Historical and Experimental Analysis of Labour Contracts

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Contracts between firms and their workers

- Labour markets generally do not behave like neoclassical markets
  - Long-term relationship between workers and firms
  - Quality and effort are more like experience goods than search goods
  - Quality and effort can improve over time (on-the-job training or learning)
  - Quality and effort may not be verifiable to third parties
  - There are often relationship specific assets
  - Workers may have preferences over fairness, kindness, and other non-monetary attributes of the contract
- Thus many labour contracts deviate considerably from predictions offered by simple supply and demand models

Approaches to contracts in the literature

- HRM approach (Doeringer and Piore, 1971)
  - Contracts characterised by ports of entry, internal promotion, career ladders, job rotation, administrative determination of wages according to rules
  - Approach is largely descriptive based on case studies
- The transaction costs economics approach (Williamson, Wachter, and Harris, 1975)
  - Emphasises idiosyncratic investment (human capital)
  - Internal labour markets are a response to the problems of moral hazard and bounded rationality
- The personnel economics approach (Lazear, 1995 and Prendergast, 1999)
  - Piece-by-piece modelling of the labour contract
  - Largely motivated by the problems of adverse selection (attracting and retaining the right workers) and moral hazard (effort on the job)
- The Fairness Approach (Akerlof, 1990, Khan 1997, Fehr and Schmidt, 1999)
  - Workers may withhold effort if they believe wages to be unfair
  - A fair wage may be very different from the market wage

“Too Many Theories, Too Few Facts”

- There has (for a long time) been a very rich set of models looking at aspects of labour contracts
- Empirical evidence has been much thinner
  - Contemporary data is hard to come by and often not entirely adequate
    - Firms treat their employment records as confidential
    - Even when data is available it rarely covers entire careers, whereas career concerns are often very explicitly integrated into the models
    - The underlying hypothesis is that contracts can be used to increase effort, yet are used where effort is difficult or impossible to directly observe
- The limited evidence (e.g. Baker, Gibbs, and Holmstrom, 1991) partially supports each of the different approaches

The Historical Approach to Labour Contracts

- My research has used historical personnel records surviving in various archives to examine the nature of worker/firm relations
- The records contain information about the individual's background (age, sometimes previous experience), wages, sometimes position at the firm, dates of entry and exit
- The records cover the following industries:
  - Australian banking (with David Merrett and Ken Simons) – Union Banking of Australia (data covering the entire careers of everyone at the bank in 1887 and all entrants through 1900); smaller data sets from the Bank of South Australia, Bank of Australasia, Bank of Adelaide, Queensland National Bank.
  - Victorian Railways (with André Sammartino) – *Government Gazette* information from Triennial Censuses 1904-1919
  - English banking (with Jeff Frank) – Williams Deacon's Bank (data covers all staff from 1890-1936 and most through 1941); smaller data sets from Sheffield and Rotherham Bank, Manchester and Liverpool Bank.

The Data, sample records

Born 24 February 1847
Engaged for Bank's Service at Brisbane
Sailed for 18
Passage paid by
Entered Service at Brisbane on 15 February 1864
Details of previous experience

PARTICULARS OF BOND OF FIDELITY.

Date.	In force from	Amount.	Premium.	Due.	Parties thereto.

Agreement signed to Serve the Bank for years, terminable at months' notice.

No.	Advised Per letter.	Dated.	Where Employed.	Rank.	Salary.	Remarks.
	15	1864 Febr	Brisbane	clerk	80	
	1	1865 January	-	-	100	
	1	1866 January	-	-	125	
	1	1867 January	-	-	150	
	1	Sept	Wellington	-	150	
	1	1868 January	-	-	165	
	1	July	Nelson	-	165	
	2	1869 Augt	Charlestown	-	185 £50 per Goldfields allow. (from 1st July)	
	22	1871 January	Melbourne Inspector's Office	-	185	
	29	July	Daylesford	-	185	
	1	1874 January	-	-	200	
	25	1875 Augt	Maryborough	Acting Manager	200 £50	Allowance
	1	1877 July	-	-	300	
	8	1878 April	-	Manager	300	
1015	4	Dec	Daylesford	Manager	300	
1165	1	1882 July	-	-	350.	
1243	17	1884 Dec.	Portland	-	350.	during Mr Rose's leave 1 mo
			Daylesford	-	350.	Resumed duty.
70/5	28	1887 Dec.	Rockhampton	Act. Man.	350 & £100	Allowance while in charge
179	6	1888 Feb.	-	Act. Manager	350 & £100	Allowce + £70 Trop. Allowce
595	1	1889 Jany	-	Manager	500 & £100	Trop. Allowance
438	14	1889 Novr	Six months leave on full pay			
427 558/5	11	1890 June	Rockhampton	Manager		Resumed duty 2nd June
571	2	June			500 & £100	Tropical Allowance
602/4	9	Sept	As to Mr. [redacted] capabilities.			
1011/9	5	1892 July	Resigned rather than accept a reduced position (3 months Salary paid him)			
1040	2	July	Resigned			
1061	26	Septr	Has joined the Salvation Army.			

The Data, sample records

Name	birth year	bth month	bth day	entry year	ent month	ent day	branch year	br month	br day	1921	1922	1923	1924	1925	1926	1927	1928	1925 + bonus	exit year	ex month	ex day	reason	transferred to
Mr. LT	1874	4	6	1893	2	27	1920	1	19	640									1921	5	1	transfer	birchin lane
Mr. LR	1884	5	25	1901	3	25	1919	11	26	435	435	450	450	465	529	545	545	529					
Mr. HSB	1889	6	19	1908	5	4	1917	7	23	360									1921	7	1	transfer	birchin lane
Mr. WGCD	1893	6	25	1911	7	10	1919	11	26	280	290								1922	3	1	transfer	birchin lane
Mr. HNI	1901	2	10	1916	9	18	1920	10	1	135	145	155	170						1924	2	29	left	
Mr. JDW	1884	1	2	1899	3	6	1921	5	1	455	480	500	500	520	600	620	620	591					
Mr. HCS	1906	11	30	1924	4	14							75	90					1925	1	10	left	
Mr. LMD	1905	6	23	1924	4	14	1925	1	1				90	105	130	145		128					
Mr. WASM	1908	7	11	1925	10	19	1927	3	1					75	90	105	105		1927	2	28	left	
Mr. GNW	1909	12	3	1928	2	1											90		1928	2	18	left	
Miss GML	1903	5	25	1920	8	23	1927	8	29	90	100	110	120	130	140	170	180	159					
Miss DBS	1907	12	5	1926	7	7	1927	8	31							90	100		1927	8	31	transfer	birchin lane
Miss EGA	1900	9	6	1918	5	21	1922	3	1	110	120	130	140	150	160			181	1926	5	31	left	
Miss EJMT	1900	11	8	1917	5	7	1917	10	8	125	135	145	155	165	175	210	220	199					

The Data, sample records

No. 123.] THURSDAY, OCTOBER 9. [1902.

