absenteeism Shocks

Fact 1: Absenteeism shocks are frequent

Lines with at least a 0.5 S.D. shock



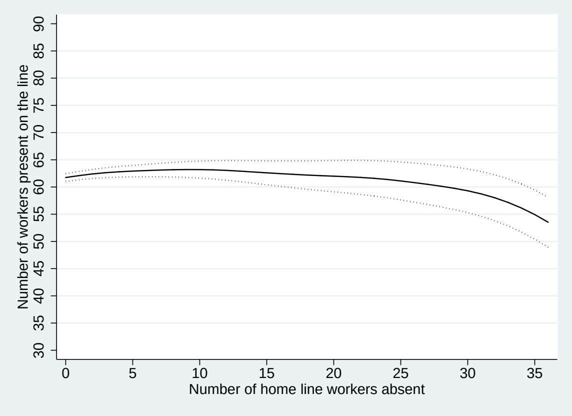
Lines with at least 1 S.D. shock



Absenteeism Shocks

Fact 2: Absenteeism of "home line" workers has a small impact on the number of workers working on the line on a given day

Average number of workers on the line by number of workers absent



Idiosyncratic Absenteeism Shocks Are Smoothed

Fact 3: Managers seem to be able to mitigate the negative effects of absenteeism on productivity

Efficiency on percentage of workers present

	(1) Efficiency (%)	(2) Efficiency (%)
Absenteeism (%)	-0.0449***	-0.0656***
	(0.0116)	(0.00924)
Observations	29919	29893
Mean	50.987	50.987
SD	16.542	16.542
UnitXfloor	Y	Y
UnitXfloorXyear	Y	Y
UnitXfloorXmonth	Y	Y
UnitXfloorXd.o.w	Y	Y
Line A	Y	Y
Styles	N	Y

Standard errors in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

- From all present to mean abs. (13%) $\Rightarrow$ productivity $\downarrow \sim 1.7\%$

Hard-to-smooth Absenteeism Shocks and Factory Unit Productivity

Fact 3B: Hard-to-smooth absenteeism has larger productivity impact

Efficiency on absenteeism of the line with the least absenteeism

	(1)	(2)	(3)	(4)	(5)	(6)
			Efficiency (%)			
Min % of absentees	-0.165**	-0.178**	-0.179**			
	(0.0718)	(0.0755)	(0.0743)			
Min nb of absentees				-0.185**	-0.185**	-0.202**
				(0.0891)	(0.0891)	(0.0922)
Observations	2394	2394	2391	2394	2394	2391
Mean	51.2	51.2	51.2	51.2	51.2	51.2
SD	9.4	9.4	9.4	9.4	9.4	9.4
Clustering	N	N	N	N	N	N
Unit	Y	Y	Y	Y	Y	Y
year	Y	Y	Y	Y	Y	Y
month	Y	Y	Y	Y	Y	Y
day of the week	Y	Y	Y	Y	Y	Y
UnitXyear	Y	Y	Y	Y	Y	Y
UnitXmonth	N	Y	Y	N	N	Y
UnitXd.o.w	N	N	Y	N	N	Y

Standard errors in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

- From all present to mean abs. (13%) $\Rightarrow$ productivity $\downarrow \sim 5\%$

Qualitative Evidence of Relational Contracts Between Managers

Some excerpts from our conversations with managers:

> *When facing absenteeism, a manager will try to get workers from other managers by talking to them directly.*
>
> *Usually, managers don't need to take additional efforts to convince other managers, as everyone understands the situation.*
>
> *Co-operation is usually assumed as a professional practice. The managers share workers with an understanding that they might need to borrow workers in future.*
>
> *Managers form relationships mainly through being on the same floor [spatial contiguity] and understanding that co-operation is mutually beneficial.*

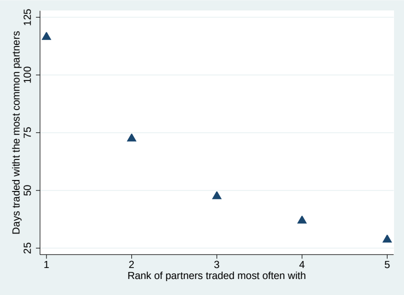
Preliminary Empirical Evidence of Relational Contracts

