The Legal Bases of Sticky Wages

Erich Remiker

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Advised by Robert Driskill

Executive Summary

Sticky wages are a well-known economic phenomenon, in which wages don't respond quickly to changes in economic conditions. This is important in derivations of macroeconomic theory from microeconomic phenomena, in setting monetary policy, and in many other applications, but the origins of them remain debated among economists. In this thesis, I will explore differential employment contract structure as a mechanism for sticky wages, then will seek empirical evidence for this behavior. I will begin in Section One by providing some background into the phenomenon of sticky wages, existing theories for how they originate, and their importance. Section Two will propose four research questions and describe why each is worthy of study. Sections Three through Six will address each of these questions, and Section Seven will provide overall conclusions. Section Eight is a bibliography.

Section One: Background

Sticky wages have been well-known as a concept since at least Keynes, as Keynes's theories of macroeconomic cycles depended in part on wages not adjusting quickly to market fluctuations. There are two main descriptions of what sticky wages actually are: sticky, or sticky-down, where sticky-down means that wages don't decrease. At their most fundamental level, stickiness of wages means that wages do not temporally mirror productivity, as they should in the long-run. Instead, people are liable to have the same wage for a long period of time, before a significant increase, and then stagnation once again.

This phenomenon has myriad implications across the field of economics. As was previously mentioned, the assumption of sticky wages is used in derivations of everything from macroeconomic cycles (where the failure of the market to reduce wages partially resulted in recessions) to growth models, where the distinction of the short-run and the long-run can be whether or not wages are sticky.[1] Beyond these more theoretical questions, sticky wages also play an important role in monetary policy—one of the reasons that central banks target 2% inflation is that with sticky-down wages, it allows firms to cut real wages during recessions without cutting nominal wages, thereby increasing efficiency.[2] This is a correction for a potentially corrosive element of sticky wages: their propensity to decrease efficiency and accelerate unemployment. Bordo, Erceg, and Evans traced this impact, and found that sticky wages are among the potential reasons the Great Depression was so severe, as they added great rigidity to the labor market.[3] Dicecio argues convincingly that sticky wages help create business

[1] Hall, R. E. (2005). Employment efficiency and sticky wages: evidence from flows in the labor market. The Review of Economics and Statistics, 87(3), 397-407. Retrieved from https://doi.org/10.1162/0034653054638346
[2] Danthine, J., & Hunt, J. (1994). Wage bargaining structure, employment and economic integration. The Economic Journal, 104(424), 528. doi:10.2307/2234629
[3] Bordo, M., Erceg, C., & Evans, C. (1997). Money, sticky wages, and the Great Depression. https://doi.org/10.3386/w6071

cycles, as they increase and introduce volatility, and prevent an equilibrium from remaining stable.[4] The study of stick wages is a worthwhile enterprise that could potentially provide insight across a range of subdisciplines of economics.

While there is substantial empirical evidence for sticky wages' existence (see Hall (2005)) there is not universal agreement for why these sticky wages exist, or how they are mechanized. It is this topic to which I will turn now, and throughout this thesis.

There are four main theories for why sticky wages exist, well laid out in Haley (1990). First is the theory proposed by Keynes himself: bargaining. Keynes postulates that workers will refuse a cut in nominal wages but will largely accept a decrease in real wage due to an increase in price level. It is crucial to note that this theory does not account for lock-in—Keynes postulates that this action takes place simultaneously with productivity changes and is a more informal process. This theory has the benefit of simplicity, but has issues being applied on a microeconomic scale: there ought to be mutually attractive bargaining positions that workers and firms can take that stickiness impairs. Thus, economists have largely turned to other explanations to attempt a fuller understanding of the causes of sticky wages.

The first of these newer explanations is the implicit contract approach, supported by Okun, among many others, which makes some complicating assumptions to argue that workers and firms implicitly agree to an exchange of labor in the long run. As an example, during the 2008 recession, there were a number of human-interest stories that showed the shock workers that had been employed at one company for 20+ years had at being laid off. This provides anecdotal support for the idea of implicit contracts—many of the workers in these articles cite their longstanding service and that they would never have expected to be laid off. The implicit

[4] DiCecio, R. (2008). Sticky wages and sectoral labor comovement. Journal of Economic Dynamics and Control, 33(3), 538-553. Retrieved from https://doi.org/10.1016/j.jedc.2008.08.003

contracts model assumes that workers are not easily substitutable, making there be mutual benefit to employers and employees to stay together. This does provide an explanation for why wages aren't well modelled by auction-style models but fails to come to a real understanding of why these connections between firms and employees must be price-rigid, as it just provides a reasoning that the connections exist in the first place.