VICTORIAN RAILWAYS.

A LIST of all persons permanently employed in the Railway Service on the 1st January, 1902. Published pursuant to section 91, Act 1185.

Departmental No.	Name in Full (Alphabetically)	Branch.	Position.	Date of Birth.	Date of Entry. Approximate.	Date of Entry. After 1.11.50.	Salary or Rate of Pay at 1.1.02.
1	Abbertou, James	Traffic ...	Operating porter ...	25.12.00	...	27.8.88	7s 6d
6781	Abbey, Albert William ...	Locomotive ...	Lad labourer ...	3.3.84	...	19.3.00	3s
2	Abbott, Alfred	Existing Lines ...	Ganger	1.5.50	...	4.1.88	7s 6d
4	Abbott, James	Existing Lines ...	Skilled labourer ...	7.8.50	6.4.82	...	8s
6	Abbott, John Alfred	Locomotive ...	Apprentice ...	30.12.82	...	10.1.99	3s
6	Abbott, Robert William ...	Traffic ...	Labourer	31.1.25	...	1.9.99	7s
7	Abbott, Samuel	Existing Lines ...	Repairer	10.10.69	...	1.11.90	7s
8	Abell, William	Locomotive ...	Leading hand fitter	2.1.50	4.4.79	...	13s
9	Abraham, George	Existing Lines ...	Repairer	16.1.60	...	2.7.80	7s
10	Abraham, Taliesin Parry ...	Telegraph ...	Engine-driver ...	12.11.59	15.10.83	...	10s 6d
11	Ackers, George	Traffic ...	Signalman	25.8.64	...	23.4.88	8s
12	Acton, Edward Addleman ...	Locomotive ...	Plumber	23.11.64	...	8.11.87	9s
13	Adair, David	Locomotive ...	Fireman	31.8.74	...	13.4.94	8s
15	Adam, George Noble	Locomotive ...	Waggon builder ...	18.11.60	...	2.6.80	9s 6d
16	Adams, Henry	Traffic ...	Clerk	2.8.01	23.5.78	...	£270
2205	Adams, Arthur Hubert ...	Telegraph ...	Switchboard attendant	29.6.74	...	1.6.00	8s
17	Adams, Frank	Telegraph ...	Assistant driver ...	11.8.07	...	12.2.08	8s
18	Adams, George	Locomotive ...	Carriage painter ...	4.10.53	28.4.82	...	10s

The Data, organization of information

- The data for the UBA and WDB is continuous. The UBA data contains full information about position, it is possible to identify the branch manager at WDB. I have recorded information annually to create a panel data set.
- The smaller samples from other banks provide a mix of cross-sectional and panel data.
- The VR data is triennial. It contains wages and position, but not location.
- Across all firms, the data contains over 100,000 observations from over 10,000 individuals.

Data, contents

Organisation	Time period	Nature of Data	Nature of sample	Position	Location	Sample Size
UBA	1850-1970	Panel	Complete career, Complete organization	YES	YES	1767 staff, ≈32000 obs
BSA	1864-1874, 1879-1891	Panel	Complete organization	YES	YES	566 staff, 4578 obs
ASIA	1888-1945	Panel	Complete career	YES	YES	125 staff, 2048 obs
BoA	1926	Cross-section	Complete organization	YES	YES	290 staff, 290 obs
QNB	1893	Cross-section	Complete organization	YES	YES	319 staff, 319 obs
WDB	1890-1941	Panel	Complete organization	NO	YES	1979 male staff, ≈ 39700 obs; 1300 female staff, 7775 observations
SRB	1894-1907	Panel	Part organization	NO	YES	65 staff, 791 obs
MLB	1908-1919	Panel	Part organization	NO	YES	258 staff, 1492 obs
VR	1902, 05, 08, 11, 14, 18, 21	Repeated cross-section	Surname ABC	YES	NO	3750 staff, ≈15600 obs

Additional sources of evidence

- Published pay scales for large bureaucracies
- Trade union archives
- Trade journals
- Internal documents of the various firms
  - Managers' papers
  - Policy papers sent to staff
  - Rules for employees

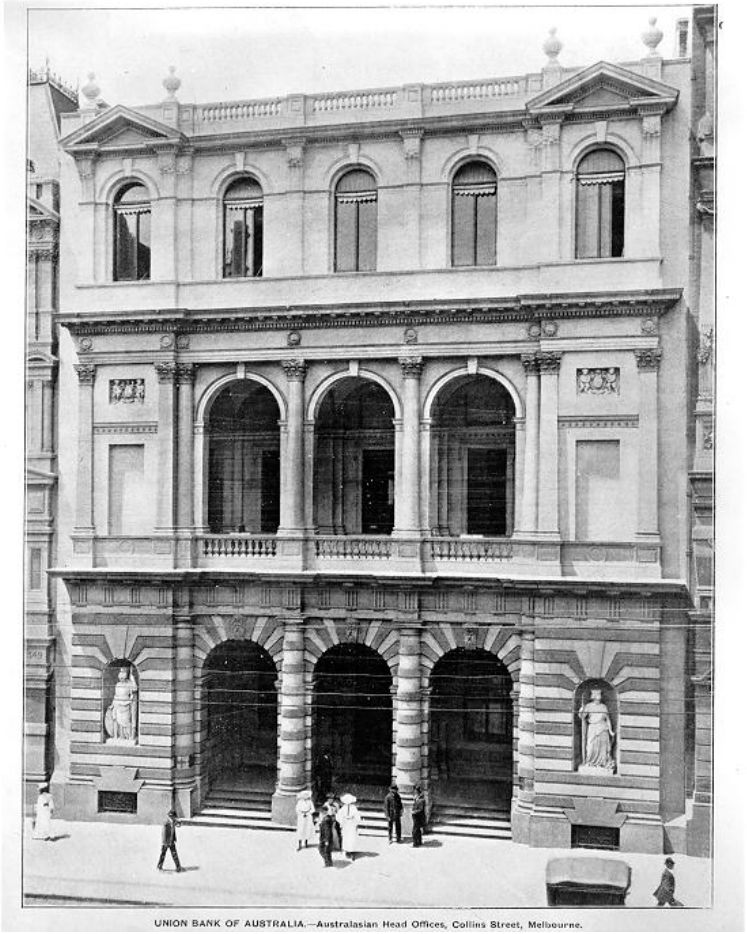
Issues that can be addressed with this data

- The nature of internal labour markets in large bureaucracies
  - Hiring
  - Internal mobility and promotion
  - Separations
  - Pay
    - MRP or Incentives
    - Impersonal rules or managerial discretions
    - Long-run incentives – promotion tournaments, deferred compensation
    - Variation over the business cycle
- Monitoring and Incentives – moral hazard and banking
- Nominal wage rigidity
  - Rigidity over the business cycle
  - Effect on real wages
- Employment of women, compensation and promotion practices