- 77% of trades occur on the same floor; 54% of trades happen between adjacent lines
- Managers do 80% of all their trades with the same 3 partners despite having on average 22 potential partners
- Managers entirely forgo 11 potential partnerships on average, for a total of 655 inactive partnerships among 1352 potential partners
- 13.35% of active partnerships "break" *(active = the pair traded at least one worker a week for one consecutive month; break = lapse in trading for more than 6 months)*
- 46% of active partnerships never stop trading for more than a month
- When a manager leaves, 74% of active partnerships break for at least a month

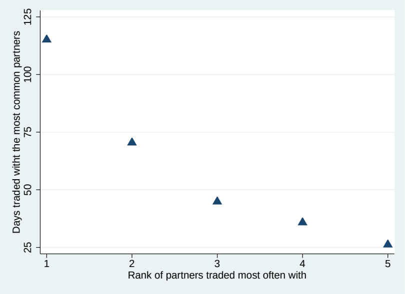
Existence of Primary Trading Partners

Fact 4: Managers have primary trading partners

Trade outs



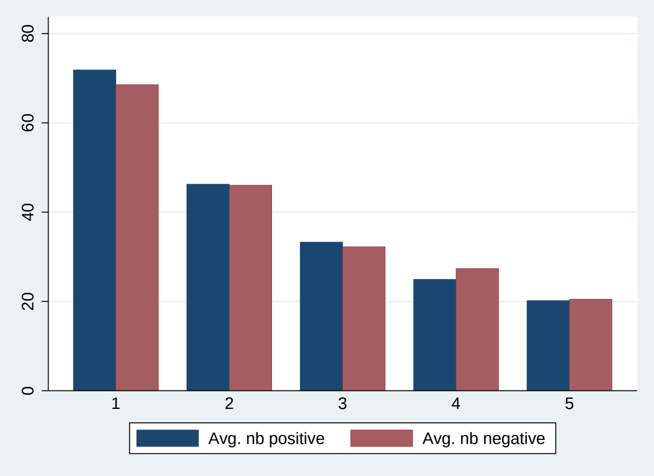
Trade ins



Balanced Relationships

Fact 5: Managers switch between being principal and agents, balance lending and borrowing

Average number of net trades in and out by partner rank

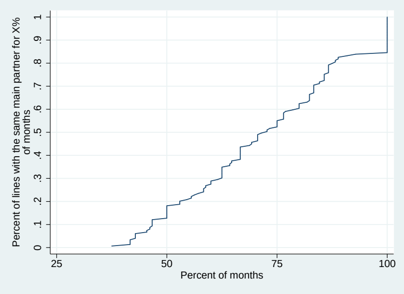


Primary Partners Persist over Time

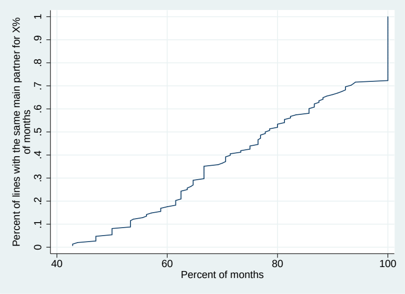
Fact 6: The most common partner is the same month after month

Percent of lines for which the main partner is the same for x% of months

Trade outs

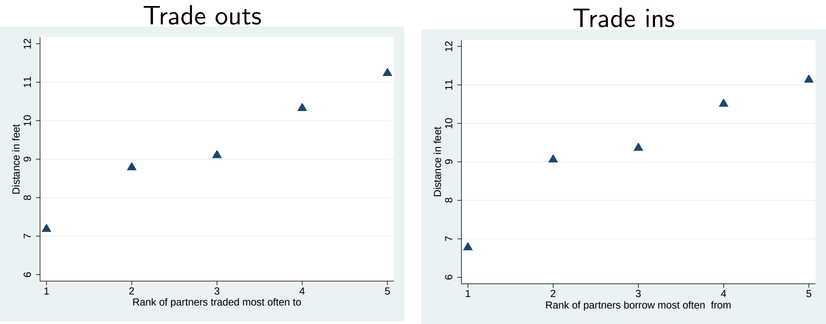


Trade ins



Distance between Partners

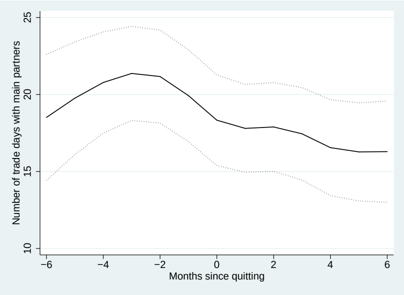
Fact 7: The main partners are closer to each other on the factory floor



