Nominal Wage Rigidity Under Low Inflation: Evidence from Personnel Records

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Abstract

This paper examines downwards nominal wage rigidity in the late 19th and early 20th centuries using personnel records from the Union Bank of Australia, the Victoria Railways (Australia), and Williams Deacon's Bank (England). Although it was common for workers at these firms to receive a zero nominal increment, wage cuts were very rare, even in years of low or negative inflation. Turnover at these firms was extremely low and, thus, despite flexibility in the wages of incoming workers, did not offset the effects of individual-level wage rigidity. Consequently both real wage levels and increments moved counter-cyclically.

Keywords: nominal wages, labor market adjustment, historical Australian and British labor markets

JEL codes: N30, J31

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One of the most fundamental principles of neoclassical economics is that markets adjust swiftly and fully to shocks in supply and demand. The behavior of wages in post-World War II labor markets thus presents a puzzle, as studies across a range of countries have consistently confirmed that nominal wages are rigid downwards.[1] These studies have found that, even in years with low or negative inflation, there is considerable heaping of nominal wage changes at exactly zero and relatively few workers receive pay cuts. One interpretation of downwards wage rigidity is that it reflects fundamental preferences of workers concerning loss aversion or fairness.[2] Other scholars have questioned this conclusion, arguing instead that it is a social norm that only exists in an environment where inflation effectively eliminates the need for nominal wage cuts (Gordon, 1996; Mankiew, 1996; Hanes and James (2003). In this context, the evidence on nominal wage rigidity prior to the Second World War, when expected inflation was far lower and there were extended periods of severe deflation, can provide important insights to the behavior of labor markets.

This paper examines downwards nominal wage rigidity in the late 19th and early 20th centuries using records from three large organizations in Australia and England: The

[1]A non-exhaustive list of recent studies includes Akerloef, et al. (1996), Altonji and Devereux (1999), Bewley (1999), and Kahn (1997) on the United States; Fehr and Goette (1999) on Switzerland; Dwyer and Leong (2003) on Australia; Elsby (2004) and Nickell and Quintini (2003) on the United Kingdom; and Knoppik and Beissinger (2003) on Germany.

[2]See Bewley (1999); Fehr and Falk (1999); Kahnman, Kneitsch, and Thaler (1986); on wage rigidity as a response to fundamental preferences. An important implication of this research is that if nominal rigidity stems from the fundamental preferences of workers, wages can not be adjusted downwards following a negative productivity shock without adversely affecting worker morale and productivity. This view is in line with a long tradition of Keynesian beliefs on wage rigidity and informs much of the subsequent research on nominal wage rigidity.

Union Bank of Australia (UBA), The Victoria Railways, Australia (VR), and Williams Deacons Bank, England (WDB).[3] For each firm there are wage records for male staff reported over extended periods of time. The data used in this paper cover annual wage increments at the UBA between 1888 and 1900 and at WDB between 1890 and 1936 and triennial increments at the VR between 1902 and 1921. The same workers are observed year-on-year, and thus the data is better suited to examining questions about nominal wage rigidity before the Second World War than the job-level data used in previous studies. Although the number of firms used in this study is small, the results will be of broader interest for three reasons. First, both railways and banking accounted for large and growing numbers of employees, and a range of evidence suggests that personnel practices were fairly standardized within both industries. Second, in the late 19th and early 20th centuries the railroads and banks more closely resembled modern firms than did firms in the manufacturing sector (which has been the subject of previous studies). Third, the wage setting analyzed in this paper occurred during periods of strong downwards pressure on wages (from both sustained deflation and firm-specific factors) and in a bargaining environment that had few institutional barriers to nominal wage cuts.

The traditional view of late 19th and early 20th century labor markets is that wages were relatively flexible. Downwards nominal wage rigidity did not emerge until the interwar period. In the United States a range of evidence suggests that downwards nominal wage rigidity was pervasive by the 1930s (Akerloef, et al., 1996; Gordon, 1982; O'Brien,

[3]The UBA data are from Union Bank of Australia Limited (1887-1900). The VR data are from Victoria, Parliament (1902, 1905, 1908, 1911, 1914, 1918, 1921). The WDB data are from William Deacon's Bank Limited (1890-1936). See Seltzer and Merrett (2000), Sammartino (2002), and Seltzer and Frank (2007) for a fuller description of the UBA, VR, and WDB data sets, respectively.

1989). Similarly in Great Britain, economists dating back to Keynes have argued that downwards nominal wage rigidity emerged during the late 1920s, and that prior to the inter-war period wages were rigid downwards (Keynes, 1936 and Thomas, 1994). There has been less research on wage flexibility in Australia during this period, but the general thrust of the evidence also suggests that nominal wage rigidity emerged some time during the interwar period (Gregory, et. al., 1988).

To date there has been little micro-level evidence to support the view of nominal wage flexibility in Great Britain and Australia prior to the First World War. Rather, the evidence has largely consisted of aggregated wages series and descriptive evidence from industrial action. Existing wage series for both countries show relatively frequent declines in nominal wages both within and across professions (Routh, 1954; Feinstein, 1972; Williamson, 1995; Allen, 1994; Pope and Whithers, 1994).[4] Each of these series show frequent year-on-year cuts average nominal wages; although the level of aggregation makes it impossible to infer from these series whether and how frequently individual workers received nominal pay cuts. To the best of my knowledge, there have not been any studies on the frequency with which individual workers in Australia or Great Britain received pay cuts.[5]

[4] Allen (1994) presents real wage series for bricklayers in Sydney and Manchester between 1880 and 1913. The implied nominal wage series (using Vamplew, 1987 and Feinstein, 1972 price deflators) show that in both cases nominal wages dropped in 14 of 34 years. Feinstein (1972) constructs a series of weekly wages of manual workers in the United Kingdom over the period 1870-1940, which shows nominal declines in 23 of 71 years. Roth (1936) constructs series of British Civil Service wages between 1890 and 1936. There are nominal declines in clerical salaries in 27 of 46 years and executive salaries in 23 of 46 years. Pope and Withers (1994) construct a series of wages of unskilled Australian workers between 1861 and 1938, which shows nominal declines in 20 of 78 years.