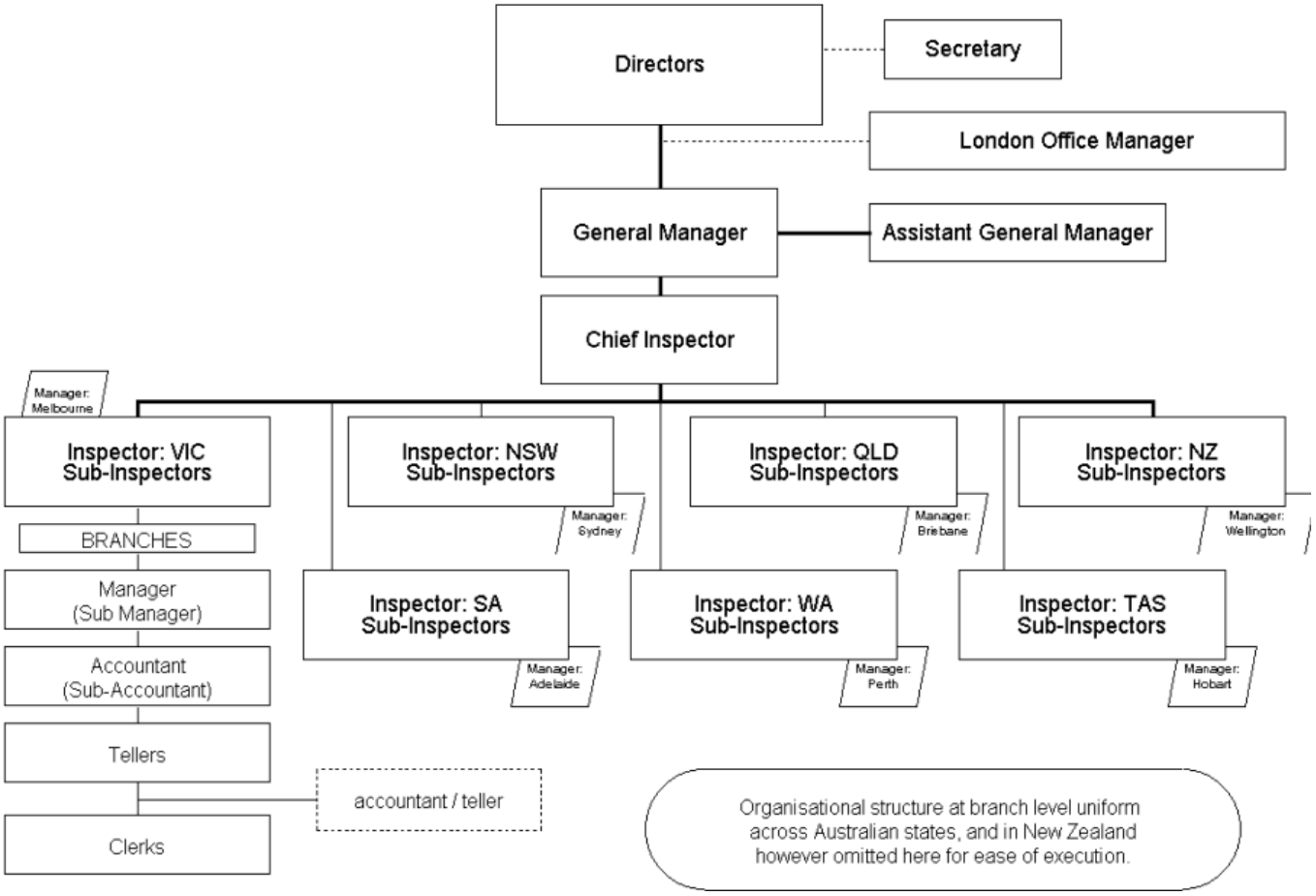
Organization of the firms

- Banks
  - Multiple branches spread over large geographic areas
    - Day-to-day monitoring from the centre is prohibitively expensive
  - A few large branches in the big cities handle administrative tasks
  - Work characterised by extreme moral hazard (threat of theft, fraud, collusion with customers and other staff)
  - Paternalistic set of rules designed to (partly) mitigate moral hazard
  - Australia faces a shortage of suitably qualified (secondary education) workers, England less so
- Railroads
  - Multiple branches (Traffic, Locomotive, and Existing Lines employ 90+% of staff). Separate ILM's within each branch.
  - Stations are spread out across the state
    - Day-to-day monitoring from the centre is prohibitively expensive
  - The extent of moral hazard is less than in the banks, but the cost of incompetence or dishonesty is higher