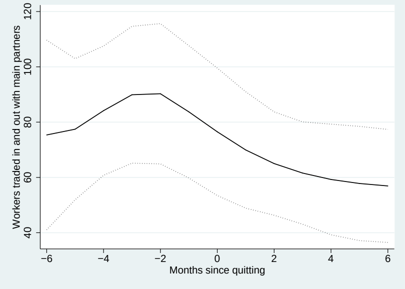
Quitting affects trade

Fact 8: When a manager who quits, his main trading partners are slow to trade with his replacement

Number of trade days



Number of workers traded in and out



Model

- Two Lines $k = A, B$ that live forever:
  - Random (identically distributed but independent) states for each lines, $y_t^k \in \{y_{A,t}, y_{B,t}\}$.
  - The states are number of "home-line" workers that show-up.
  - $y_{i,t} \in \left[\underline{y}, \overline{y}\right]$, $y_{i,t} \sim G_i(\cdot)$.
  - $G_i(\cdot)$ independently across time and of the state of their peers $y_{-i,t}$, $G_{-i}(\cdot)$.
  - Distribution functions are symmetric, $G_i(\cdot) = G(\cdot)$, for $i \in \mathcal{K}$.

- Time is discrete, indexed by existing $t = 1, 2, ...,$.

- Production fuction $f(\cdot)$ (increasing and concave).
  - Input: net number of workers.

Model

- In each period, managers are matched randomly and establish bilateral relationships.
- In a potentially ongoing relationship, manager i agrees to help j if i is in a better state (i.e., more present "home-line" workers) than j; in return, j agrees to help i when their states are reversed in the future
- A transaction cost exists between potential partners which determines whether a particular trade is worth completing
- A match can be dissolved endogenously if either party in the current match decides to leave

Managerial Type

- Managerial type (fixed, private info): reliable (R) and Unreliable (U)
- Measure of R-type managers is γ_0; measure of U-type is $1 - \gamma_0$
- R-type managers can always help their trading partner when their state is better than their partner's
- U-types are subject to random shocks that make lending impossible
    - The probability of a shock conditional on the manager being a U-type, ρ, is known to both parties and constant over time
- After τ trades from i to j, the probability manager j is reliable is

$$\gamma_\tau^i = \frac{\gamma_0}{\gamma_0 + (1-\rho)^\tau (1-\gamma_0)}$$

Payoffs

- Suppose i's state in period t is better than j's; if i does not shirk, payoffs for i from t onward are

$$U_{i,t}^{R}\left(\boldsymbol{\theta}_t;\gamma_\tau^i\right)=f\left(y_{i,t}-\theta_{ij,t}\right)-c_{ij}+\delta U_{i,t+1}^{R}\left(\boldsymbol{\theta}_{t+1};\gamma_\tau^i\right)$$

- If i shirks, payoffs from t onward are (where $V\left(n_i\right)$ is i's outside option)

$$U_{A,t}^{S}\left(\boldsymbol{\theta}_t;\gamma_\tau^i\right)=f\left(y_{i,t}\right)+\delta V\left(n_i\right)$$

- Incentive compatibility constraint (no shirking condition) is

$$f\left(y_{i,t}\right)-f\left(y_{i,t}-\theta_{ij}\right)+c_{ij}\leq\delta\left(U_{i,t+1}^{R}\left(\boldsymbol{\theta};\tau\right)-V\left(n\right)\right)$$

Characterizing the Symmetric Stationary Relational Contract

Proposition: A stationary contract exists and is uniquely defined by

$$\theta_{ij}^{*} = \min \left\{ \hat{\theta}_{ij}, H \left(y_i, c_{ij}, \frac{\delta \left(\bar{U}^R \left(\boldsymbol{\theta}^* \right) - V \right)}{1-\delta} \right) \right\}$$

where $H\left(\cdot\right)$ is such that $\left(y_i, c_{ij}, \frac{\delta\left(\bar{U}^R(\boldsymbol{\theta}^*)-V\right)}{1-\delta} \right)$ satisfy

$$\Delta\left(y_i, x, H\left(y_i, w\right)\right) \equiv f\left(y_i\right) - f\left(y_i - \theta_{ij}^{*}\right) + c_{ij} - \delta \frac{\left(\bar{U}^R\left(\boldsymbol{\theta}^*\right) - V\right)}{1-\delta} = 0$$

where, $\hat{\theta}_{ij}$, is the first best allocation, equal to $\hat{\theta}_{ij} = \frac{y_i - y_j}{2}$