[5] There is considerably more historical evidence for the United States. In a recent study Christopher Hanes and John James provide micro-level evidence using firm-level data from the Aldrich Report, a broad-based mid- to late-19th century survey of wages in American manufacturing establishments (Hanes and James,

A second indication that nominal wages in late 19th and early 20th century Great Britain and Australia may have been fairly flexible comes from the history of industrial action in the two countries. During this period strikes were frequently fought in both countries over the issue of nominal pay cuts. In Great Britain strikes against pay cuts probably date back to the beginnings of the industrial revolution. In her classic novel North and South, Elizabeth Gaskell wrote of worker resistance to pay cuts, "Why, yo' see, there's five or six masters who have set themselves again paying the wages they've been paying these two years past... And now they come to us, and say we're to take less. And we won't" (Gaskell, 1855). The nation's first broad-based union, the National Association for Protection of Labour, established a rule in 1830 that local unions had to pay contributions to central funds that "were to be used only for strikes against cuts in wages" (Pelling, 1987, p. 28). During the late 19th and early 20th centuries there were major strikes against pay cuts by coal miners, engineers, railwaymen, textile workers, and transport workers, culminating in 1926 with the General Strike against widespread post-war wage reductions in several industries (Pelling, 1987; Laybourne, 1992).

Australia's position as a labor-scarce, rapidly growing economy meant that there were relatively few wage cuts and little union organization during the early to mid 19th century. The late 1860s and early 1870 witnessed the formation of unions in mining and

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2003). They find that nominal wage cuts occurred nearly as frequently as increases. Using data from a Ohio Bureau of Labor Statistics survey of manufacturing establishments between 1892 and 1910, William Sundstrom finds considerable evidence of downwards nominal wage rigidity (Sundstrom, 1990). However, both the Aldrich Report and Ohio BLS data are aggregated to the level of the job within an establishment. This aggregation is problematic inasmuch as job-level wages may appear to have declined whenever there were changes in the composition of workers, even if individual workers never took a nominal pay cut

manufacturing, specifically in response to wage cuts caused by migration-induced increases in the labor supply (Fitzpatrick 1944; Sutcliffe, 1921). The frequency and intensity of industrial action over the issue of pay cuts increased dramatically during the depression of the early 1890s, when many employers decided to cut wages. The defeat of major strikes by the maritime workers and the shearers coupled with the severity of the depression led to significant wage cuts across a wide range of industries (Sutcliffe, 1921; Svensen 1995). Following the comprehensive defeat of the strikes of the 1890s there was a move toward arbitration, rather than industrial action, with state-level compulsory arbitration adopted throughout Australia in the 1890s and Federal-level arbitration established in 1907. Subsequent wage cuts, such as across-the-board cuts for workers covered under Federal arbitration in 1931 were based on a negotiated process involving all parties.

The underlying approach of this paper follows a considerable existing literature on downwards nominal wage rigidity. I examine individual increments using simple descriptive statistics to determine whether zero and negative increments occur more or less frequently than would be expected given the underlying distribution of wage changes. I then examine the determinants of individual-level nominal wage increments, focussing on the extent to which wages were responsive to individual and macro-economic shocks to productivity. I then examine the behaviour of nominal wages immediately prior to worker's departures and the wages of new entrants to determine whether the firms used turnover as a means to reduce wages during cyclical downturns. Finally, I examine the behaviour of real wages at these firms.

I find a number of interesting results across the three firms. Despite a lack of institutional impediments to wage cuts and strong downwards pressure on wages, negative increments were very uncommon in the sample data, with the exception of an across-the-board 10 percent cut at the UBA in 1895. This can not be explained by underlying supply and demand factors, as a very high proportion of individual-level nominal increments in all three firms are exactly zero. Wages responded asymmetrically to productivity shocks; wage increases and zero increments were much more responsive to individual characteristics and changes in the inflation rate than were wage cuts. Senior workers received smaller percentage increments and were much more likely to receive zero increments than their junior colleagues, but nonetheless rarely took pay cuts. Similarly, during years of deflation increments above zero decreased but negative increments remained uncommon at all three firms (increasing slightly only at the VR). Although wages of existing staff were rarely cut, the wages of new entrants were much more flexible, and the average annual entry wage decreased about as frequently as it increased. However, low rates of turnover at all three firms meant that this did not fully offset the effects of individual-level downwards rigidity, and real wages at each firm moved counter-cyclically.

Data and Institutional Background

The data used in this study are unusual in that they provide individual-level wage observations for large numbers of workers at the same firms over an extended period.

The WBD and UBA data are drawn from personnel records kept by the two firms. The Williams Deacon's records contain virtually all staff at the bank between 1890 and 1936.[6] These records provide continuous information on age, tenure at the bank, branch of employment, position (manager or clerk), and annual wage. The Union Bank records are organized by individual employee, providing the same information as the WDB records plus complete position information over each individual's entire career. I have collected records for all individuals at the UBA in 1887 and all entrants between 1888 and 1900.[7] The VR records consist of cross-sections of all employees with surnames beginning with A, B, or C drawn from the triennial Government Gazette as of January 1 in 1902, 1905, 1908, 1911, 1914, 1918, and 1921. The VR records provide earnings and job title, but not location of employment. The employees of both banks came from very homogenous backgrounds, almost all were hired by the banks onto a single career ladder immediately after completion of secondary school.[8] The VR employees were a diverse set of white and blue collar workers, with a range of career paths. In the empirical analysis, I identify career tracks using the different railway branches.[9]

[6] No information is available for Williams Deacons' staff who left prior to 1896. Excluding these years from the data does not substantively change any of the results of this paper.

[7]The UBA data covers the complete careers of all sample employees. Although the records provide salary information prior to 1887 and after 1900, I only use the data between 1888-1900 because these are the only years for which I have a complete sample of all employees of the Bank. In other years there will be a problem of sample selection bias, whereby individuals with short careers would be more likely to be omitted from the data. The omitted employees were probably less suited to banking careers than the included employees, and thus would have been more likely to receive pay cuts.

[8]See Seltzer and Merrett (2000), Seltzer and Simons (2001), and Seltzer and Frank (2007) on career ladders in the banking industry.

[9]The larges branches by far were Traffic, Existing Lines, and Locomotive, which in 1899-1900 employed 37.9, 30.1 and 29.0 percent of VR staff. The other branches were Accountant's, Telegraph, Audit, Engineer-in-Chief, Secretary's, and Stores (Sammartino, 2002).

In each organization, workers were paid monthly and wages were normally adjusted annually.[10] Although the UBA and WDB data are continuous, in order to maintain some comparability to the VR data and to the data used in previous studies I have recorded wages at a single point in time (normally October 1) each year.[11] Thus the data are organized as annual panels for the two banks and a triennial panel for the VR. The only observations that I have excluded from the analysis are those with implausibly large wage adjustments, namely the less than .1 percent of observations with a 60 percent or greater wage cut or a 200 percent or greater wage increase.[12] The sample size for each firm is large: for the UBA, an average of 662 staff per year; for the VR, an average of 1,695 per year; and for WDB, an average of 622 per year. All totalled the data set contains 45,725 individual-level observations.