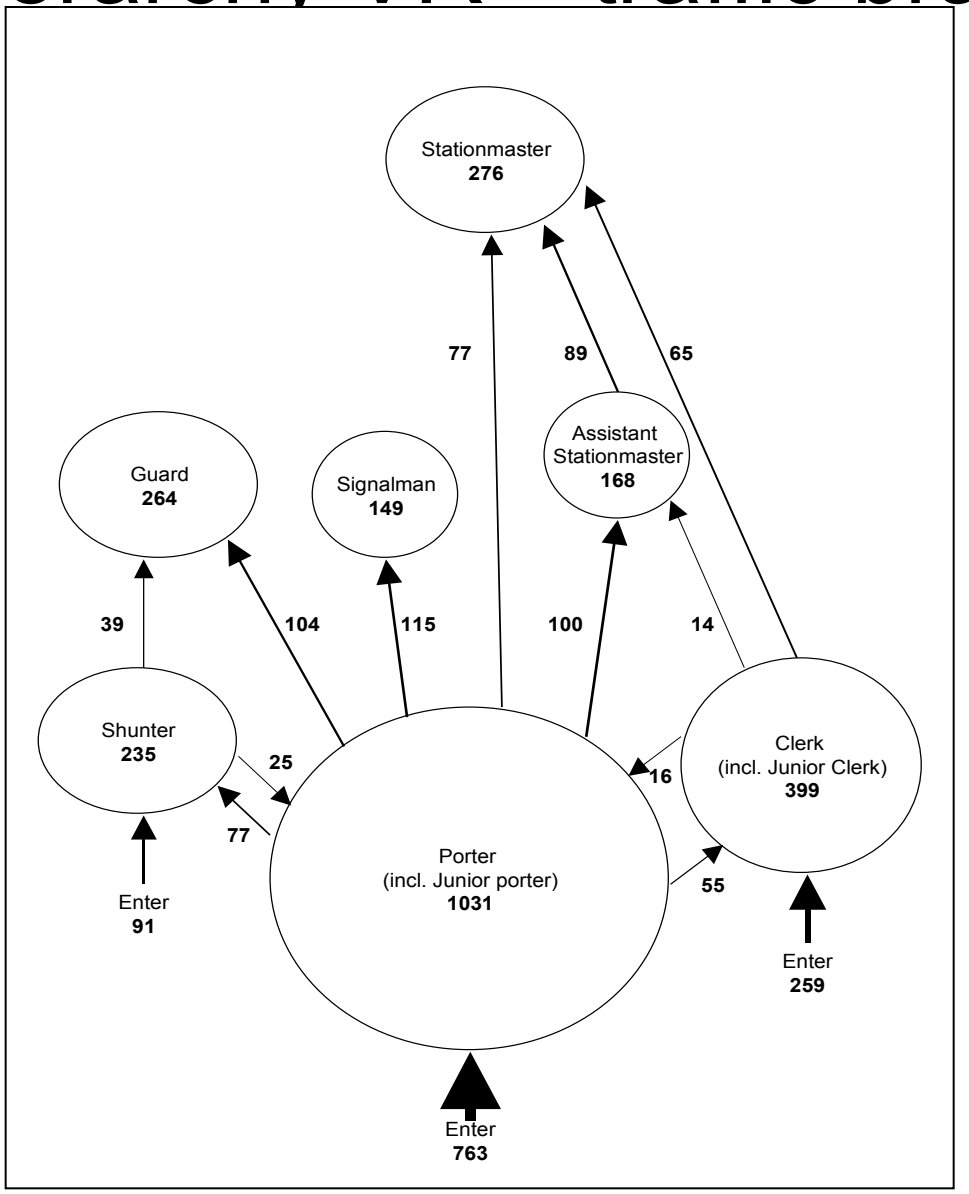
The monitoring problem, two pictures



Internal hierarchy UBA



Internal hierarchy VR – traffic branch



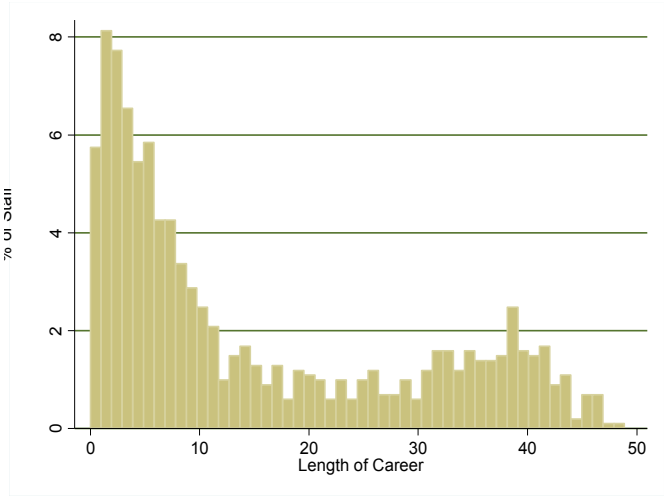
Hiring and internal mobility

- Bank workers were typically hired young (16-18) and promoted from within, except after the acquisition of another bank.
- Railway workers hired at slightly older ages (15-25), and often had prior experience outside the railways
- Movement between bank branches was common
  - Clerks started as juniors in bigger branches, moved after 3-4 years to country branches. Job rotation was essential for later promotion.
  - Almost all staff at smaller branches were moved periodically in order to reduce the opportunities to collude or steal
- Career tracks
  - Well defined track in banking: clerk – teller – accountant – manager – inspector/GM. Most people advancing to higher levels work at each of the lower levels, though a few skip steps
  - Multiple career tracks in railroads, at least one standard career track per branch

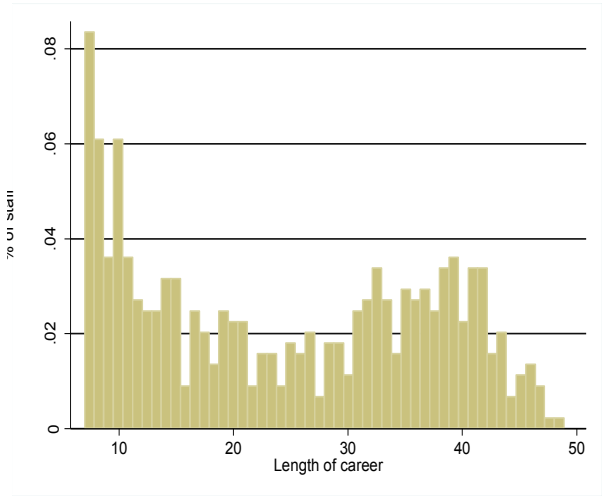
Internal mobility and exit

- Promotion was slow.
  - UBA and WDB: A talented bank clerk typically took 12-15 years to reach branch manager. Some clerks took over 25 years.
  - The VR operated several internal labour markets, divided by function. In the locomotive branch the normal career was 3-4 years as an engine cleaner, 6-10 years as a fireman, before promotion to driver.
- Careers were lengthy – exit rates exceptionally low
  - Banking: high exit rates in first 5 years, most surviving 7 years stay until retirement or death
  - Railroads: slightly lower early career exit rate (older start age and probability of a bad fit), can't observe reasons for leaving but more leave before the retirement age

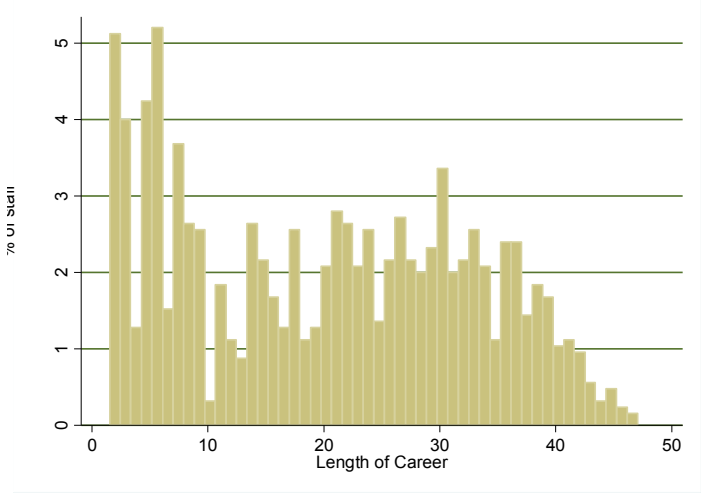
Distribution of Career lengths UBA and VR