The next approach to sticky wages is the wage efficiency model advocated by Solow, in which firms intentionally overpay for labor, because productivity is a function of wage (higher wages can cause employee morale to increase, lowers turnover rate, and may incentivize employees to work harder). This hypothesis then suggests the creation of sticky wages as those that are unemployed are unable to get firms to drop wages to the level necessary for them to be employed. This theory has merit in explaining the initial wage-setting role of firms and takes into account the competitive nature of the labor market and the symbiotic relationship that workers and firms may face. It's especially valuable in its adaptation of sociological research that shows that if workers feel unfairly compensated they will stop providing full effort, thereby lowering productivity (Akerlof and Yellen). However, one issue this model faces is that it largely fails in explaining why there are not major wage changes in response to economic downturns—just because the wage is higher doesn't mean it can't track productivity changes or profitability more efficiently.

The last major theory of why sticky wages arise is the insider-outsider theory, proposed by Lindbeck and Snowner, wherein those that are already employed at a firm control significant bargaining power, due to labor replacement costs. These workers raise the cost of labor for firms and incentivize the firm to hire as few "outsiders" as possible. This then prevents firms from being adaptive and increases wage stickiness. This model has the least major issues of the ones

presented here, but still has flaws: namely, while it well-explains why wages don't fall enough to create an equilibrium with unemployed workers, it doesn't do much to explain rigidity within the insiders, who still ought to have beneficial reasons to bargain with the firm for wages matching economic output.

These four explanations are not necessarily mutually exclusive. The first two are largely focused on descriptive mechanics, explaining what the mechanisms are for causing sticky wages. The second two are more focused on the rational reasons that agents may prefer a sticky wage structure, and that the mechanisms themselves arise. Each has potential strengths and weaknesses, and I will attempt to show throughout this thesis when evidence supports one particular theory or another.

Section Two: Research Questions

In all the theories that have been discussed to this point, there is a somewhat conspicuous lack of attention to the actual employment contracts that workers sign as a potential mechanism for the stickiness of wages. This omission is what I seek to rectify, by examining how different explicit employment contract structures may affect the stickiness of wages. To do this, I propose four research questions, which the remainder of this thesis shall be focused on.

Q1: What legal mechanisms may potentially contribute to sticky wages, and how can they be modelled?

Q2: How does the modelling of these phenomena interact with the existing literature on the causes of sticky wages?

Q3: Do we see differential firm performance based on different prevailing contract structures?

Q4: At the sectoral level, do we see different stickiness of wages based on different prevailing contract structures, and does this have traceable macroeconomic impacts?

Each of these questions will be addressed in a separate section to follow. Justification for why each question is important and worthy of study will take up the remainder of this section.

Before beginning to study the legal mechanisms behind sticky wages, first we must define our space by understanding a little bit about different labor market structures that exist, and how they could potentially show up in a model. Q1 seeks to do this, by identifying a base model to work with as well as modifications to reflect the complex contracts that can be formed in the labor market. There are nearly infinite variations on contracts that may exist, so this section will naturally not be fully comprehensive, but it is necessary in defining the scope of the investigation. This section will also examine how the inclusion of different components in the

modelling can change the equilibria that markets reach, showing theoretical impacts that exist from differential contract structure.

Q2 will seek to interact this theoretical work with the existing literature discussed in Section One, attempting to frame the contributions that this model presents in the context of other literature. It will both attempt to show the ways that the consideration of legal contracts strengthens the various models, as well as the ways that the existing literature fails to cover the complexity and reality of these legalities. This is crucial, as framing this work in the existing literature enables

Q3 will begin the empirical study of contract structure and sticky wages, at the firm level. This research question will enable the discussion and analysis of whether we can see contract structure have the effects that sticky wages will be expected to have. This is important because it allows us to test whether contract structure is a unique reason for stickiness of wages outside of the other theories, as well as verifying that sticky wages have a measurable real impact on performance, both in terms of overall performance, as well as adaptability to adversity, where we would expect firms that have less sticky contract structures to bounce back more quickly.

Q4 will abstract one level higher and will examine contract structure on the industry level. Naively, some sectors have different prevailing structures, whether due to an underlying economic reason or due to harder to measure factors such as tradition. We can expect there to be different stickiness of wages, so I shall examine the data to see if that assumption is held up. From here, the goal is to see if there is different sectoral performance, especially in terms of response to macroeconomic shock.

Each of these questions interacts with a slightly different aspect of the problem, and together they provide a fuller picture of the role of legal employment contracts in creating sticky wages, and the impacts this has on the broader economy.