The nature of these data makes them well suited to the study of wage rigidity within large organizations. One advantage of these data is their completeness and accuracy. The data come from administrative records and their initial accuracy was essential for the firms' efficient operations. The UBA and WDB samples contain all clerical and managerial staff in the firms over an extended period. The VR sample, although not complete, is nonetheless large, random, and is sampled from the same set of employees in each

[10] A few employees in the VR sample were paid hourly. Following Sammartino (2002), I have converted their hourly wages into an annual wage assuming a 50 week year and a 5½ day week.

[11] In cases where an employee was present for part of a calendar year, but not on October 1, I have recorded the salary as of the latest available date.

[12] It is likely that these changes are the result of considerable change in career circumstances (junior employees returning from military leave at the end of the First World War or senior employees dramatically reducing hours in the last year before retirement) rather than standard wage adjustments based on productivity. In addition, some of these observations may simply be the result of transcription errors in either the original data or the creation of the data set.

period.[13] There are two circumstances in the VR sample where negative nominal increments will not be captured in the data: wage cuts in at least one year between censuses which are offset by equal sized or larger increases in the other years and wage cuts given to employees who then left before the next census date. These caveats mean that greater caution must be used in the interpretation of the VR results.

A second advantage to using firm-level data rather than broader-based surveys is that it is possible to identify the wage bargaining environment and macroeconomic shocks faced by firms and their likely effects on wage adjustment. The UBA faced essentially no labor market regulation and a non-unionized workforce prior to the First World War (Hill, 1982). Williams Deacon's also faced few labor market regulations throughout the period. Their workforce was completely non-unionized workforce until the founding of the Bank Officers' Guild in 1917. The Guild was a non-militant voluntary union which never claimed a majority of bankers as members or directly bargained with any of the major English the banks during the period of this study (Blackburn, 1967). Thus the post-1917 bargaining environment was very similar to the earlier environment, providing few institutional barriers to nominal wage cuts.

The bargaining environment faced by the Victoria Railways was considerably more complex. As a public corporation, wage setting at the VR occurred in a heavily regulated environment. The Victorian Parliament approved the total annual funding for wages and designated the "basic wage" (of unskilled labor). The Victoria Railways Commissioners

[13]See Sammartino (2002) for evidence that the A to C sample closely corresponds to the overall population of staff at the VR.

(a public body corporate) were responsible for setting the wages of individual workers and grades, given the total allocation from parliament. The Victorian Railways was extensively unionized from the late 19th century and throughout the period of this study a majority of VR workers were union members (Sammartino, 2002). The railway workers' unions, though clearly more active than those of the bankers, were not directly involved in the bargaining process.

There was strong downwards pressures on wages at all three firms during the period of this study. The inflation rate was low throughout the sample years.[14] British inflation averaged -0.83 percent annually over the WDB sample period (excluding the years 1915-20, which had very high inflation rates due to the war), and was zero or negative for 22 of 47 sample years. The price level dropped by approximately 44 percent between 1920 and 1933. Australian inflation averaged -2.45 percent annually over the UBA sample period and was negative for 10 of 13 years. The price level dropped by approximately 33 percent between 1888 and 1897. Australian inflation averaged 1.55 percent annually for the VR sample period (excluding 1915-20) and was negative for 1 of 7 triennial periods. In addition to the macroeconomic environment, industry-specific and firm-specific factors also created downwards pressure on wages. The Australian banking industry suffered one the worst crises ever experienced by a branch banking country in the 1890s. Seven of the country's 31 trading banks permanently closed between 1890 and 1893 and 13 of the 24 surviving banks (including two of the three largest banks) temporarily suspended operations for between 30 and 128 days in 1893 (Butlin, 1986 and MacKay, 1931).

[14]See Vamplew (1987), series PC31 for Australian price indexes. See Feinstein (1972), table 65 for English price indexes.

Williams Deacon's faced financial troubles throughout the 1920s, as its Lancashire manufacturing base underwent a deep recession (Royal Bank of Scotland, 1997). A second source of downward pressure on male wages at WDB was the growth of female employment.[15] As was common throughout the British banking industry, WDB employed no women prior to the First World War. During the War, the Bank lost nearly half of its male staff to the Services, and needed to hire women to maintain its operations. Most of these women remained after the War, and between 1915 and 1936 women comprised an average of 25.3 percent of total staff employed at the Bank and 49.9 percent of new hires (Williams Deacon's Bank, 1915-1936). Parliament felt a need to rein in Railways spending and generally granted relatively low increases in the overall wage bill per worker (Samamrtino, 2002). Throughout the period of this study the unions complained bitterly about Parliamentary allocations and campaigned for compulsory arbitration as a wage-setting mechanism.

The disadvantage to using firm-level data is that, by nature, there are questions as to the extent to which the results based on three firms can be generalized to the broader economy. It could not be argued that these organizations were in any sense random for the overall Australian or English economies. Their employees were long-term hires and had much higher skill levels than most contemporary workers, and thus may have been less likely to receive pay cuts.[16] Nevertheless, there are compelling reasons to study wage rigidity in these sorts of firms. First, the industries covered by this study were large and employed a significant and growing proportion of the overall workforce in both

[15] See Seltzer and Frank (2008) on female employment at Williams Deacons.
[16] Nickell and Quintini (2003) show that in Great Britain in the 1990s the wages of higher-skilled workers are more likely to be sticky downwards.

countries. Clerical employment accounted for approximately 4 percent of the workforce in both Britain and Australia in the early 20th century.[17] The VR was the single largest private employer in Victoria, and was likely only rivalled by the New South Wales Railway as the largest private employer in Australia.[18] A range of evidence shows strong similarities in the wage and employment practices throughout the English and Australian banking industries in the late 19th and early 20th centuries, thus the practices identified here probably extend across the industry (and perhaps more broadly the clerical sector).[19] Likewise, studies of railroads in Canada and England have shown a range of wage and employment practices similar to those at the VR (Sammartino, 2002; Howlett, 2000; Hamilton and MacKinnon, 1996). Secondly, both banks and railways were large enterprises with sophisticated managerial hierarchies and internal labor markets (Chandler, 1990 and Gilbart, 1865). The organizational structure of these firms more closely resembles that of the typical post-war firm than does the structure of 19th century manufacturing firms. One implication of this is that the existence of nominal wage rigidity in these firms suggests that any trend toward increased downwards nominal wage rigidity since the Second World War may be more due to the increasing prevalence of large firms rather than to a regime of higher inflation.

[17]The 1921 British Census records 581,000 men in clerical and related employment, about 4.2 percent of total male employment (Mitchell, 1985). The 1911 Australian Census records 75,000 workers in clerical occupations, about 4.1 percent of the total workforce (Vamplew, 1987).

[18] In 1891-92 the Victorian Railways employed 11,801 permanent staff and 1,309 temporary staff. These numbers had increased to 19,273 and 7,688 by 1921-22 (Victoria, Parliament, 1892 and 1922).