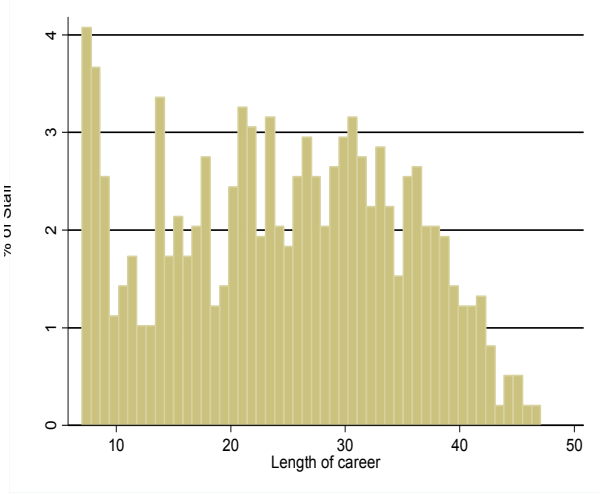
UBA– Full Sample



UBA – Career 7 years+



VR – Full Sample

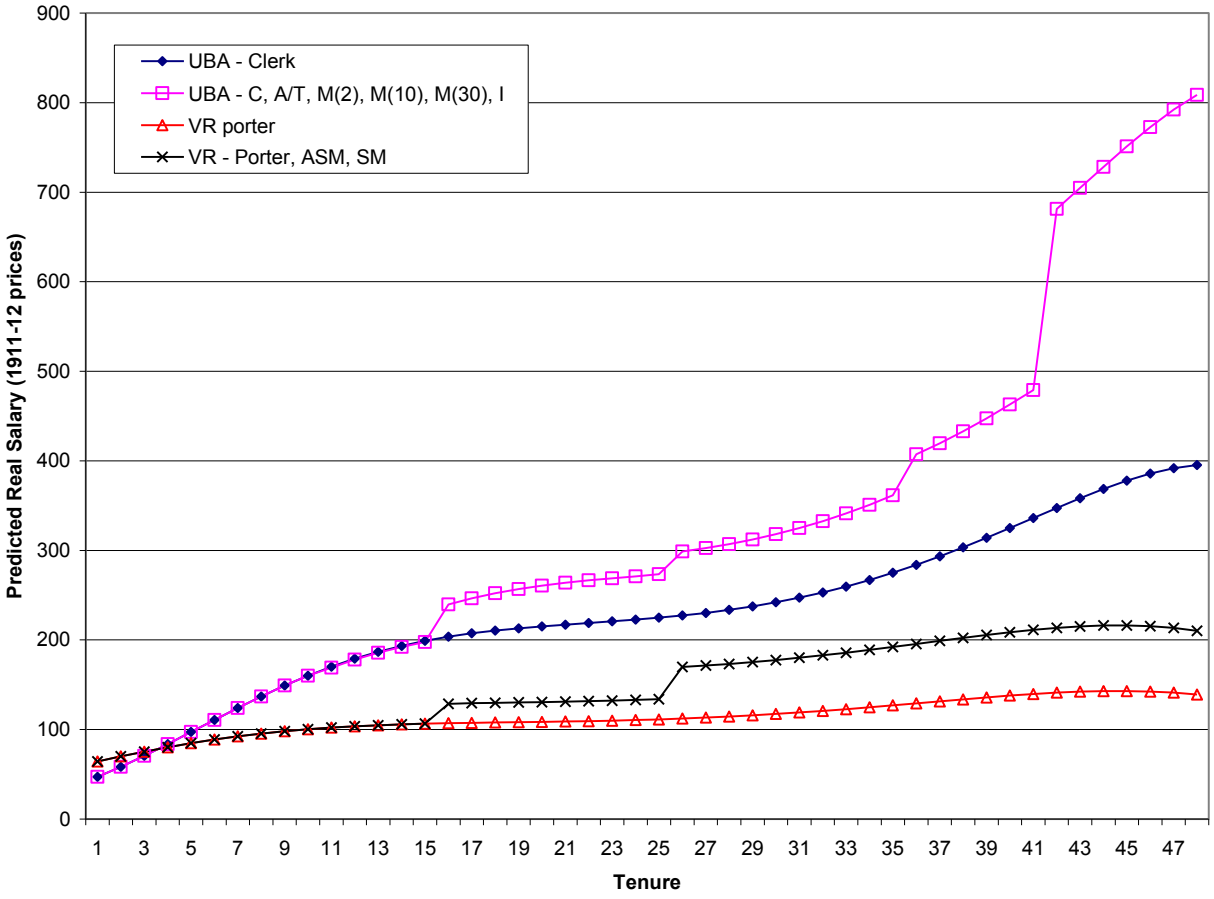


VR – Career 7 years+

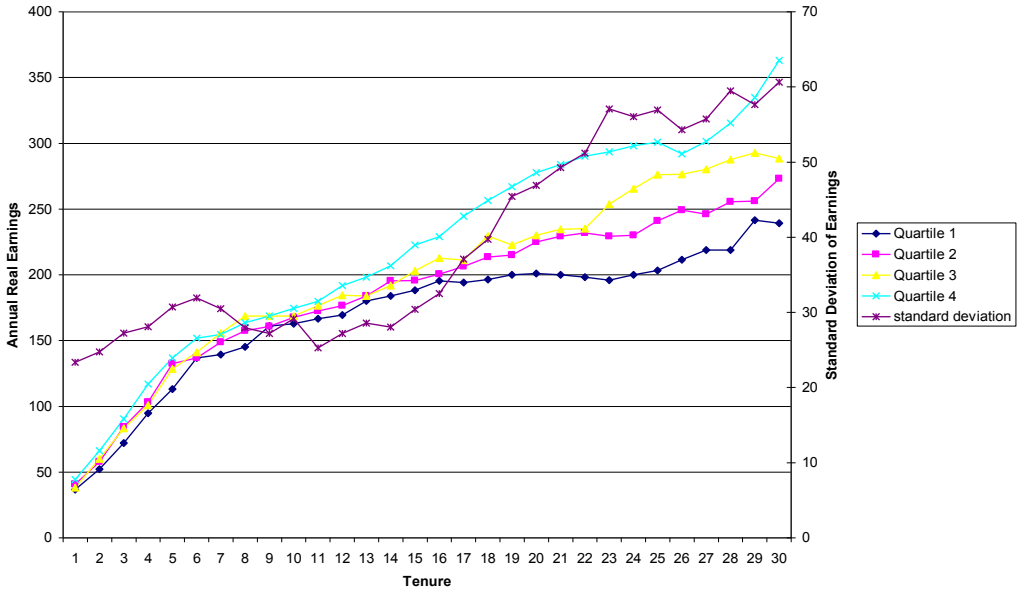
Real wages

- Wages closely linked to tenure at all firms. The wage profile in banking is much steeper than at the railroads
  - Tenure is much more important than position for banking wages, similar in importance at railroads
  - Wages increase throughout the career, suggests that on-the-job training is not driving the importance of tenure
  - Banks and railroads maintained mandatory retirement and offer generous pensions, further evidence of deferred compensation
  - Relationship is very econometrically robust, not driven by selective exits
  - This wage profile provided workers with an incentive to stay and to not do anything that would lead to dismissal
- Wage policies were impersonal, scales and implicit rules mattered
  - A very high proportion of staff earn exactly the salary proscribed by the scale operating when they enter
  - High ability staff don't earn much more than low ability staff until after 15 years

The relationship between wages and tenure, UBA and VR



Explicit and implicit rules, UBA



Percent of Employees on the 1889 Wage Scale by Entry Cohorts

	entered 1889-1894		entered 1882-1888	
year	% on the 1888 Scale	Sample Size	% on the 1888 Scale	Sample Size
1889	76.0	25	9.6	135
1890	87.8	49	14.4	118
1891	84.6	78	25.0	100
1892	92.4	118	12.9	85
1893	89.3	169	27.1	70
1894	89.9	179	82.2	45

The returns to promotion

- Evidence overall is consistent with tournament models.
- Earnings increase all else equal with moves up the hierarchy
- The promotion premium increased further up their hierarchy. At WDB the expected value of promotion was fairly constant across hierarchical levels.
- Increments are considerably above normal (5%-20%) at the time of promotion, but not in the surrounding years
- Seniority was explicitly a criteria for promotion in both banking and railroads, but there was no entitlement based on seniority alone. Consistent with handicapping in a tournament model.
- At WDB there was an exogenous increase in probability of promotion to small branch manager from about 1920 due to expansion of the branch network. The premium for these promotions declined, the premium for promotion to medium to large branch manager stayed fairly constant.