Section Three

Let us begin the task of modelling by identifying a base model. I chose to analyze a variant of the Taylor overlapping contracts model. Under Taylor, the labor force is divided into four cohorts, and in each period one cohort negotiates their wage for the next four periods. Each worker has a utility function $U_h = k\sum_0^4 \beta^t * (\mu \ln(C_t) + (1-\mu)\ln(\frac{M_t}{P_t})$, where U is utility, k is an arbitrary constant between 0 and 1, β is a discount rate bounded by 0 and 1, mu is a parameter representing utility of consumption vs savings, C is Consumption in a given time period, M is savings, and P is a price level. Each worker maximizes this utility with respect to the following budget constraint: $B_t = (1+R_{t-1}) * B_{t-1} + W_t * L_t + J_t * K_t + X_t - P_t C_t - P_t I_t - M_t + M_{t-1}$. Each worker can buy bonds (B), make money from past bonds with an interest rate R, make money from their labor (L) in accordance to their wage (W), returns (J) to owned capital (K), and transfers from the government X. They spend their money on consumption, investments (I), and on savings to transfer the money into the next time period. Capital depreciates according to $K_{t+1} = (1-\delta)K_t + I_t$, where delta controls the constant rate of capital depreciation. A few quick notes on the consumption side of the model before moving on: it assumes that the utility functions are constant over time, which is often necessary to ensure consistent results. It is a money-inclusive model, with inflation being permitted to occur. Workers are also owners of capital in this model, which can represent potentially either workers investing their savings in investment funds, or in their own workplace through an equity model. Lastly, as a simplifying assumption, the value of leisure to a worker is not included in the utility function they face. This is an especially important note, as it potentially biases the analysis against contracts that give workers more leisure.

Moving on to the constraints facing producers in this model, producers as always seek to maximize profitability. Their profitability is $\pi = max \sum_{t=0}^{4} \psi_t \{P * K_t^{\theta} * \left(L_t - \frac{q_L}{2} * \frac{(L_t - L_{t-1})^2}{L_{t-1}}\right)^{1-\theta} - W_t L_t - J_t K_t$, where pi is profits, phi is a stochastic discount factor bounded at 0 and 1 that represents the volatility of profits, q_L represents the cost of labor adjustments, and all other variables are as listed above. A few remarks: these production functions are based on a Cobb-Douglas production function, with an added quadratic cost for labor adjustment. Specifically, if the quantity of labor used either increases or decreases, the efficiency of labor is decreased. The intuition for this is that in either case there will be costs associated, whether it's the cost of retraining current employees on new material, or the costs of onboarding new workers. The symmetricity of this assumption is perhaps questionable, but that is beyond the scope of this paper. Note also the summation sign: as the labor force is divided into four cohorts each with different negotiated wage that lasts for four time periods, the firm has to maximize profitability with respect to each cohort individually. If we let each cohort's wage be x_t, and W_t represent the geometric mean of all cohorts wages in a time period, we get the following equation: $\ln(x_t) = \varphi_0 \ln(W_t) + \gamma\left(L_{t+i} - \overline{L}\right) + \psi_t \sum_{i=1} \varphi_i \ln(W_{t+i}) + \gamma\left(L_{t+i} - \overline{L}\right)$. Essentially, workers are able to negotiate a wage starting with their wage from the prior period, and then adjust it based on the wage that other workers are able to demand. Specifically, γ (which is bound between 0 and 1) regulates how volatile worker demands are based on how much labor demand is changing. Phi regulates how much each past cycle regulates the current cycle, meaning older cycles are less relevant. When labor demand in the prior cycle was above the average of the last four periods, the workers can negotiate their wage up and vice versa. Similarly, when the company is more profitable (psi is closer to one), the workers' wage is more volatile, while when it is lower, the workers are more "stuck" at their prior wage.

The prior case relies on strong contracts—that is contracts in which there is no way to sever them. In reality, most firms either operate on weak contracts (where there is a way out, for some sort of penalty), or on spot contracts. In order to facilitate comparison to the various weak contract models that this paper dives into, it is constructive to first analyze a spot contracts model. In the spot contract model, the primary difference is that wages are reset every period, such that MPL=Wt, and there are no longer separately bargaining cohorts. The implications of the importance of the strong contract model are well-covered in Taylor's work, but are shortly summarized here: there results persistent serial unemployment, as there is an inability of the market to quickly adapt to shifting conditions, workers face a wage-stability tradeoff, in which they negotiate more stable but generally lower wages (i.e. wages become sticky), and the Phillips curve can become effectively vertical.[5] The strong contracts model also results in more equal wages for workers across periods, smoothing consumption and thereby increasing utility. Corporations face equal average profits, but higher volatility in said profits without the ability to adjust wages. Thus, in models incorporating corporate closures and the like, strong contracts may be less preferable. The model itself is important for its understanding in how contract bargaining can create sticky wages and aggregate economic effects. What follows below is an attempt to extend this analysis from strong contracts to the more prevalent weak contracts that we see more often in the real world.