[19] See Baxter (1883), Seltzer and Merrett (2000), and Seltzer and Simons (2001) on the Australian banking industry and Gilbart (1865), Blackburn (1967) and Seltzer and Frank (2007) on the English banking industry.

Evidence at the Individual Level

As a first approach to examining wage adjustment, the distribution of wage changes at each organization is shown in Figure 1. The dominant feature of Figure 1 is heaping of increments at zero and the almost complete absence of wage cuts. In 46.6%, 26.7%, and 33.5% of observations at the UBA, VR, and WDB, respectively the wage change is exactly zero.[20] In only 6.0%, 2.4%, 0.2% of observations do individuals take a pay cut. Most of the wage cuts in the sample (431 of 838) occurred at the UBA in 1895, when, after over a decade of deflation, the Bank implemented an across-the-board 10% decrease.[21] During the remaining years only 1.1% of wage increments at the UBA were negative.

The absence of nominal wage cuts and the frequency of zero increments suggests that wages did not fully adjust in response to productivity shocks. I explore this further, focussing particularly on the effect of inflation. Table 1 presents summary statistics of wage increments split into years with positive inflation and years with zero or negative inflation. The WDB figures are further split into the pre-war (1890-1913) and post-war (1921-36) periods in order to examine whether longer-term inflation regimes as well as year-to-year variation mattered for wage adjustment.[22] The evidence that increments

[20]Zero increments were less common at the VR than the UBA or WDB, even though the mean increment for the VR was lower than for the UBA or WDB. This is likely an artefact of the triennial nature of the VR data (which effectively requires 3 successive zero annual increments for the observed triennial increment to be zero), rather than a policy of more frequent wage increases.

[21]All UBA employees received a 10 percent cut on July 1, 1895. However, the UBA gave employees regular tenure-based and promotion-based increments during the year. For the year, 40.38 percent of employees received zero or positive increments.

[22] In the pre-war period British inflation averaged 0.6% percent per year and was negative 6 of 24 years. In the post-war period inflation averaged -3.2% and was negative 11 of 16 years. There was further

responded to inflation is very weak for the UBA and WDB. In both banks the mean increment is about the same in inflation and deflationary years. Although wage cuts are more prevalent at the UBA in deflationary years, this can be entirely explained by the 1895 across-the-board cut. In other deflationary years only 1% of increments were negative. At WDB, wage cuts occurred at about the same rate and zero increments actually decreased in the deflationary period 1921-36 compared to the period 1890-1920. Wages at the VR were somewhat more responsive to the business cycle. In 1905, the only trienium in the sample period in which the price level declined, zero increments occurred much more frequently than in other years. Wage cuts were also more common than other years, although they still were relatively rare.

To further examine the relationship between productivity shocks and wage changes, in Table 2 I run OLS regressions on annual individual-level nominal wage changes. The independent variables are tenure (and its square), age, dummy variables for moving position or location, and the national inflation rate. In addition the VR regressions include branch dummies (traffic, ways and works, stores, accounting, engineer-in-chief), as the individual branches had essentially separate internal labor markets. The UBA and WDB regressions also include a time trend and dummy variables for 1895 (UBA) and 1914-19 (WDB).[23] Overall, Table 2 shows that average wage increments adjusted to demand shocks in a manner consistent with neoclassical theory. Wages responded to changes in

downwards pressure on male wages in the post-war period due to the Bank's financial troubles and to the growth of female employment.

[23] As noted earlier 1895 was unusual for the UBA because of the across-the-board adjustment. The War years were unusual because Williams Deacon's continued to pay its staff on military leave (normally the difference between their Bank salary and military salary), but did not grant annual increments to staff on leave. Approximately 46 percent of staff interrupted their careers to join the services.

productivity, but the adjustment process differed somewhat across the three firms. At all three firms the average increment decreased with age and decreased at a decreasing rate with tenure. The inflation rate had a large and significant positive effect on average increments at the VR; a smaller, but still significant effect at WDB; and an insignificant effect at the UBA. Moving between positions and locations has a large and statistically significant positive effect on increments at the VR and WDB and a small, but statistically significant negative effect at the UBA.[24]

Table 3 shows the results of multinomial logit regressions on negative and zero increments (with positive increments as the omitted category). Although wage changes are continuous, I examine positive, zero, and negative increments as discrete outcomes because imperfections in the adjustment process may have led to wage cuts be driven by different factors than increases or zero increments. The independent variables in Table are the same as those used in Table 2. Most of signs of the regression coefficients in Table 3 are consistent with those in Table 2, with the exception that moving position or location strongly increases the probability of a wage cut and reduces the probability of a zero increment. A likely explanation for this result is that many moves were likely due to unusually good or unusually poor performance (promotions and demotions). These moves were typically accompanied by large change in pay and, in the case of demotion, a dramatically increased probability of a nominal pay cut. [25] Table 4 shows the predicted

[24] Approximately 28.4% of position changes at the UBA over the sample period were demotions. I have run the regression separating MOVED POSITION into promotion and demotion dummies. The demotion dummy has a large (-.042) and statistically significant negative effect, whereas the promotion dummy is insignificant. Demotions rarely occurred at the other two firms.

[25] The UBA records, which are more comprehensive than those of the VR or WDB, provide anecdotal evidence supporting this. On several records performance problems or questions concerning individuals' abilities are specifically noted at the same time as pay cuts.

probabilities of a zero or negative increment using the regression results from Table 3 and varying assumptions about the independent variables. It can be seen that, as with the raw data shown in Table 1 and Figure 1, zero increments were much more common than wage cuts after controlling for other characteristics. Indeed, it is evident from Table 4 that wage cuts at all three firms were fairly unlikely for any type of worker and under any inflation regime. A second observation from Table 4 is that pay cuts were more likely to follow individual-specific factors (individual–specific productivity associated with seniority or with demotion) than inflation. Indeed the Table provides little evidence of any effect of inflation for wage cuts at the UBA and WDB.

Overall the evidence from Tables 1, 3, and 4 and Figure 1 strongly suggests that wages were rigid downwards and that nominal wage cuts were not used to adjust to small productivity shocks. Wage cuts occurred considerably less frequently than zero increments, both in the raw data and after controlling for worker characteristics. At the UBA and WDB wage cuts remained uncommon even after prolonged periods of deflation. Only the VR adjusted nominal wages to short-run changes in the inflation rate; however, the predicted proportion of wage cuts remains very low for any in-sample values of inflation.[26] Finally, the regressions suggest that, excluding an across-the-board cut at the UBA, younger workers almost never took a pay cut and pay cuts were often associated with demotion.

[26]Unlike the UBA and WDB samples, the VR sample did not cover a period of severe deflation. The largest price drop in the sample (between 1902 and 1905) was 1 percent. *Ceteris paribus* the predicted probability of a wage cut (estimated as in Table 4) with 1 percent deflation is only 3.1 percent.

