Firm-level determinants of wages and productivity: Rent-sharing

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1 Preliminaries

A long literature in economics has documented evidence of what are called interindustry wage differentials. For example, a well-known *JEP* article by Richard Thaler opens with an anecdote about a secretary who was hired in his department and - a few months later - left to accept a job as a secretary at IBM, which at least at the time paid its secretaries much more than other local employers. This example captures the idea that some industries appear to pay higher wages than others, even when (measured) labor quality and occupation are held constant.

Slichter (1950) was the first analysis I am aware of which documented evidence of such interindustry wage differentials. Dickens and Katz (1987) and Katz and Summers (1989) both document evidence of such interindustry wage differentials using the Current Population Survey (CPS) by estimating the relationship between the log wage rate and individual characteristics (including occupation) together with industry indicator variables. Such regressions document large, statistically significant "industry effects," in samples of both union workers and non-union workers. Subsequent work argued that these interindustry wage differentials were unlikely to be easily explained by compensating differentials; as documented by Katz and Summers (1989), for example, high wage industries tend to have low quit rates, which is consistent with workers in such industries begin paid wages in excess of their opportunity costs. Whether unobserved quality is a sufficient explanation is more controversial, but I would say that in general the literature has argued that unobserved quality is not sufficient to explain interindustry wage differentials.

Four industry characteristics appear strongly associated with high levels of compensation: firm size, profits, capital intensity, and union density. From a theoretical perspective, these patterns suggest that either some firms are choosing not to maximize profits, or that - for

some reason - high wage firms find that lowering wages would decrease profits (as in "efficiency wage" models). Several different versions of the efficiency wage model have been proposed, with different sources of a positive wage-effort relationship (shirking models, turnover models, adverse selection models, and fair wage models).

Note that these models stand in contrast with the textbook model of a competitive labor market, in which a worker's wage depends only on her productivity – the profitability of her employer is irrelevant to the wage setting process. We care about whether there is a real relationship between e.g. employer profitability and wages because deviations from the competitive model of wage setting have important implications for a host of topics in labor economics, public finance, and macroeconomics including the effects of productivity dispersion on wage inequality (Barth et al., 2011), the incidence and employment effects of the minimum wage (Flinn, 2006, 2010), optimal corporate and income taxation (Piketty et al., 2014), and the propogation and incidence of macroeconomic shocks in a frictional environment (Shimer, 2005; Hagedorn and Manovski, 2008).

While a large literature in labor economics has documented a positive correlation between firm profitability and workers' wages in both unionized and non-unionized sectors (e.g. Slichter (1950); Dickens and Katz (1987), Katz and Summers (1989)), for the reasons discussed above unexplained wage differentials are difficult to attribute to rent-sharing as opposed to sorting based on unobserved dimensions of human capital. For this reason many researchers have turned to panel data to investigate the dynamic relationship between firm profitability and the wage dynamics of incumbent workers (e.g. Card, Cardoso and Kline (2014)); however, these studies typically rely on strong assumptions regarding the stochastic process driving firm profitability. Few papers have studied rent sharing using variation in firm profitability owing to observable shocks. We will start by discussing one paper that relies on a panel data approach to test for evidence of rent-sharing (Dafny, 2010), and will then discuss three papers that take a more quasi-experimental approach to this question (Van Reenen, 1996; Rose, 1987; Black and Strahan, 2001).

2 How competitive are health insurance markets? Dafny (2010)

Dafny (2010) proposes an empirical test to investigate the following question: how competitive are health insurance markets? Her key idea is to test for evidence of conduct that can only occur in imperfectly competitive markets.

Based on field interviews, she hypothesizes that employers are reluctant to switch health plans during "good times," i.e. profits increase willingness-to-pay for incumbent health plans. Her empirical test is based on this assumption, and after documenting empirical evidence consistent with this assumption she then proposes a bargaining model to explain why this may be the case. Her empirical test investigates whether firms with higher profits pay higher health insurance premiums, controlling as best as possible for differences in the plans selected, employee populations, and market conditions. A competitive industry would be characterized by uniform pricing at (employer-specific) cost. Although a "market conduct parameter" (ranging from 0

to 1, with 0 representing perfect competition and 1 representing monopoly) cannot be derived from her estimates of rent extraction, this is a test of whether health insurers are able to extract employer-specific rents.