With this basic analysis of the model out of the way, we are ready to propose three key additions to model real-world labor market conditions. We will examine the impact on the market for three changes: the addition of severance pay, the addition of incentive pay, and the addition of multitier contracts (e.g. a wage/salaried worker split, tenure/not tenure split, etc.).

[5] Taylor, J. (1998). Staggered price and wage setting in macroeconomics. https://doi.org/10.3386/w6754

Before beginning this, it is worth noting that there are two parameters in the base model that already reflect the reality of differential contract structure: gamma and q_L. A change in q_L directly models the additional transition costs that may result from different contracts, while a change in gamma can represent the flexibility of these contracts with respect to how much workers are able to demand. As such, we would expect gamma and q_L not to be exogenous, and in fact to be influenced by the addition of new parameters. With this, let us move on to severance pay, comparing it both to spot contracts and to the strong contracts Taylor model.

To model severance pay, I introduced a new variable: s, the cost of severance pay that a firm must pay to a worker that they no longer choose to retain. s is strictly bounded by 0, but does not necessarily face an upper bound (e.g. the founder of WeWork recently was given a severance package of 2.4 billion, exceeding his prior salary).[6] This has an impact on both the production and the consumption side of the model. On the production side of the model, the profitability equation becomes $\pi = max \sum_0^4 \psi_t \{P * K_t^\theta * \left(L_t - \frac{q_L}{2} * \frac{(L_t - L_{t-1})^2}{L_{t-1}}\right)^{1-\theta} - W_t L_t - J_t K_t - s * \max((L_{t-1} - L_t), 0)$. Note that this is very closely analogous to an asymmetric version of the q_L adjustment, with there only being a cost to losing workers.[7] Further note that this simple model only includes severance being paid out under one time period, while in the real labor market it is plausible for payouts to continue for a significantly longer period of time. Also notably, this assumes that any change in the size of the labor force is not due to replacement: it doesn't account for if the new cohort undercuts the demanded wage by more than s+ qL/2*$\frac{q_L}{2} * \frac{(L_t - L_{t-1})^2 \theta}{L_{t-1}}$, in which case replacement of workers will directly occur. With sufficiently high s

[6] https://slate.com/business/2019/10/adam-neumann-wework-severance-largest-ever.html
[7] Note further that in this model, the firms can fire the workers. This is not the case for the strong contracts model.

and qL this occurrence should be rare enough that it is acceptable to overlook for the sake of simplicity. The worker budget constraint becomes the function: $B_t = B_{t-1} + R_{t-1} * B_{t-1} + J_t * K_t + X_t - P_t C_t - P_t I_t - M_t + M_{t-1} + W_t * L_t + s * \max((L_{t-1} - L_t), 0)$. Workers are, on net, paid severance for less labor hours demanded. What are the labor market results of this introduction? Firms obviously have less incentive to fire existing labor compared to the spot contract approach, but by increasing the average cost of labor, there also should be a shift towards capital production. Whether this substitution effect will outweigh the effect to the workers of the income effect depends on the specific values used. Workers may also have an incentive to trade lower wages for higher severance pay. Remembering that workers' utility functions benefit from equalizing consumption across periods, it is theoretically plausible for workers to be receiving higher utility from lower wage, if they judge there to be sufficient probability of being laid off and thereby receiving severance pay. Severance isn't a direct tradeoff with wages (in the way that say, health benefits, are modelled as just another form of compensation), but it acts as a hedge against risk and thereby stabilizes the wages of laborers, at the probable cost of lower wages both implicitly (acceptance of lower wages to stabilize income) and explicitly (by increasing labor costs). Severance pay directly increases the stickiness of wages, just as hard contracts do, while likely decreasing overall compensation and resulting in efficiency gaps that would not occur without its introduction. However, it can be assumed to be at least utility neutral for workers, since if it were utility negative the value of s could just be set to zero in the negotiation process.