Turnover and Wage Adjustment

Much of the recent literature on downwards wage rigidity argues that, although downwards nominal wage rigidity is widespread in contemporary labor markets, it has relatively little impact on market clearing, as firms can use alternative mechanisms to bring wages in line with productivity. The absence of observed cuts is not sufficient by itself to show that wages *could* not be adjusted downwards or that downwards rigidity had an important effect on the overall wage bill. The literature has examined changes in hours worked (****) and turnover (Altonji and Deveroux, Haines and James) as possible mechanisms to offset the effects of nominal wage rigidities. I do not examine changes in hours worked, as almost all of the workers in the sample were salaried and there is no information available on their hours of work. I explore two issues related to turnover and wage flexibility. First, the lack of observed wage cuts may have been due to workers choosing to leave the firm rather than accepting a cut. Secondly, individual wages may have been sticky downwards, but firms may have offset this by increasing turnover and paying lower wages to new entrants during economic downturns.

If individual wages are rigid downwards, firms can only maintain flexibility in their overall wage bill though turnover. Unlike the late 19th and early 20th century manufacturing sector, the turnover rates for all 3 firms were extremely low by historical and even modern standards. The average exit rate for the UBA was 6.9 percent of staff per year. The exit rate at Williams Deacons was even lower at 3.8 percent of staff per year. The observed exit rate at the Victoria Railways was also very low, averaging

approximately 9.41 percent between triennial survey periods or about 3.04 percent per year. However, this figure must be interpreted with a degree of caution as it excludes very short stayers who entered and then left between census dates, and thus is lower than the true exit rate.

The low rates of exit imply that even under the implausible assumption that *all* exiting workers would have received a wage cut had they remained at their jobs, the overall distribution of increments would still have considerable clustering at zero and relatively infrequent pay cuts. The actual distribution of increments for exiting workers can not be observed; however, the distribution of increments immediately prior to exit (the point in the data when poor worker-firm matches would likely have been most observable to the firm) is a reasonable approximation and is shown in Table 5.[27] The table suggests that exiting workers were more likely to be poor fits than stayers. In all three firms (though particularly for the VR and WDB) zero increments are more common in the last full period than in other periods (shown in table 1). However, the table also provides further evidence of downwards nominal rigidity. Although the UBA and VR have slightly higher rates of wage cuts for staff in their in the last full period of employment, wage cuts remain far less frequent than zero increments at all three firms and are almost completely absent at WDB.

[27]It is an empirical regularity that there is serial correlation of wage increments, i.e. higher ability workers receive larger increments year after year (Baker, Gibbs, and Holmstrom, 1994). In the three firms the correlations between percentage increments over successive periods are .196 for the UBA, .310 for WDB, and .393 for the VR.

A second mechanism by which the firms could have used turnover to adjust the overall wage bill in response to macroeconomic shocks would have been to increase dismissals or encourage resignations or retirements during cyclical downturns and pay incoming staff lower rates.[28] The very low turnover rates for the 3 firms would have limited the effectiveness of this mechanism, nevertheless it is possible that changes in turnover partially offset the effects of productivity shocks. To examine whether turnover was countercyclical, I have run regressions of the annual exit rate on the national inflation rate. The results are shown below (t-statistics in parentheses, * indicates significance at a 5% level).[29]

WDB	Percent Exit = 3.59* + .110 Inflation*		Adj. R^2=.253, F=14.56*, N=41
	(16.58)	(3.82)	
VR	Percent Exit = 8.04* + .549 Inflation		Adj. R^2=.122, F=1.69, N=6
	(5.72)	(1.30)	
UBA	Percent Exit = 7.25* + .133 Inflation		Adj. R^2=.074, F=1.96, N=13
	(13.27)	(1.40)	

The coefficient on inflation is positive in all three regressions (though only significant for the VR), suggesting that turnover actually decreased during downturns in the business cycle. Although the small sample sizes means that strong conclusions can not be drawn from the results, the regressions provide no evidence to suggest that the firms increased dismissals or encouraged retirements or resignations as a means of reducing their wage bill over the business cycle.

[28] Simon (2001) shows that asking wages of job seekers dropped much more than the actual wages of employees for female clerks in the United States during the Great Depression. Kahneman, et. al. (1986) offer a behavioral explanation for this mechanism; showing that a large majority of survey respondents regard wage cuts to existing employees as unfair, but nearly an equally large majority regard paying new entrants lower wages than outgoing employees as acceptable.

[29] The Wiliams Deacon's regressions cover 1896-1936 because data is not available for staff who left prior to 1896.

Although the evidence above suggests that the firms did not proactively use turnover to reduce their wage bill, it is nevertheless possible that normal levels of turnover brought about some wage flexibility if the wages of incoming staff were lower than those than wages of existing staff. Virtually all incoming staff at each organization were appointed to very junior positions, and in order to ensure sufficient sample sizes and comparability of successive cohorts, I restrict the analysis to these employees. The distribution of the annual changes in the average entry level wage is shown in Table 6. Unlike the wages of incumbents, wages of new entrants were flexible downwards, with year-on-year cuts occurring about as regularly as increases in each firm.

Tables 1, 2, and 6 suggest that the 3 firms at least partially offset the absence of individual wage cuts during downturns in the business cycle through changes in the distribution of increments above zero and through changes to the entry wage. *A priore* it is ambiguous to what extent these mechanisms were sufficient to offset downward nominal rigidity, thus I examine the behavior of real wages. Table 7 shows the distribution of real wage increments. Real increments were more likely to be negative than nominal increments. However, Table 7 also shows that real increments moved countercyclically. The mean real increment was considerably higher in years with zero or negative inflation and virtually all real wage cuts occurred during years with a positive inflation rate. Regressions on the average real wage at each firm on the annual inflation rate provide further evidence that real wages moved coutercyclically. These regression results are shown below (t-statistics in parentheses, * indicates significance at a 1% level).

UBA	Average real wage=	212.83* - 1.027INFL (39.77) (1.11)	Adj. R^2=.018, F=1.22, N=13
VR	Average real wage=	137.15* - 2.89INFL* (47.37) (4.09)	Adj. R^2=.724, F=16.72*, N=7
WDB	Average real wage=	176.50* - 2.76INFL* (43.44) (4.83)	Adj. R^2=.326, F=23.29*, N=47

In each case the coefficient on the inflation rate is negative and it is statistically significant for the VR and WDB. The evidence on the cyclicality of real wages implies that downwards nominal wage rigidity had a considerable effect on real wage adjustment in response to shocks.