She uses a proprietary panel database on fully insured health plans offered by a sample of large, multisite employers from 1998-2005. The data is at the "plan" level, where a plan is an employer-geographic market-insurance carrier-plan type combination - e.g. Worldwide Widgets' CIGNA HMO in Pheonix Arizona. She merges on profit data from Compustat.

Table 2. Her first empirical specification regresses log premiums on a two-year lag of the firm's profit margin, in addition to a variety of covariates (fixed effects for employers, markets, carriers, plan types, and years as well as contemporaneous firm demographics and some additional controls); her key coefficient of interest is not very sensitive to the choice of covariates. Her estimates in Table 2 imply that an employer with a ten percentage point increase in profits pays approximately 0.3 percent more in health insurance premiums. The estimates in columns 2, 4, 6, and 8 include plan design characteristics, to investigate the possibility that firms with positive profit shocks respond by increasing benefits for workers (which could then have higher premiums); the coefficient on lagged profits tends to increase when this control is included, which cuts against the simplest omitted variables bias story. More directly, in the online appendix she shows that plan design does not increase when employers experience increases in profitability.

TABLE 2—THE RELATIONSHIP BETWEEN EMPLOYER PROFITS AND HEALTH INSURANCE PREMIUMS

	Dependent variable = ln(annual premium); $N = 50{,}217$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged profits	0.024***	0.026***	0.043***	0.052***	0.043***	0.051***	0.030**	0.040***
	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Family size	0.317***	0.317***	0.297***	0.297***	0.297***	0.297***	0.299***	0.298***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Plan design		0.362***		0.411***		0.413***		0.451***
		(0.024)		(0.032)		(0.032)		(0.032)
Plan fixed effects	N	N	Y	Y	Y	Y	Y	Y
Market-year covariates								
Unemployment rate					0.023	0.002	N/A	N/A
					(0.185)	(0.184)		
ln(average Medicare costs)					0.073**	0.084***	N/A	N/A
					(0.033)	(0.032)		
Market-year interactions							Y	Y

Notes: Models are estimated using the LEHID-FI–Compustat Sample. The unit of observation is the employer-market-carrier–plan type–year. Specifications correspond to equation (1) in the text, and are estimated by FGLS to account for serial correlation of errors among observations of the same employer-market-carrier–plan type (or "plan"). All specifications include fixed effects for employer, market, carrier, plan type, year, plan type–year, and employer-market.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Source: Dafny (2010).

Table 3. She then investigates how this estimated effect varies by the market structure of the local insurance industry, based on the idea that rent extraction by insurance carriers should be larger where competition is less fierce. Other stories - such as more profitable employers providing more generous benefits - do not give a prediction with respect to market structure of the insurance industry. Table 3 documents that indeed the coefficient on lagged profits declines as the number of insurance carriers increases (her proxy for market competitiveness).

TABLE 3—THE RELATIONSHIP BETWEEN EMPLOYER PROFITS AND HEALTH INSURANCE PREMIUMS, BY MARKET STRUCTURE OF THE INSURANCE SECTOR