Compared to the hard contracts, however, nearly all of the opposite claims as above apply (indeed, if s=0.5, the severance case can be conceptualized as exactly halfway between the case of spot contracts and the case where it's impossible to fire workers). Wages will adjust more

rapidly with severance pay included, leading to less stickiness, and therefore less distortion of the labor market. However, the claims about risk-hedging should still be largely captured, with severance being able to act as a smoothing agent to increase average utility for workers. This form of weak contract still results in sticky wages, and still results in consumption smoothing (for sufficiently high s), and thereby acts as an intermediary case between spot and strong contracts. It is also worth noting that this case can be modelled as identical to unemployment insurance. If, rather than the payout coming directly from the employer, there is some sort of tax that is then distributed through a government transfer (X), then this approach is fundamentally similar to unemployment insurance. Of course, this skirts the hard question of tax incidence, and thereby potentially abstracts out of the realm of reality.

Modelling incentive pay takes a slightly different approach. The approach I took to this problem was to assume that incentives took the form of profit-sharing, a not uncommon form of pay especially designed to help workers and employees save for retirements. With this assumption, the model becomes $\pi(1-N) = max \sum_0^4 \psi_t \{P * K_t^{\theta} * \left(L_t - \frac{q_L}{2} * \frac{(L_t - L_{t-1})^2}{L_{t-1}}\right)^{1-\theta} - W_t L_t - J_t K_t$ for the employer and $B_t = B_{t-1} + R_{t-1} * B_{t-1} + W_t * L_t + J_t * K_t + N\pi + X_t - P_t C_t - P_t I_t - M_t + M_{t-1}$ for the employees, where N is the share of profits allocated to labor (and as such is bounded by zero and one, although practically it will never be one). A few quick things to note: first, laborer's pay is no longer dependent strictly on the contract wage xt negotiated in the prior time period. Rather, it now adjusts directly with response to the profitability of the company in the current time period. It is also worth noting that this model does not account for any increased productivity, which could potentially occur as a result of this introduction and provide a concrete rationale for firms to offer this payment. One interesting implication about what happens with this modification is that if N is higher and w is lower, then

it dramatically decreases wage stickiness compared to the strong contracts case: compensation for each cohort can change directly with each period, so there is definitively less wage stickiness. In a negotiation setting, direct wages will decrease as a result of the inclusion of incentives into the compensation package, but workers potentially could experience an overall increase in compensation, if they expect the company to remain profitable. It's notable as well that in this contract structure income in each period is directly dependent on psi, the stochastic multiplier of output in a period. This means that we should see greater swings in income, so further incentive for workers to save to try to equalize consumption. This contract structure should also increase the number of workers that are able to be hired, since when revenue is higher it automatically increases costs to match, so there's greater economic efficiency (recall that profit is decided for each time period after the hiring decisions are made). It is worth noting that the manifestation of these characteristics entirely depends on how significant N is. If $N\pi << wL$, the model devolves back into the spot contracts case. Risk minimizing firms should generally seek to increase the proportion of compensation that is paid in terms of these incentives. If π is higher than its long run average $\bar{\pi}$, the firm pays $wL+N(\pi-\bar{\pi})$, while when it is lower than average, it pays $wL+N(\bar{\pi}-\pi)$. This means that the net profit is more evened out in the case of incentive pay for the firm, so risk-averse firms should seek to pay a higher percentage of their compensation in incentives, when available. Similarly, workers aware of this should be able to negotiate marginally higher overall expected compensation, creating a mutually beneficial situation provided expectations of the distribution future profits are perfectly accurate.

The last potentially divergent model that I wish to examine is that of a two-tiered wage structure. In this structure, there are two "classes" of workers: they could potentially represent union and non-union workers (as in the insiders-outsiders model), or salaried and wage workers,

or tenure and non-tenure faculty. It is worth noting here that the insiders-outsiders theory has not fully been mathematized, so much of this has potential to overlap with findings from that model. In this model adaptation, we assume that there are two classes of workers: i=0 and i=1. Without loss of generality, we can assume $\gamma_1 > \gamma_0$ (the time to adjust for group one is lower than for group zero). Under the assumptions of the insiders-outsiders model, this corresponds to $q_{L0} > q_{L1}$ (that is, labor adjustment costs are higher for group zero). With this in mind, we can set out the model.

$$\ln(x_t) = \sum \varphi_i \ln(W_{t+i}) + \gamma_i\left(L_{t+i} - \overline{L}\right)$$

$$\pi = max \sum_{0}^{4} \psi_t \{P * K_t^{\theta} * \left(L_t - \sum_{i=0}^{1} \frac{q_{L,i}}{2} * \frac{\left(L_{t,i} - L_{t-1,i}\right)^2}{L_{t-1}}\right)^{1-\theta} - W_t L_t - J_t K_t$$