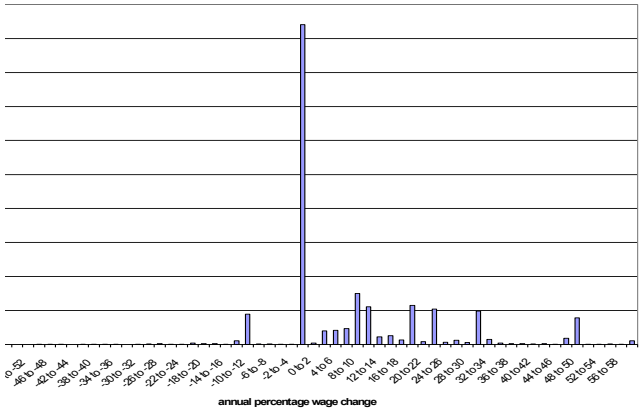
Increments for promoted and not promoted staff, UBA and VR

		Δ(log real salary), promoted	Δ(log real salary), not promoted
UBA	Teller	.096	.024
	Accountant/Teller	.049	.022
	Accountant	.077	.026
	Manager	.068	.028
	Inspector	.086	.031
	Senior Head Office	.139	.035
VR	Fireman	.189	.009
	Driver	.207	-.043
	Examiner	.201	.007
	Operating Porter	.265	.020
	Stationmaster	.145	.013

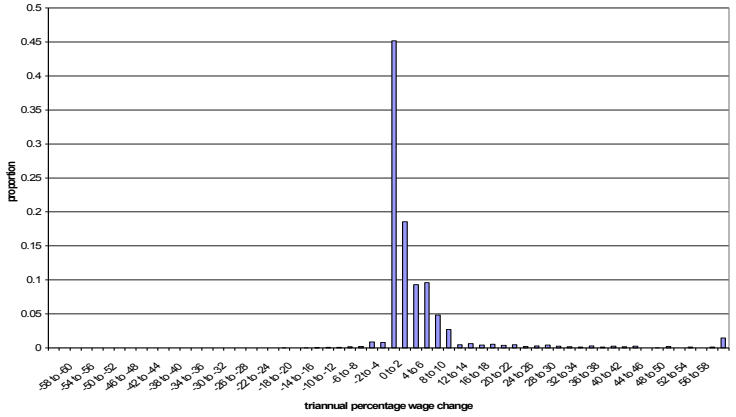
Wage rigidity

- Findings for WDB, UBA, VR generally consistent with New-Keynesian models
- Incumbent workers almost never receive pay cuts, even during periods of deflation. Contemporary studies on look at periods of zero or positive inflation.
- Nominal increments of zero were extremely common
- The characteristics of workers taking pay cuts were very similar to those receiving zero increments, suggesting that the two were substitutes
- The only wage cut in the 3 firms was a 10% across-the-board cut at the UBA in 1895, after a severe depression and banking crisis
- Wages of new workers were very flexible. Many year-to-year cuts in average starting salary