	Dependent variable = ln(annual premium); $N = 50{,}217$			
	(1)	(2)	(3)	(4)
Lagged profits ×				
<=4 carriers	0.151***	0.148**	0.145**	0.168**
	(0.058)	(0.072)	(0.072)	(0.075)
5–6 carriers	0.047*	0.092**	0.092**	0.060
	(0.027)	(0.042)	(0.042)	(0.043)
7–8 carriers	0.034***	0.056***	0.055***	0.042**
	(0.012)	(0.018)	(0.018)	(0.018)
9–10 carriers	0.013**	0.043**	0.042**	0.034*
	(0.014)	(0.019)	(0.019)	(0.019)
>10 carriers	0.011	0.035	0.034	0.027
	(0.015)	(0.024)	(0.024)	(0.024)
Demographic factor	0.317***	0.297***	0.297***	0.298***
	(0.003)	(0.005)	(0.005)	(0.005)
Plan design	0.363***	0.413***	0.415***	0.451***
	(0.024)	(0.032)	(0.032)	(0.032)
Plan fixed effects	N	Y	Y	Y
Market-year covariates				
Unemployment rate			−0.109	N/A
			(0.185)	
Average Medicare costs			0.078**	N/A
			(0.033)	
Market-year interactions	N	N	N	Y
p-values from H_0: $\gamma_{1,1} = \gamma_{1,5}$; H_1: $\gamma_{1,1} > \gamma_{1,5}$	0.01	0.07	0.07	0.04

Notes: Models are estimated using the LEHID-FI–Compustat Sample. The unit of observation is the employer-market-carrier–plan type–year. Specifications correspond to equation (2) in the text, and are estimated by FGLS to account for serial correlation of errors among observations of the same employer-market-carrier–plan type (or "plan"). All specifications include fixed effects for employer, market, carrier, plan type, year, number of carrier category, plan type–year, and employer-market.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Source: Dafny (2010).

The paper documents a number of tests of other alternative explanations as well a variety of robustness checks, which I won't cover in detail.

Table 7. Her results are consistent with a story in which firms are willing to pay more for health insurance when times are good, and in which - in concentrated health insurance markets - carriers successfully extract some or all of this increased willingness to pay. She notes that a potential source of cost inefficiencies in "fat firms" is rent sharing with workers. Although previous empirical work on rent sharing had largely focused on wages, the relationship with fringe benefits such as health insurance may be similar. She notes that interviews with industry experts suggested that this explanation was empirically relevant. Specifically, these interviews stressed the high switching costs that employees incur when changing health plans - arguing that plan switches are a "tough sell" in good times, whereas workers are more willing to tolerate such actions when viewed as necessary. She proposes a bargaining model to explain why insurers may be more effective at extracting higher rents from more profitable firms in markets where fewer insurers compete. The bargaining model predicts that firms should be less likely to switch plans when they are more profitable, and Table 7 provides empirical evidence consistent with that idea. Table 9 (not shown) documents that firms in more competitive markets are less likely to switch carriers when they experience a profit shock, also consistent with her bargaining model.

TABLE 7—SWITCHING ANALYSIS

Dependent variable	carrierswitch	planswitch	carrierswitch	planswitch	carrierswitch	planswitch	carrierswitch	planswitch
FI + SI combined ($N = 46{,}546$)								
Lagged profits	−0.580***	−0.516***	−0.584***	−0.523***	−0.406***	−0.234***	−0.340***	−0.162**
	(0.033)	(0.034)	(0.033)	(0.034)	(0.057)	(0.059)	(0.063)	(0.064)
Market-year FEs	N	N	Y	Y	Y	Y	Y	Y
Employer FEs	N	N	N	N	Y	Y	N/A	N/A
Employer-market FEs	N	N	N	N	N	N	Y	Y
FI sample ($N = 18{,}743$)								
Lagged profits	−0.528***	−0.423***	−0.534***	−0.432***	−0.405***	−0.207**	−0.418***	−0.167
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.104)	(0.103)
Market-year FEs	N	N	Y	Y	Y	Y	Y	Y
Employer FEs	N	N	N	N	Y	Y	N/A	N/A
Employer-market FEs	N	N	N	N	N	N	Y	Y

Notes: Specifications correspond to equation (4) in the text. All models include year fixed effects. The unit of observation is the employer-market-year. Standard deviations in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Source: Dafny (2010).

While this analysis is very suggestive, the panel specification of course relies on strong assumptions about what is driving the underlying within-firm changes in profitability. Van Reenen (1996), Rose (1987), and Black and Strahan (2001) instead rely on more quasi-experimental sources of variation in firm profitability.