This structure increases complexity rather dramatically, but it is still possible to glean insights. First, it is evident from the differences in q_L that the more flexible of the two will be more at the whims of the market—it is significantly cheaper to hire and fire those of the "lower" tier. As such, we should expect to see divergent stickiness of wages, with workers in the "higher" tier receiving substantially stickier (as well as higher, for unrelated reasons) wages. Second, the efficiency of this model vis-à-vis the base model is entirely dependent on the adjustment cost q_L lining up with the assumptions of the insiders-outsiders model. Otherwise, this model inherently results in economic inefficiency, as the less flexible group is likely miscompensated depending on how overall economic conditions fluctuate. It is difficult to see why this would be considered beneficial from a strictly profit-maximizing perspective for the firm, which lends credence to the idea of a structure like this arising from a more behavioral model, like the insiders-outsiders model.

To summarize the results of this analysis, a few key insights come to mind. First and foremost, it is possible to rediscover wage stickiness even relaxing the assumptions made in the

Taylor contract model. This is important in that it connects the legal mechanisms to the economic effect more tightly. Second, incentive pay decreases wage stickiness, while increasing overall utility for both the worker and the firm, allowing a more separated equilibrium. Third, the use of tiered contracts maps on to our understanding of insider-outsider models, and while it doesn't necessarily increase utility from a strict perspective, it has separating advantages that permit one group to benefit more. Let us now turn to the question of how this impacts our understanding of the theoretical origins of sticky wages, as was discussed above.

Section Four

First and foremost, these models lend potential credence to the explicit bargaining theory, while modifying it somewhat. Specifically, these modifications of the Taylor overlapping contracts specifications mechanize the bargaining model and provide a framework for empirical analysis: if bargaining is true, we ought to be able to see specific contract structures being more prominent in some specific conditions (as will be expounded upon later). This gives a potential angle to examine the bargaining theory of sticky wages with increased rigor. The real-world existence of these legal strictures, and their theoretical impact on wage stickiness, indicates that there are existent structures that occur due to bargaining at an explicit level. While this theory has been discounted to some degree, an analysis of more complex legal structures may promote increased validity for the bargaining model, by providing reasons that firms and employees may mutually wish to seek legal reassurances of their wage payouts. This can especially be seen in the analysis of risk. Wage stickiness decreases risk for employees, while overall compensation may fall in cases of high labor supply relative to labor demanded. This creates situations where through prevailing contract structure and normal bargaining procedure, we may see mutually beneficial bargaining positions occurring. This strengthens the bargaining theory of stick wages, especially if borne out by empirical evidence.

Simultaneously, this work gently pushes back against the implicit contracts approach. While the implicit contracts approach absolutely has merit and can act in parallel to an explicit contracts approach (there may be an implicit expectation of a contract extension, for example), anecdotally, many if not most jobs especially in the professional fields now have employment contracts that specifically determine many of these aspects. This perhaps leaves a less prominent place to implicit contracts as a primary determiner of sticky wages. There is one intriguing legal

situation where the two cases actually overlap directly: when considering employment contracts in states with implied contract exceptions to at-will employment. At-will employment means that an employee, barring the existence of a contract, may be fired at any time for any reason. This is the condition in every state except for Montana. However, in 36 states there are exceptions for "implied contracts". While these contracts typically require greater commitment than the mechanisms proposed in the implicit contract literature (e.g. an employee handbook specifically stating that the company abdicates the right to fire employees at will), they remain an interesting area where the line between implicit and explicit contracts is not necessarily clear.

This work largely ignores efficiency wage theory, which is to its own detriment. For purposes of this work, it is perhaps best to imagine w as a wage negotiated with the behavioral work from the efficiency wage model already included. As with the other theories discussed, no work here can not function in conjunction with the efficiency wage model, it just operates at a separate level of theorization. No single theory is likely sufficient to explain sticky wages, and there is little reason to expect the efficiency wage model to conflict with the ways explicit contracts are formed.

Lastly, we come to the insiders-outsiders model. Here, the two-tiered contract structure discussed near the end of the previous section has a substantial possible advantage. In most theorizations of the insiders-outsiders approach, contract bargaining is abstracted out of to instead focus on labor markets more directly.[8] One issue with applying this work to the insiders-outsiders model is that the insiders in that model are required to have permanent length contracts (at least in the formulation used by Guillaud and Marx). Modifications of this model, where only

[8] See Lindbeck and Snower, Insiders versus Outsiders, JEP, and Guillaud and Marx, Preferences for Employment Protection and the Insider–Outsider Divide: Evidence from France, West European Politics; for an exception that takes a different approach to the one in this work see Gottfries's Insiders, Outsiders, and Nominal Wage Contracts,

low wage workers renegotiate wages, may resolve this, or emergent behavior may emerge from requiring different renegotiation periods. This is likely the most fruitful approach to mechanizing the insiders-outsiders model in the context of an overlapping contracts approach. For example, if one set of workers only renegotiates every four periods while one renegotiates every period, it should be possible to see the behavior that the insiders-outsiders model predicts. It does make the model more mathematically non-trivial if the periodicity of the cohorts don't match either each other or the periodicity of the economic readjustment, which would require a deeper level of analysis than has been done to this point.