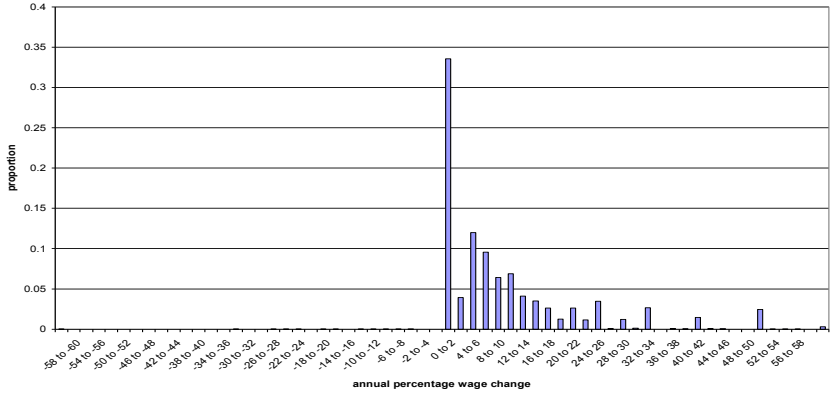
Distribution of nominal wage increments



UBA



VR



WDB

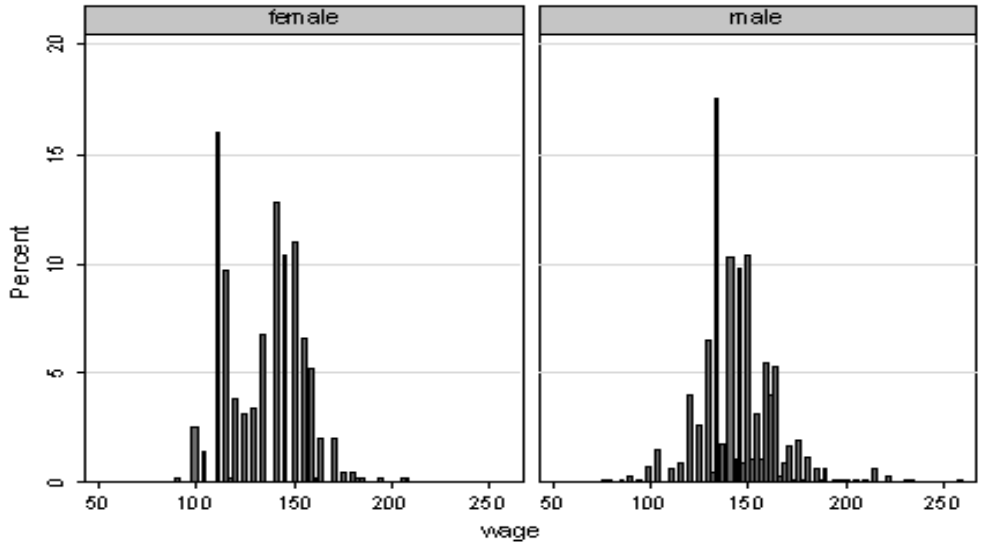
Female salaries and careers

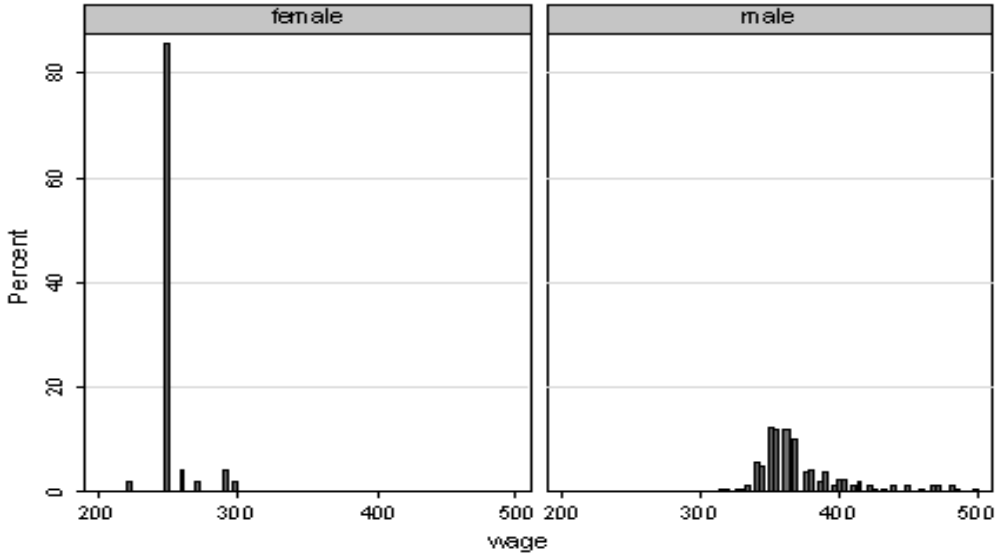
- Women hired at WDB from 1915, initially temporary replacements for men on service leave, permanent from 1919
- After 1919 most women are in routine positions only a few rise to positions of responsibility
  - Concentrated in larger back offices
  - Glass ceiling at the level of manager
  - It is possible to identify in the data at least some of the women in positions of responsibility
- Women required to leave (and forfeit pension) upon marriage

Female Salaries

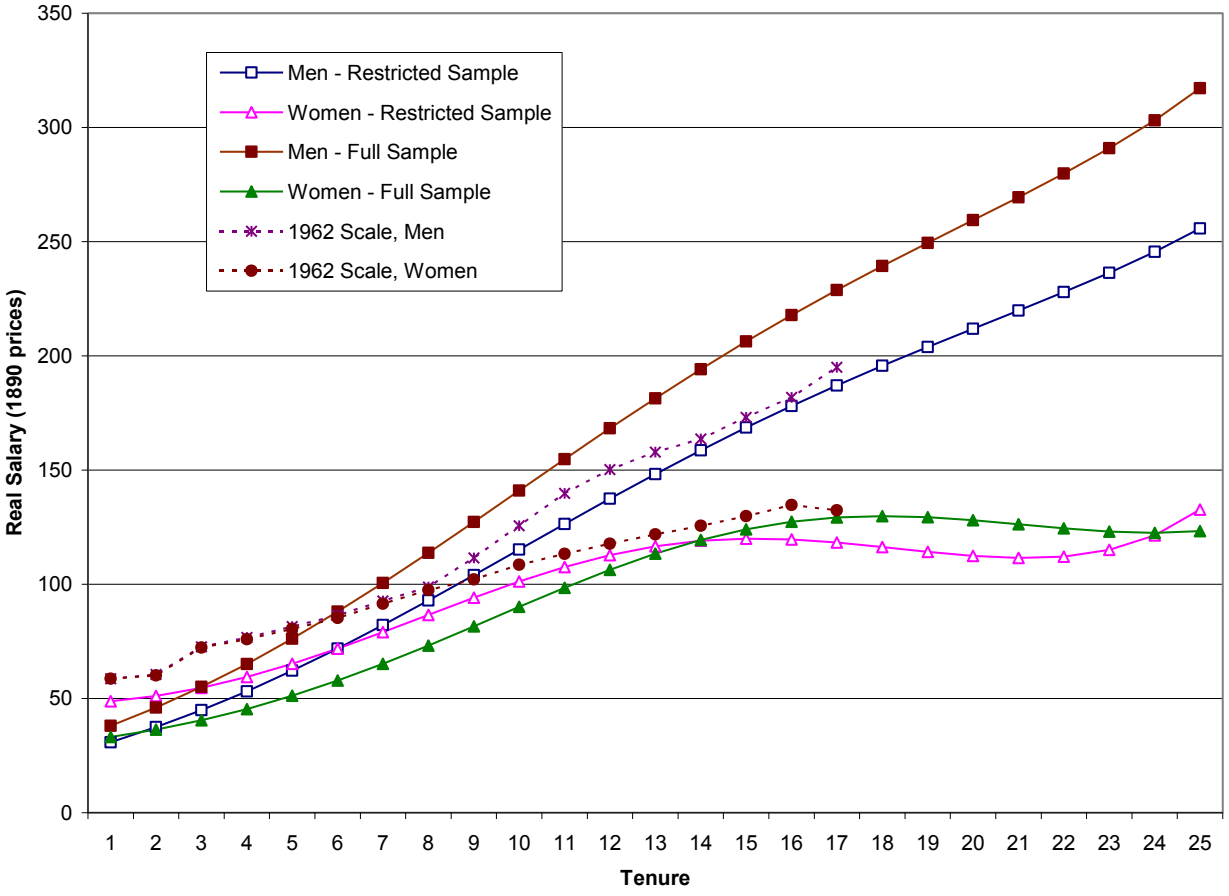
- Similar to male salaries early in the career, substantial divergence after about 10 years
- Blinder-Oaxaca decomposition shows that that this is entirely dues to differences associated with tenure. Women have lower average tenure than men because of marriage bars and lower returns to tenure.
- Effect of glass ceilings on salary is relatively small because, even for men, the probability of promotion to manager is relatively low and even the best men spend long periods as clerks before promotion
- Turnover is higher than for men, but still relatively low. Evidence from NSLLL and pay scales for railway clerks, teachers, civil servants suggests women did not have better outside opportunities.

Distribution of salaries after 5 and 20 vears tenure





Estimate male and female real salary profiles



Deferred compensation: Incentives and fairness, some experimental evidence

- One problem with field data is that we can not observe effort. Yet it is where effort is unobservable where theory predicts that long-term incentive contracts should be important
- Another issue is that we believe that fairness issues should matter for effort levels, but it is very difficult to observe how they might matter in field data.
- For these reasons, the controls offered by laboratory experiments provide an additional way to examine contracts and workers' effort levels.