3 Sharing innovative rents: Van Reenen (1996)

This paper was John Van Reenen's job market paper. His key insight was to use the quasi-rents earned by firms developing technological innovations as a source of quasi-experimental variation in firm rents, and to then ask whether those (instrumented) firm rents are passed through to workers in the form of higher wages.

Van Reenen is conceptualizing quasi-rents here in the Schumperterian sense of being the reward for the first commercialization of an invention. The firm could be earning quasi-rents because of patent rights, or due to other first mover advantages.

I think of this paper as grabbing exactly the right conceptual thought experiment in a very novel way. That said, in practice the study is limited by the data available (firm-year aggregate wages, for example, as opposed to link firm-worker micro-data where you could test for rent-sharing across different groups of workers) and the lack of an exogenous shifter in the timing of arrival of technological innovations across firms. Addressing both of these limitations seems important particularly given that Van Reenen's estimates of rent-sharing are arguably quite large.

3.1 Data

The author focuses on a panel of all British manufacturing firms who were listed on the London Stock Exchange for at least five continuous years between 1976 and 1982. The accounts were matched to information on innovations using the Science Policy Research Unit (SPRU) database, which details over 4300 innovations that were first commercialized in the United Kingdom since World War II. The data were compiled in three waves over a period of fifteen years by interviewing a large number of experts from trade, science, and industry. The definition of innovation was *"the successful commercial introduction of new or improved products, processes, and materials introduced in Britain between 1945 and 1983."* To qualify, an innovation had to be both technologically important and commercially successful.

Importantly, some of Van Reenen's previous work had used the SPRU data linked to firm outcomes to document that SPRU innovations are associated with significant increases in firm rents: profit margins rose by about 6.2 percent relative to the mean after an SPRU innovation. This fact is important because it is essentially a "first stage" for the analysis in this paper.

Van Reenen argues that looking at SPRU innovations is much better than looking at e.g. patents, because the value of patents is quite right-skewed. While true in general, in practice there would be ways of identifying "high value" patents and focusing on those, and using the patent data may be preferable for other reasons. In practice, Van Reenen takes seriously the idea that patents do not generate substantial rents on average and uses lagged patents as instruments for current innovations in some specifications (although he doesn't show the first stage estimates here, so it is hard to assess how useful this strategy is).

Using the SPRU data, Van Reenen observes a count of the number of major and successful innovations each firm produced per year and also its entire innovative history back to 1945.

Aggregating innovations, the author also constructs measure of innovation at the industry level.

The wage data is the average real renumeration of UK workers in the company. As we will see, the aggregate nature of this data means that Van Reenen cannot observe compositional changes in the set of workers at a given firm around the time of an SPRU innovation, which is a potentially first-order problem for the rent-sharing estimates.

3.2 Summary statistics

Table 1. Table 1 defines variables and presents summary statistics for the 598 firms in the sample. In the cross-section, innovating firms have higher wages than non-innovating firms.

		Innovators[b]		Noninnovators	
Mnemonic	Definition	Mean	Stnd dev.	Mean	Stnd dev.
W	Firm average wage	7.0002	1.2384	6.2515	1.5013
N	Firm employment in U. K.	11.8624	19.0551	2.7579	9.0473
MS	Sales/industry sales	0.0670	0.1142	0.0148	0.0412
INNOV	No. of firm innovations	0.2299	0.6528	0	
INNOV (prod)	No. of firm product innovations	0.1682	0.5372	0	
PATENTS	No. of patents granted to firm	4.5548	18.5596	0.1078	0.5591
$\overline{W}$	Industry wage	7.3108	1.0452	6.8180	1.3718
$\overline{U}$	Industry unemployment	0.0647	0.0345	0.0681	0.0362
IDENSITY	Industry union density	0.7194	0.1097	0.6868	0.1318
K/L	Firm capital-labor ratio	1057.8	2885.7	146.2	459.6
IPI	No. of innovations produced in industry	12.179	15.427	8.257	13.478
R&D	Industry R&D over sales	0.0145	0.0221	0.0113	0.0199
CONC	5 firm sales concentration ratio	0.4024	0.1650	0.4073	0.1669
IMPORTS	Industry imports over home demand	0.1864	0.1600	0.1949	0.1737
Π/N	Real profits per worker	5.0718	4.0301	3.5718	3.6255
QR/N	Real quasi rents per worker	48.1204	84.9467	35.2396	39.4070
Average Q[c]	(Market value/capital)−1	−0.2707	1.2361	−0.3599	1.2458
	Number of firms	449		149	
	Number of observations	2876[d]		957	