Section Five

With the theory more or less dispatched, it is now time to turn to the daunting question of whether or not there is empirical support for any of this. Let us begin at the firm level. Here, we seek two things: evidence that stickiness of wages exists in terms of contracts (preferably in the forms discussed in Section Three), and its potential impacts on firm performance.

The data source chosen for this question is one with 32 comparably sized firms in a competitive market, with variable wage structures that are publicly available. I'm talking of course, about the NFL. The NFL has a number of desirable traits that make analyzing stickiness of salaries doable. First, it has a salary cap (in contrast to a luxury tax system employed by the NBA or MLB). This means that firms/teams have a strict budget constraint, somewhat obviating concerns that budgets are irrelevant to the billionaires that own the teams.[9] Second, there is a relatively clear distinction between different types of pay. Specifically, players may be paid in salary, signing bonuses, or incentive pay. Salaries and incentives are not guaranteed (i.e. if a player is cut from the roster they will not receive the salary) but bonuses are. This makes for a great contrast and allows a straightforward analysis of the impact of stickiness. Thirdly, there are clear outcomes: the more wins a team receives the better, as historically teams appear win-maximizing.[10] Notably, teams have a minimum level at around 90% of the salary cap that they cannot go below, which minimizes ability to game the system and "profit maximize". Fourthly, and most importantly, the contract data is freely and publicly available, and is collected relatively nicely via Spotrac. This means that the analysis can proceed with relatively little data transformation and cleaning required. Fifthly, many of the assumptions made by explanations of

[9] Except for the Green Bay Packers, who are nominally publicly owned.
[10] This is not necessarily the case in MLB, where the Tampa Bay Rays regularly spend substantially less than other teams over the long-run, and appear to try to maximize revenue instead of wins.

sticky wages don't apply to professional sports. For example, implicit contract theory shouldn't apply, as NFL careers are very short so the time horizon for that models' explanation of "expectation to continue employment" should largely not apply. Similarly, the insiders-outsiders approach is of limited efficacy: each player has significant bargaining power embodied in the ability to holdout, and there is no clear example of what insiders and outsiders would look like in this situation.[11] The efficiency wage model probably applies most directly to the NFL, although it is perhaps difficult to countenance that teams that employ professional coaches to improve the morale of their millionaire employees are highly worried about the effect of salary on productivity. This means that we are able to directly probe how a weak contract structure contributes to stickiness of wages, and also determine how this stickiness impacts performance. Lastly, there is a clear analog between severance pay and the NFL: dead cap. A quick note on proration to understand this. In the NFL, a player who is given a signing bonus pays that bonus in year 1, but it is prorated over the lifetime of the contract (i.e. it effects the budget constraint in every future year, split equally on the lifetime of the contract). When a team cuts a player who still has years left, they must have the remainder of the bonus effect their cap, so they are effectively paying money to a player who is no longer with them. While no actual money changes hands, this is a good analog to severance in that it impacts the budget constraint similarly—the team/firm must pay less than the full value of the contract, but is getting no labor in return.

The specific data set I'm using comes from spotrac. I'm using wins from the last five years as dependent variables, such that there are 160 observations. I aggregated the player-level spotrac data on contracts (total cap, dead cap, incentives, and guaranteed) to the team level, then

[11] One exception may be players on their rookie contracts. This may be worth excluding in future analysis.

added a wins column as a regressor (note that ties are rare but existent in the NFL). I also normalized the data, to make analysis easier in terms of "dollars spent above an average team".

With that, let us move into the analysis. I made four hypotheses:

- H1:We do not expect to see that there is any immediate correlation between the amount of money given in guarantees and the success of the team
    - A correlation here supports the bargaining hypothesis: there are stars able to demand stickier wages and that stars help teams win
- H2: We expect to see that teams with a higher portion of their cap paid out in bonuses ("guaranteed" money) should struggle more to bounce back after a lost season
- H3: Proportion of money allotted to severance (i.e. dead cap) is negatively correlated to wins
    - This suggests that sticky wages directly impact performance of firms
- H4: Proportion of money allotted to incentives is positively correlated to wins
    - Decreased stickiness, aligns incentives

Let us test each hypothesis in turn.