Conclusions

This paper has examined downwards nominal wage rigidity in the late 19th and early 20th century using personnel data from three large firms, the Union Bank of Australia, the Victorian Railways (Australia), and Williams Deacon's Bank (England). The data has an important advantage over data used in previous studies of wage rigidity during this period; namely that observations are at an individual level and thus there are no concerns about changes in the composition of workers. Moreover, each of these firms faced considerable macroeconomic and firm-specific downwards pressures on wages during this period. Although these firms are not representative of the broader Australian or English economies, they are probably fairly representative of two large and important industries, both of which more closely resemble large modern firms in their internal

organization and labor relations than did the manufacturing firms which have been the subject of previous studies).

The main finding of this paper is that nominal wages at all three firms were very sticky downwards. Wage increments clustered at zero at all three firms. Wage cuts were rare at the UBA and VR and almost completely absent at WDB. Most of the wage cuts in the sample occurred during a single across-the-board cut at the UBA in 1895. Otherwise individual wages cuts were frequently accompanied by a change of position, suggesting that they were used only as a punishment for sub-standard performance and not to bring wages in line with small changes to productivity. A second important finding is that turnover was very low did not increase during downturns in the business cycle. Consequently, although the wages of new hires were often cut from year to year and were lower than existing employees, turnover was not sufficient to offset downwards nominal wage rigidity, and both individual-level and firm-average real wages moved countercyclically. Finally, the results provide strong evidence that nominal wage rigidity was a feature of labor contracts at large Australian and British firms dating back to at least the late 19th century, and that this wage rigidity is in line with behavioral models which posit that workers have fundamental preferences regarding fairness of loss aversion and may reduce their effort level following wage cuts.

Bibliography

Akerlof, George; Dickens, William; and Perry, George (1996). "The Macroeconomics of Low Inflation." Brookings Papers on Economic Activity, 1: 1-59.

Allen, Robert (1994). "Real Incomes in the English-Speaking World, 1879-1913," in George Grantham and Mary MacKinnon, eds., *Labour Market Evolution: The Economic History of Market Integration, Wage Flexibility and the Employment Relation*, London, Routledge: 107-138.

Joseph Altonji and Paul Devereux (1999). "The Extent and Consequences of Downward Nominal Wage Rigidity." National Bureau of Economic Research (Cambridge, MA) Working Paper 7236.

George Baker, Michael Gibbs, and Bengt Holmstrom (1994). "The Wage Policy of a Firm", Quarterly Journal of Economics, 109: 921 - 55.

Baxter, A. B. (1883). Banking in Australasia, London: Blades, East & Blades.

Truman Bewley (1999). Why Wages Don't Fall During a Recession. Cambridge, MA: Harvard University Press.

Blackburn, R. M. (1967). Union Character and Social Class: A Study of White-Collar Unionism. B. T. Batsford Ltd., London.

Butlin, S. J. (1986). The Australian Monetary System 1851-1914. Sydney: Ambassador Press.

Chandler, Alfred (1990). Scale and Scope: The Dynamics of Industrial Capitalism. Cambridge, Harvard University Press.

Dwyer, Jacqueline and Leong, Kenneth (1983). "Nominal Wage Rigidity in Australia." Australian Journal of Labour Economics, 6 (1): 5-24.

Elsby, Michael (2004). "Evaluating the Economic Significance of Downward Nominal Wage Rigidity." Mimeo.

Fehr, Ernst and Falk, Armin (1999). "Wage Rigidity in a Competitive Incomplete Contract Market." Journal of Political Economy, 107, 1: 106-134.

Fehr, Ernst and Goette, Lorenz (2005). "Robustness and Real Consequences of Nominal Wage Rigidity." Journal of Monetary Economics, 52(4): 779-804.

Feinstein, Charles (1972). National Income, Expenditure and Output of the United Kingdom 1855-1965. Cambridge: Cambridge University Press.

Fehr, Ernst and Goette, Lorenz (1999). "Robustness and Real Consequences of Nominal Wage Rigidity." Institute for Empirical Research in Economics, University of Zürich, Working Paper No. 44.
Fitzpatrick, Brian (1944). *A Short History of the Australian Labor Movement*. Melbourne, GPO.

Gaskell, Elizabeth (1855). *North and South*. London: Chapman & Hall.

Gilbart, James W. (1865). A Practical Treatise on Banking. London: Bell & Daldy.

Gordon, Robert (1982). "Why U.S. Wage and Employment Behaviour Differs from that in Britain and Japan." Economic Journal, 92: 13-44.

Gordon, Robert (1996). "The Macroeconomics of Low Inflation: Comment." Brookings Papers on Economic Activity, 1: 60-66.

Gregory, R. G., Ho, V. and McDermott, V. (1988) Sharing the Burden: the Australian Labour Market During the 1930s. In R. G. Gregory and N. G. Butlin, eds, *Recovery from the Depression: Australia and the World Economy in the 1930s* (Cambridge University Press).

Hanes, Christopher and James, John (2003). "Wage Adjustment Under Low Inflation: Evidence from U.S. History." American Economics Review, 93, 4: 1414-1424.

Hamilton, Barton and MacKinnon, Mary (1996). "Quits and Layoffs in Early Twentieth Century Labour Markets", Explorations in Economic History, 33, 3: 346-66.

Hill, John (1982). From Subservience to Strike: Industrial Relations in the Banking Industry, St. Lucia: University of Queensland Press.

Howlett, Peter (2000). "Evidence of the Existence of an Internal Labour Market in the Great Eastern Railway Company, 1875-1905", Business History, 42, 1: 21-40.

Kahn, Shulamit (1997). "Evidence of Nominal Wage Stickiness from Microdata." American Economic Review, 87(5): 993-1008.

Kahneman, Daniel, Knetsch, Jack, & Thaler, Richard (1986). "Fairness as a Constraint on Profit Seeking: Entitlements in the Market." The American Economic Review, 76, 4: 728-741.

Keynes, John Maynard (1936). The General Theory of Employment, Interest and Money. London, Macmillan.

Knoppik, Christoph and Beissinger, Thomas (2003). "How Rigid are Nominal Wages? Evidence and Implications for Germany." Scandinavian Journal of Economics, 105 (4): 619-41.

Laybourne, Keith (1992). *A History of British Trade Unionism, 1770-1990*. Bath, Alan Sutton Publishing Ltd.

Mankiew, Gregory (1996). "The Macroeconomics of Low Inflation: Comment." Brookings Papers on Economic Activity, 1: 67-73.

MacKay, A. L. Gordon (1931). The Australian Banking and Credit System, London: P. S. King & Son.

Mitchell, Brian Redman (1988). British Historical Statistics. Cambridge: Cambridge University Press.

Nickell, Stephen and Quintini, Glenda (2003). "Nominal Wage Rigidity and the Rate of Inflation." Economics Journal, 113: 762-81.