The last three variables are measures of a firm's rents. Quasi rents are defined as the difference between real sales per head and the average industrial wage. The second measure is profits per worker which nets out other costs (such as capital, materials, and the own wage bill). Both of these first two metrics are accounting measures which have the disadvantage of being subject to the vagaries of accounting procedures. An alternative market-based measure of rents is Tobin's q, which is (roughly) the ratio between a firm's market value and its replacement value. The idea is that if the market value of a firm solely reflected the recorded assets of a company, Tobin's q would be 1.0. If Tobin's q is greater than 1.0, then the market value reflects some unmeasured or unrecorded assets of the company. Advantages of Tobin's q are that it is a market-based measure that is forward looking. In the cross-section, innovating firms have higher rents based on all three measures relative to non-innovating firms.

3.3 Reduced form estimates

Figure 1. Figure 1 estimates the relationship between wages and SPRU innovations using a reduced-form OLS model.[1] The trend tracks the coefficient of a single innovation on the response of log wages, and implies that an innovation raises wages after four years, and lowers to its original level afterward. The pattern is consistent with innovations creating rents for several years, but imitation and entry eventually driving wages back to their pre-innovation level.

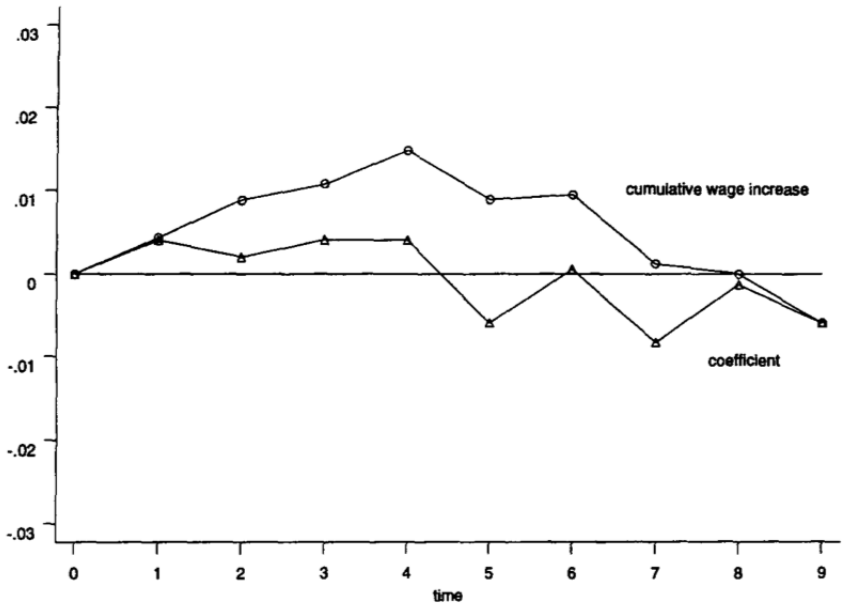


FIGURE I

[1] The full model is $w_{it} = f_{1i} + \alpha_1 w_{it-1} + \alpha_2 \bar{w}_{it} + \alpha_3 \bar{u}_{it} + \sum_{k=0}^{3} \lambda_k INNOV_{it-k} + \sum_{k=0}^{1} \mu_k IPI_{it-k} + \sum_{k=0}^{1} \zeta_k R\&D_{it-k} + \alpha_4 IDENSITY_{it} + \alpha_5 CONC_{it} + \alpha_6 IMPORTS_{it} + \delta_t D_t + \epsilon_{it}$ with D_t representing year fixed effects. The model also includes firm fixed effects.