Summary of Model Predictions (for i in better state than j)

- **Prediction 1.** The number of workers lent from i to j increases with i's state and decreases with j's state
- **Prediction 2.** The number of workers lent from i to j decreases with the value of i's outside option
- **Prediction 3**. The number of workers lent from i to j decreases as the ij-specific transaction cost rises
- **Prediction 4.** The frequency/probability of trades decreases with the ij-specific transaction cost
- **Prediction 5.** Along the transition to steady state, the number of workers lent from i to j increases with the number of completed trades between i and j

Empirical Tests of Theory

Test of Empirical Predictions: Prediction 1

$$Balance = \alpha + \beta_1 PresentA + \beta_2 PresentB + \Phi + \varepsilon$$

- Sample restriction: A is in a better state (% of "home-line" workers present) than B
- *PresentA* is the percentage of home-line workers present in SD units for the line A (analogous for B)
- Φ is a matrix of controls and fixed effects
- *Balance*: number of workers lent - number of workers borrowed (net lending)

Prediction 1: All Trading Partners

$$\text{Prediction 1}: \frac{\partial \theta^*_{ij}}{\partial y_i} > 0, \ \frac{\partial \theta^*_{ij}}{\partial y_j} < 0$$

	(1) Balance	(2) Balance	(3) Balance	(4) Balance
SD % Present A	0.0496***	0.0555***	0.0545***	0.0503***
	(0.00649)	(0.00692)	(0.00699)	(0.00727)
SD % Present B	-0.0230***	-0.0207***	-0.0201***	-0.0162***
	(0.00286)	(0.00282)	(0.00288)	(0.00336)
Observations	198193	198191	198191	198188
Mean of Y	.028	.028	.028	.028
SD	1.276	1.276	1.276	1.276
Controls	Y	Y	Y	Y
UnitXfloor	N	Y	Y	Y
UnitXfloorXyear	N	Y	Y	Y
UnitXfloorXmonth	N	Y	Y	Y
UnitXfloorXweek	N	Y	Y	Y
Line A,B	N	N	Y	Y
Styles	N	N	N	Y

Standard errors in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

- % Present $A \uparrow\sim$ 10 workers $\Rightarrow$ A lends 1 additional worker on net *(0.05 x 3.2 x 6.5)* $\approx$ *1*
- % Present $B \downarrow\sim$ 10 workers $\Rightarrow$ A lends 1/3 additional worker on net *(0.016 x 3.2 x 6.5)* $\approx$ *0.33*

Prediction 1: Primary trading partners

Prediction 1-Primary trading partners: $\frac{\partial \theta^*_{ij}}{\partial y_i} > 0$, $\frac{\partial \theta^*_{ij}}{\partial y_j} < 0$

	(1) Balance	(2) Balance	(3) Balance	(4) Balance
SD % Present A	0.231***	0.245***	0.252***	0.239***
	(0.0320)	(0.0341)	(0.0351)	(0.0390)
SD % Present B	-0.101***	-0.108***	-0.101***	-0.0678***
	(0.0162)	(0.0177)	(0.0180)	(0.0206)
Observations	31824	31816	31816	31763
Mean of Y	.113	.113	.113	.113
SD	2.851	2.851	2.851	2.851
Controls	Y	Y	Y	Y
UnitXfloor	N	Y	Y	Y
UnitXfloorXyear	N	Y	Y	Y
UnitXfloorXmonth	N	Y	Y	Y
UnitXfloorXweek	N	Y	Y	Y
Line A,B	N	N	Y	Y
Styles	N	N	N	Y

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

- % Present $A \uparrow \sim 10$ workers $\Rightarrow$ A lends 1.2 additional workers on net
- % Present $B \downarrow \sim 10$ workers $\Rightarrow$ A lends 1/3 additional worker on net