Deferred compensation in the lab: Setup

- There are two players: firm and worker
- There is a three period career: young worker, old worker, retired worker
- Worker effort can be low, medium, high (L, M, H). There is a cost of supplying effort (C) which is increasing in effort level (CL, CM, CH)
- Workers are dismissed with probability P if they supply low effort. Workers are never dismissed if they supply medium or high effort.
- Output (Z) increases with effort by a larger amount than cost
- Firms make wage offers (W) for each period. The nature of the wage offer differs across treatments.
- The experiment lasts for 20 rounds, with random matching of workers and firms to approximate a one-shot game

The treatments

- Full commitment (main treatment) – the firms announces a wage schedule at the beginning for all three periods (W1, W2, W3). This wage schedule is binding and each wage must be paid if the period is reached.
- No Commitment (control 1) the firm announces a wage schedule (W1, W2, W3) which is binding one period ahead. At the start of each period he can change the wages for the remaining periods.
- Computer firm treatment – The rules are the same as with the FCT, but the same wages offers from the FCT are now made by a computer
- Reputation treatment – The rules are the same as the NCT except that worker players can observe the firm player's history

Equilibrium in the treatments (assuming subjects maximize income)

- In general the equilibrium is solved through backwards induction. What happens in round x (if the game reaches that stage)
- FCT and CFT– firm offers deferred compensation. Wages are high in period 3 and zero in period 1. Wages are (0, X, Y) where $0 \leq X \leq CM$ and $Y = (CM - CL)/p + (CM - X)$. Effort is (M, M).
- NCT – firms offer nothing in period 3, workers know this and supply low effort in period 2, etc. W = (0, 0, 0) Effort is (L, L)

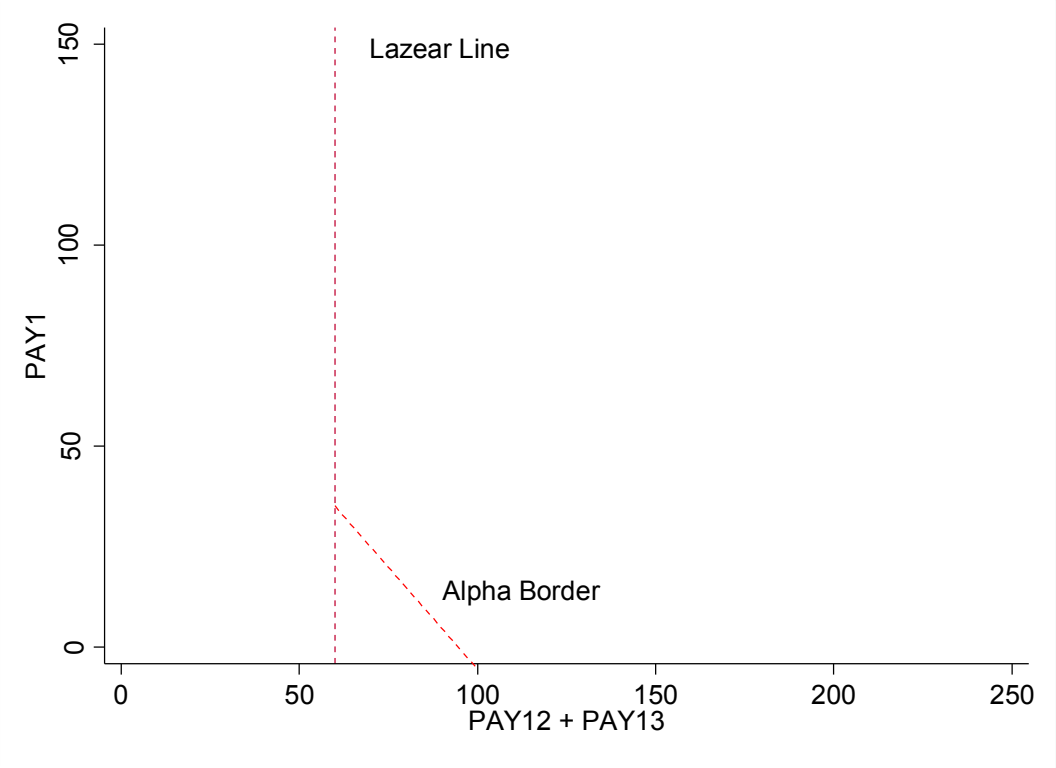
Social Preferences

- This game is characterized by inequality. In equilibrium firms earn more than workers.
- If workers have Fehr-Schmidt preferences

  $(U_W(\pi_W, \pi_F) = \pi_W - \alpha * \max(\pi_F - \pi_W, 0) - \beta * \max(0, \pi_W - \pi_F)$

  and suffer disutility from disadvantageous inequality ($\alpha > 0$), they may punish fully incentivised, but unfair wage offers. We capture this effect by differences between the FCT and CFT.

A simple diagram showing the relationship between current pay, deferred pay, and effort



Main results

- Higher deferred pay and effort in the FCT than the NCT – shows the power of incentives
- Greater incidence of low effort in the FCT than the CFT in the *Fehr-Schmidt triangle* – shows that social preferences temper the effects of incentives
- Efficiency gains of commitment are only 25% what the model predicts
  - In the NCT some subjects try to cooperate to break out of the low wage, low effort equilibrium
  - In the FCT there are output-destroying disputes over the distribution of the surplus
  - Suggests that formal institutions (contracts) and informal institutions (cooperation) may be substitutes
- Reputation produces an intermediate result
  - Higher wages and slightly higher effort than NCT
  - Workers respond to the history of the firm in terms of deferring compensation

Summary

- Labour contracts, like many other contracts within firms, do not act like spot markets
  - Labour contracts are characterised by adverse selection and moral hazard
  - Labour turnover creates search and training costs
- Long-term relationships and wages that deviate from spot wages mitigate AS and MH
- Evidence from firms suggest that contracts are motivated by the need to attract, retain, and incentivise workers
  - Deferred compensation provides an incentive for long service and honesty
  - Promotion tournaments are designed to attract and reward talent
- Contracts that are perceived to be unfair may not be fully efficient even if incentive compatible

References

- "Female Salaries and Careers in British Banking, 1915-41", *Explorations in Economic History*, forthcoming.
- "Deferred Compensation in Multi-Period Labor Contracts: An Experimental Test of Lazear's Model" (co-authors Steffen Huck and Brian Wallace), *American Economic Review,*101, 2 (2011), pp. 819-43.
- "Nominal Wage Rigidity Prior to Compulsory Arbitration: Evidence from the Victorian Railways, 1902-21" (co-author André Sammartino), *Cliometrica,* 5, 1 (2011), pp. 53-78.
- "Did Firms Cut Nominal Wages in a Deflationary Environment?: Micro-Level Evidence from the Late 19th and early 20th Century Banking Industry", *Explorations in Economic History*, 47 (2010), pp. 112-125.
- "Promotion Tournaments and White Collar Careers: Evidence from Williams Deacon's Bank, 1890 – 1941" (co-author Jeff Frank), *Oxford Economic Papers*, 59, 5 (2007), pp. i49-i72.
- "Salaries and Career Opportunities in the Banking Industry: Evidence from the Personnel Records of the Union Bank of Australia" (co-author Kenneth Simons), *Explorations in Economic History*, vol. 38 (2001), pp. 195-224.
- "Personnel Practices at the Union Bank of Australia: Panel Evidence from the 1887-1900 Entry Cohorts" (co-author David Merrett), *Journal of Labor Economics*, vol. 18, no. 4 (2000), pp. 573-613.