3.4 IV estimates

Table 3. Table 3 presents both OLS and IV estimates relating firm rents to wages. Specifically, the IV estimates use SPRU innovations as an instrument for firm rents. The IV estimates are positive, economically large, and moderately statistically significant. Van Reenen argues that the estimates are similar in magnitude to the estimates found in Abowd and Lemieux (1993), but larger than estimates from other past studies.

TABLE III
SUMMARY OF RESULTS FROM STRUCTURAL WAGE EQUATIONS

	log (QR/N)	Π/N	Average Q
(1) Static OLS	0.1137	0.0059	0.0013
	0.0227	*0.0024*	*0.0014*
(2) Static IV	0.2886	0.0537	0.0379
	0.0886	*0.0228*	*0.0206*
(3) Dynamic IV	0.2191	0.0479	0.0325
	0.0836	*0.0218*	*0.0211*
(4) Dynamic IV	0.2239	0.0489	0.0342
restricted instruments	*0.0842*	*0.0227*	*0.0225*

These are the coefficients on rents terms, and full specifications are in Appendices 2–4.
Quasi rents are in log differences, and profits per worker and average Q are in first differences.

4 Regulation and rent-sharing: Rose (1987)

This paper starts with the idea that understanding rent sharing is essential to analyzing government regulation, in part because regulatory protectionism can create rents over which workers and firms may negotiate. Her idea is that examining wage responses to reductions in rents - such as those caused by regulatory reforms - can provide a powerful test of rent-sharing. Her empirical work focuses in particular on the trucking industry, which was deregulated in the late 1970s and early 1980s. Prior literature had documented the existence of monopoly rents in this industry and linked them to economic regulations, and one very powerful union - the International Brotherhood of Teamsters - represents almost all unionized workers in the (heavily unionized) sector, which should tend to increase the bargaining power of organized labor in trucking.

From 1935 until the mid-1970s, regulation of the trucking industry included strict entry controls, restrictions on partially regulated and exempt carriers, and collective rate making. Prior work (including Nancy's undergraduate thesis!) suggested that this system of regulations increased trucking rates above competitive levels, ensuring high economic profits for regulated trucking firms. The regulatory changes that Rose examines led to substantial entry of new firms, expansion of existing firms, and enhanced price competition. She argues that these reforms created a considerable exogenous shock to potential industry rents.

4.1 Analysis

Table 1. Table 1 chronicles changes to the Teamster union contract provisions around the time of deregulations. Rose starts by documenting evidence on the effect of deregulation of labor rent sharing on union contracts. The "regulation" period includes contracts signed through 1976; the "deregulation" period includes the 1982 and 1985 agreements; the 1979 contract is less clear. The 1982 and 1985 agreements represent dramatic departures from the earlier pattern of contracts, which ended the general wage increase, and allowed less generous benefit coverage.

Contract Years	Average Base Contract Wage ($)	General Wage Increase	Cost-of-Living Provisions	Employer Contributions to Pensions, Benefits
1970–73	4.50 (est.)	$1.85/hr.	1¢/hr. per .3 CPI; 8¢ max./yr.	$8/wk. increase
1973–76	6.32	$0.95/hr.	1¢/hr. per .3 CPI; 6¢ min., 8¢ max./yr.	$16/wk. increase
1976–79	7.55	$1.65/hr.	1¢/hr. per .4 CPI (4/77) 1¢/hr. per .3 CPI (4/78) uncapped	$17/wk. increase
1979–82	9.60	$1.50/hr.	1¢/hr. per .3 CPI, defer 3d yr. increase	$30/wk. increase
1982–85	12.80	None	1¢/hr. per .3 CPI, diverted to benefits; deferred COLA: 47¢ to wages, 25¢ to benefits	No general increase
1985–88	13.26	$1.50/hr.; pay decreases for part-time, new employees	31¢ of each year's 50¢ increase considered COLA	$0.30/hr. increase

Figure 1. Figure 1 documents how the average hourly wage in the trucking industry stopped increasing compared to similar but unregulated industries such as construction, mining, and manufacturing over the time period in Table 1. These data generally support the conclusion one would draw from the union contract data.