Prediction 2: number of adjacent lines

Prediction 2: $\frac{\partial \theta^*_{ij}}{\partial OS_i} < 0$

	(1) Balance	(2) Balance	(3) Balance	(4) Balance
SD % Present A	0.122***	0.128***	0.149***	0.156***
	(0.0171)	(0.0176)	(0.0522)	(0.0520)
SD % Present B	-0.0441***	-0.0449***	-0.0440***	-0.0449***
	(0.00643)	(0.00647)	(0.00643)	(0.00647)
Outside Option	-0.0450***	-0.0456***	-0.0414***	-0.0418***
	(0.0102)	(0.0101)	(0.0118)	(0.0118)
Interaction			-0.0110	-0.0116
			(0.0174)	(0.0173)
Observations	56785	56785	56785	56785
Mean of Y	.028	.028	.028	.028
SD	1.276	1.276	1.276	1.276
Controls	Y	Y	Y	Y
Year	N	Y	N	Y
Month	N	Y	N	Y
Week	N	Y	N	Y

Standard errors in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Outside option: number of adjacent lines

Prediction 3: distance between lines on same floor

Prediction 3: $\frac{\partial \theta^*_{ij}}{\partial Distance} < 0$

	(1) Balance	(2) Balance	(3) Balance	(4) Balance
SD % Present A	0.121***	0.121***	0.124***	0.119***
	(0.0171)	(0.0177)	(0.0180)	(0.0176)
SD % Present B	-0.0446***	-0.0347***	-0.0345***	-0.0204***
	(0.00645)	(0.00665)	(0.00677)	(0.00736)
SD Distance	-0.0249***	-0.0268***	-0.0481***	-0.0456***
	(0.00794)	(0.00792)	(0.00918)	(0.0104)
Observations	56785	56777	56777	56747
Mean of Y	.028	.028	.028	.028
SD	1.276	1.276	1.276	1.276
Controls	Y	Y	Y	Y
UnitXfloor	N	Y	Y	Y
UnitXfloorXyear	N	Y	Y	Y
UnitXfloorXmonth	N	Y	Y	Y
UnitXfloorXweek	N	Y	Y	Y
Line A,B	N	N	Y	Y
Styles	N	N	N	Y

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Prediction 4: active partnerships

Prediction 1: $\frac{\partial Pr(\theta_{ij}^{*}>0)}{\partial Distance} < 0$

	(1) Ever Trade	(2) Ever Trade	(3) Ever Trade	(4) Ever Trade
SD Distance	-0.0187***	-0.0135***		
	(0.00303)	(0.00321)		
Different floor			-0.436***	-0.458***
			(0.0262)	(0.0269)
Observations	368	368	1300	1300
Mean of Y	.486	.486	.486	.486
SD	.5	.5	.5	.5
Controls	N	N	N	N
UnitXfloor	N	Y	N	Y
Line A,B	N	Y	N	Y

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

- $Ever\ trade = \alpha + \beta Distance + \Phi + \varepsilon$
- Results also hold when we use a Probit regression

Prediction 5

Prediction 5: $\frac{\partial \theta^*_{ij}}{\partial Age} > 0$

	(1) Balance	(2) Balance	(3) Balance	(4) Balance
SD % Present A	0.0496***	0.0566***	0.0554***	0.0506***
	(0.00650)	(0.00693)	(0.00700)	(0.00728)
SD % Present B	-0.0233***	-0.0214***	-0.0208***	-0.0167***
	(0.00286)	(0.00282)	(0.00288)	(0.00335)
Age	0.0755***	0.0903***	0.0901***	0.0883***
	(0.00904)	(0.00993)	(0.00995)	(0.00992)
Observations	198193	198191	198191	198188
Mean of Y	.028	.028	.028	.028
SD	1.276	1.276	1.276	1.276
Controls	Y	Y	Y	Y
UnitXfloor	N	Y	Y	Y
UnitXfloorXyear	N	Y	Y	Y
UnitXfloorXmonth	N	Y	Y	Y
UnitXfloorXweek	N	Y	Y	Y
Line A,B	N	N	Y	Y
Styles	N	N	N	Y

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Robustness

Absenteeism may be endogenous to relationship formation/growth and productivity

- We instrument absenteeism on a line at date t by the number of workers on that line that are from a state with an important cultural festival that day
- Cultural groups are localized and they celebrate different festivals
- We use the workers' language to infer which state they are likely to be originally from

Conclusion

- Relational contracting allows managers to effectively smooth the productivity impacts of large and frequent shocks to absenteeism
- We study the nature of these contracts by adapting a standard model to our context and testing its predictions using granular data on absenteeism and dynamic worker-team matches
- In particular, we show that trades depend on both lines' absenteeism; lines' outside options matter; transaction costs matter; and that relationships mature with age
- Relational contracting has a sizable risk sharing value in this context

Thanks – comments most welcome!

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