O'Brien, Anthony Patrick (1989). "A Behavioral Explanation for Nominal Wage Rigidity during the Great Depression." Quarterly Journal of Economics, 104, 4: 719-35.

Pelling, Henry (1987). *A History of British Trade Unions*, 4th Edition. London, Macmillan.

Pope, D. and Withers, G. (1994), Wage Effects of Immigration in Late-Nineteenth-Century Australia, in T. Hatton and J.G. Williamson, eds. *Migration and the International Labor Market, 1850-1939* (London, Routledge).

Routh,Guy. "Civil Service Pay, 1875 to 1950." *Economica*, 21, 83 (1954): 201-223.

The Royal Bank of Scotland (1997), The Royal Bank of Scotland: A History, Edinburgh, The Royal Bank of Scotland.

Sammartino, André (2002). Human Resource Management Practices and Labour Market Structures in the Victorian Railways 1864-1921. PhD Thesis, University of Melbourne.

Seltzer, Andrew and Merrett, David (2000). "Personnel Practices at the Union Bank of Australia: Panel Evidence from the 1887-1900 Entry Cohorts." Journal of Labor Economics, 18, 4: 573-613.

Seltzer, Andrew and Frank, Jeff (2007). "Promotion Tournaments and White Collar Careers: Evidence from Williams Deacon's Bank, 1890 – 1941." Oxford Economic Papers, 59, 5: i49-i72.

Seltzer, Andrew and Frank, Jeff (2008). "Female Salaries and Careers in the British Banking Industry, 1915-41." Mimeo.

Seltzer, Andrew and Simons, Kenneth (2001). "Salaries and Career Opportunities in the Banking Industry: Evidence from the Personnel Records of the Union Bank of Australia." Explorations in Economic History, 38: 195-224.

Simon, Curtis J. (2001). "The Supply Price of Labor During the Great Depression." Journal of Economic History, 61, 4: 877–903.

Sundstrom, William (1990). "Was There a Golden Age of Flexible Wages? Evidence from Ohio Manufacturing, 1892-1910." Journal of Economic History 50: 309-20.

Sutcliffe, J. T. (1921). A History of Trade Unionism in Australia. Melbourne, MacMillan & Co.

Svenson, Stuart (1995). *Industrial War, the Great Strikes, 1890-94*. Wollongong: Ram Press.

Thomas, Mark (1994). "Wages in Interwar Britain: a Sceptical Inquiry" in George Grantham and Mary MacKinnon, eds., *Labour Market Evolution: The Economic History of Market Integration, Wage Flexibility and the Employment Relation*, London, Routledge: 107-138.

The Union Bank of Australia Limited (1887-1900). Register of Officers. ANZ Group Archive (U/271/1, U/271/2, U271/3).

Vamplew, Wray, ed (1987). Australians: Historical Statistics. New South Wales: Fairfax, Syme & Weldon Associates.

Victoria, Parliament (1892 and 1922). Victorian Railways Annual Reports, Parliamentary Papers, Melbourne.

Victoria, Parliament (1902, 1905, 1908, 1911, 1914, 1918, 1921). The Victorian Government Gazette. Melbourne.

William Deacon's Bank Limited (1890-1936). Staff Registers. The Royal Bank of Scotland Archives, London, GB1502/WDB480/1, GB 1502/WD/480/2, GB 1502/WD/481, GB 1502/WD/46/1.

Table 1
Nominal Wage Changes by Individual Employee

		UBA,1888-1900	VR, 1902-1921	WDB, 1890-1936	WDB, 1921-1936
Years with inflation > 0	Number of Wage Changes	2114	10132	15415	4497
	Percent of observations				
	Positive	46.4	78.2	72.9	81.2
	Negative	1.2	1.5	0.1	0.1
	Zero	52.0	20.3	28.0	18.7
	Mean (%)	10.7	5.6	12.6	9.2
	Median (%)	0	2.7	6.7	6.6
Years with inflation ≤ 0	Number of Wage Changes	6487	1735	13842	9827
	Percent of observations				
	Positive	47.7	28.2	77.8	79.2
	Negative	7.5	7.3	0.2	0.2
	Zero	44.8	64.6	23.0	20.6
	Mean (%)	9.4	3.5	8.2	7.1
	Median (%)	0	0	6.6	6.4

Table 2
Regressions on Log Wage Change

	UBA	VR	WDB
Tenure	-.0178* (39.52)	-.0078* (9.99)	-.0061* (24.13)
Tenure Squared	.00037* (26.49)	.00029* (16.01)	.00017* (45.37)
Age	-.0059* (27.25)	-.0116* (40.05)	-.0045* (23.83)
Moved Position	-.0169* (4.00)	.0828* (21.49)	
Moved Location	-.0023 (0.73)		.0432* (21.25)
Inflation	-.00016 (0.64)	.0276* (45.18)	.0030* (37.39)
Time Trend	-.00028 (0.79)		-.0011* (26.29)
World War I			-.0641* (29.51)
Year=1895	-.1199* (28.01)		
Constant	.3312* (57.22)	.5454* (54.90)	.3022* (77.04)
Number of Observations	8584	11886	32845
F	516.71*	828.21*	1755.34*
Adjusted R^2	.3246	.3851	.2721

Notes: Dependent variable is ln(wage)-ln(lag wage).
* = significance at a 1 percent level.
The VR regression also includes branch dummies.

Table 3 – Multinomial Logit Regressions on Wage Change Outcomes

		UBA	VR	WDB
Nominal Wage Cut	Tenure	.4180* (13.22)	.0623† (2.01)	.0617 (0.91)
	Tenure Squared	-.0079* (8.64)	-.0014† (1.96)	-.00012 (0.11)
	Age	.1738* (14.21)	.0679* (5.96)	.0777 (1.85)
	Moved Position	.6679* (2.77)	1.1561* (8.83)	
	Moved Location	.9423* (4.81)		2.5834* (7.35)
	Inflation	-.00085 (0.03)	-.4658* (15.72)	-.0701* (3.28)
	Time Trend	.0941† (2.51)		-.0480* (3.83)
	World War I			.9234 (1.60)
	Year=1895	5.8356* (27.40)		
	Constant	-11.937* (22.16)	-5.6033* (14.28)	-9.640* (8.56)
Zero Nominal Change	Tenure	.1881* (18.65)	.0438* (3.56)	-.0582* (8.75)
	Tenure Squared	-.0026* (7.79)	-.0017* (5.93)	.0015* (13.94)
	Age	.0975* (19.25)	.0833* (17.42)	.0841* (18.28)
	Moved Position	-.2746* (3.22)	-1.5183* (20.66)	
	Moved Location	.0046 (0.07)		-.7477* (9.95)
	Inflation	.0100† (2.03)	-.4935* (42.42)	.0160* (7.31)
	Time Trend	-.0169† (2.41)		-.0195* (17.64)
	World War I			.4429* (8.07)
	Year=1895	-.6272* (4.40)		
	Constant	-3.168* (23.83)	-3.026* (18.15)	-3.227* (31.79)
	Number of Observations	8584	11886	32845
	χ^2	4002.59*	4796.22*	7611.18*
	Pseudo R^2	.2656	.2949	.2007

Notes: Omitted category is wage increase.