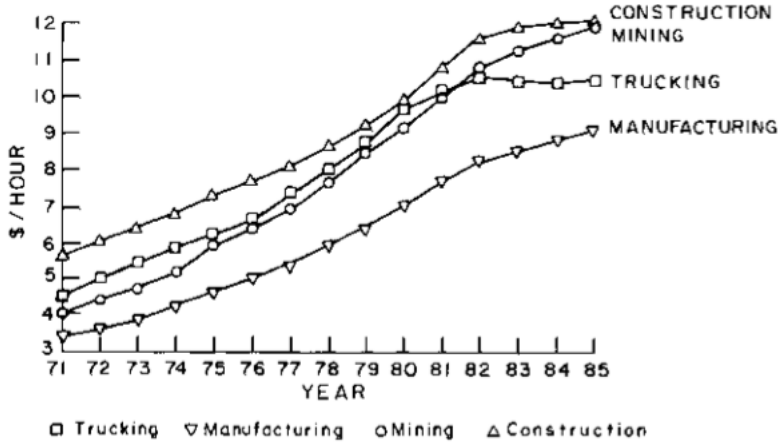
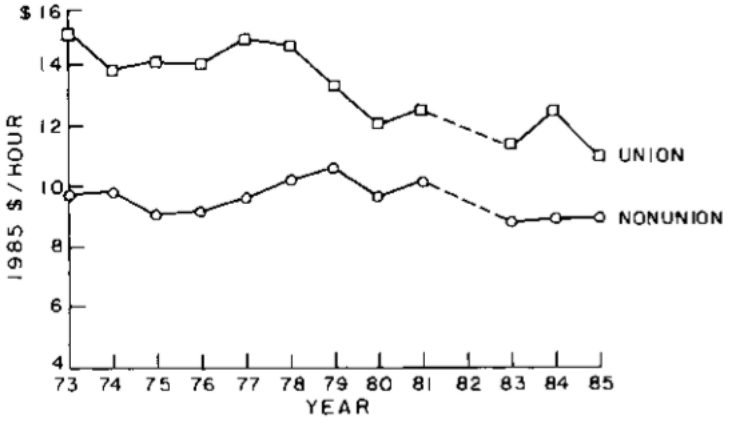


Figure 2. Her main analysis investigates how log wages (as measured in the CPS) responded to deregulation. Figure 2 plots predicted union and nonunion 1985 constant dollar wages. There was a notable decline in the union wage premium around the time of deregulation.



Separately, Rose also tries to test for evidence of rent spillovers to nonunion trucking industry drivers or truck drivers outside the regulated trucking industry, and argues that there is little evidence for either. A back-of-the-envelope calculation suggests that the union may have been the dominant beneficiary of trucking regulation, capturing 65-76 percent of the total rents in the industry, which are 5-9 percent of industry revenues.

5 Regulation and rent-sharing: Black and Strahan (2001)

In a related paper, Black and Strahan (2001) estimate the relationship between state-year level changes in banking regulation and wages, with a focus on whether rents were disproportionately shared with male (relative to female) workers. Until the mid-1970s, regulations constrained banks' ability to enter new markets, either by opening branches or by owning banks in multiple states. Over the subsequent 25 years, states gradually lifted these restrictions. From a research perspective, banking deregulation is a particularly useful empirical setting because states deregulated banks at different times, providing an opportunity to use panel variation in a way that wasn't possible in Rose (1987).

As in Rose (1987), deregulation is conceptualized as a shock to market competitiveness that reduced rents; to test for rent-sharing, Black and Strahan investigate whether compensation and wages in banking fell after deregulation. They first document that post-deregulation, wages declined in general in the banking sector. However, their focus is on how the gender wage gap in banking changed following deregulation. They document that post-deregulation, male wages fell by about 12 percent whereas female wages fell by only 3 percent, suggesting that rents were shared mainly with men. They also find that women's share of employment in managerial positions increased following deregulation.

This gender gap in rent-sharing also comes up in Card, Cardoso and Kline (2014), which will be covered in section this week.

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