* = significance at a 1 percent level.

† = significance at a 5 percent level.

Table 4
Estimated Probabilities of Nominal Cuts and Zero Wage Change

	UBA – Cut	UBA – Zero	VR – Cut	VR – Zero	WDB – Cut	WDB - Zero
Baseline	.0144	.7689	.0252	.4246	.0002	.1510
Tenure = 0	.0003	.2092	.0175	.3647	.0001	.1057
Tenure = 20	.0730	.8954	.0316	.4048	.0008	.2654
Tenure = 30	.1088	.8846	.0340	.3114	.0021	.4969
Inflation = -5%	.0139	.7777	.0445	.8609	.0004	.1410
Inflation = 5%	.0149	.7600	.0041	.0612	.0002	.1616
Moved Position	.0338	.7048	.1107	.1286		
Moved Location	.0360	.7529			.0035	.0774
Moved Position and Location	.0822	.6704				
Start Age = 16	.0096	.6993	.0220	.3483	.0002	.1128
Start Age = 25	.0270	.8294	.0288	.5238	.0003	.2131

Notes: The baseline specification assumes entry age of 20, tenure of 10, mean values for the time trend, year other than 1895 (UBA) and other than a War year (WDB).

Probabilities are calculated using the coefficients in Table 3. The formula is: $P_i = \frac{\text{EXP}(\sum_i \hat{\beta}_i \mu_{Xi})}{\sum \text{EXP}(\sum_i \hat{\beta}_i \mu_{Xi})}$

Table 5
Nominal Wage Changes in the Last Full Period Before Exit

	UBA	WDB	VR
Number of Wage Changes	733	917	885
Percent of observations			
Positive	41.61	54.85	54.35
Negative	8.73	0.22	4.18
Zero	49.66	44.93	41.47
Mean (%)	8.61	10.49	3.61
Median (%)	0	3.51	0.63

Table 6
Change in the Average Wages of Incoming Junior Staff

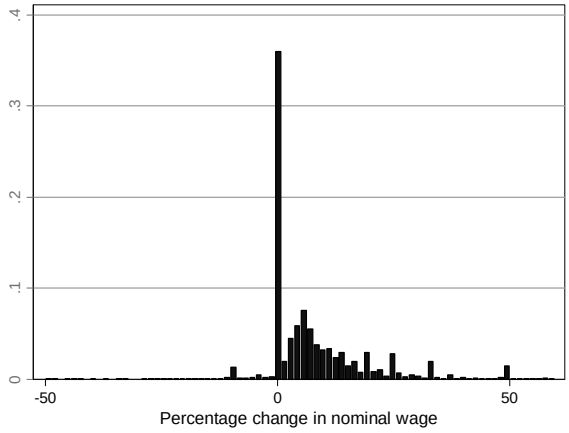
	UBA	WBD	VR
Number of observations	13	44	15
Percent of observations			
Positive	46.15	47.73	53.33
Negative	46.15	40.91	46.67
Zero	7.69	11.36	0
Mean (%)	-0.40	3.17	3.23
Median (%)	0	0	4.63

Notes: Junior entrants are defined as follows: UBA – staff entering before age 17, with less than one year of tenure; VR – staff entering before age 19, with less than two years tenure, divided by branch (traffic, locomotive, existing line, other); WDB - staff entering outside of London before age 17, with less than one year of tenure.

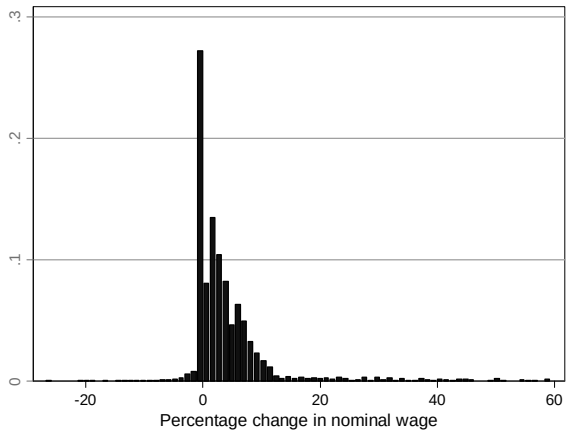
Table 7
Real Wage Changes by Individual Employee

		UBA,1888-1900	VR, 1902-1921	WDB, 1890-1936	WDB, 1921-1936
All Years	Number of Wage Changes	8601	11867	25257	14324
	Percent of observations				
	Positive	77.9	45.7	74.53	93.5
	Negative	19.0	40.2	23.98	6.4
	Zero	3.1	4.1	1.48	0.1
	Mean (%)	12.6	3.1	9.74	11.1
	Median (%)	8.0	1.4	6.25	9.3
Years with inflation > 0	Number of Wage Changes	2114	10132	15415	4497
	Percent of observations				
	Positive	43.8	45.8	73.12	79.6
	Negative	54.4	50.7	36.81	20.3
	Zero	0.05	4.8	0.07	0.2
	Mean (%)	6.2	2.4	7.26	7.8
	Median (%)	-1.7	0	3.95	5.0
Years with inflation ≤ 0	Number of Wage Changes	6487	1735	13842	9827
	Percent of observations				
	Positive	88.5	92.7	96.45	99.9
	Negative	7.5	7.3	0.15	0.1
	Zero	4.1	0	3.40	0
	Mean (%)	14.7	7.61	12.50	12.6
	Median (%)	8.5	1.81	10.34	11.0

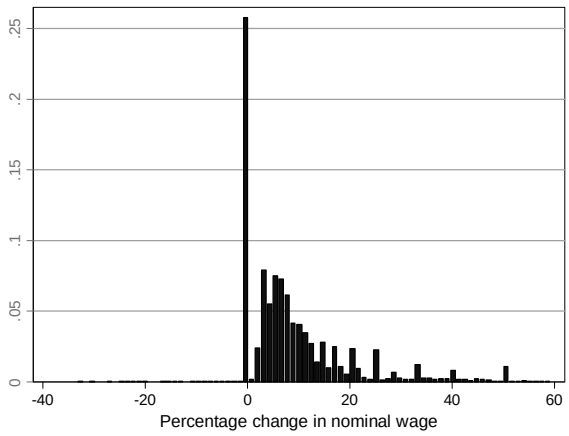
Figure 1
Nominal Wage Change Histograms



UBA



VR



WDB