- R1: $Wins_t = B_0 + B_1 * Guar + B_2 * Total\ Spend$
    - If B1 is not 0 we reject H1.
- R2: $Wins_t = B_0 + B_1 * Guar + B_2 * Total\ Spend + \sum_{l=1}^{2}(B_{3l} * Guar_{t-l} + B_{3l+1} * Total\ Spend_{t-l} + B_{3l+2} * Wins_{t-l})$
- R3: $Wins_t = B_0 + B_1 * Guar + B_2 * Total\ Spend + B_3 * Dead\ Cap + B_4 * Incentives$

H1 will be tested by R1, H2 by R2, and H3 and H4 by R3.

R1:

B0	B1 (Guaranteed $)	B2 (Total Spend $)
7.94	-6.5e-9 *	1.0 e-10
(1.47)	(4.3e-9)	(7.1e-11)
X	0.065	0.44

As can be seen from these regressions results, we do not see a statistically significant relationship between spending and wins, which is perhaps surprising. This is a warning sign as we proceed deeper in this analysis: sports are difficult to predict, and it can be far from certain how results will turn out. It's also a good sign for the parity of the NFL, and perhaps indicative of the minimum salary floor as well. A further note is that this data doesn't include salaries of coaches or assistants or staff, all of which have unlimited spending caps and likely contribute to team performance. There is a weak negative correlation between amount of money given in guarantees, and performance of the team. This is not an expected result—it is possible that here guaranteed money is acting as an instrument for team pay inequity, which could explain the weak negative correlation. This is evidence against H1, in that there was not expected to be an immediate direct correlation between guaranteed money (i.e. how sticky the team's wages are) and performance.

R2:

B0	B1 (Guar)	B2 (Spend)	B3 (Guar-1)	B4 (Spend-1)	B5 (Wins-1)	B6(Spend-2)	B7 (Guar -2)	B8 (wins-2)
5.01	-2.2e-9	1.2 e-10 **	-8.3 e-9*	4.2e-10	0.23***	-9.2e-11	-5.7e-11	0.27
(2.26)	(1.7e-9)	(5.4e-11)	(6.0e-9)	(5.3e-11)	(9.7e-2)	(1.4e-10)	(8.3e-10)	(0.23)
X	.11	.013	.084	.21	.009	.33	.47	.12

There are a few notable results here. First, the sign on spending flips, giving a positive correlation in this regression. This is a very worrying sign and is quite likely a result of a high degree of multicollinearity—the prior year data is quite correlated with the current year data. We do see a weak negative correlation between lagged 1 guaranteed spending and wins, which weakly supports H2, in that having a higher proportion of your money in guaranteed contracts possibly leads to "ruts" of losing. I am wary of drawing too strong of conclusions on this data, however, as the estimates are rather unstable. That said, this is a promising indicator that there is a tangible impact to stickiness of wages on future performance, as an impactor of team volatility. There's also a statically significant degree of autocorrelation (i.e. wins in the prior year predict wins in the current year). While at first blush this may not seem particularly interesting, the NFL has long prided itself on a high degree of parity, with the goal being for each season to be completely new. It is wholly possible a few teams (the Patriots and the Browns being top offenders, in opposite directions) are contributing more than their fair share to this. Removing the Patriots from the data set decreased the effect size, but significance was maintained.

R3:

B0	B1 (Guaranteed $)	B2 (Total Spend $)	B3 (Incentives $)	B4 (Dead Cap $)
7.94	-7.2e-9*	1.1e-10	5.0e-10	-2.6e-9***
(1.47)	(4.9e-9)	(1.0e-10)	(1.3e-9)	(1.1e-9)
X	.07	.13	.35	.009

The notable results here are twofold: first, the role of incentives seems effectively negligible, with no statistical significance, pushing back on H4. This is entirely reasonable diving into the data further, as most NFL teams pay out very little in incentives (on the order of a few hundred thousand dollars, compared to the ~200 million dollar salary cap).[12] However, the portion of the cap paid out in dead cap is highly statistically significant ($p<0.01$). This is strong evidence for H3, that teams that are paying out more in "severance" are less successful. Note that there is high potential for reverse causality here—as teams engage in rebuilds, they are likely to jettison expensive contracts, and also lose more. This is not the same as evidence that wage stickiness through contract structure is directly detrimental to firm performance, but it is a suggestive sign worthy of future consideration.

The data set has a number of drawbacks. Sports are inherently messy, there is a high degree of autocorrelation, and it is not at all clear that a group of multimillionaires with short contracts is in any way indicative of a broader economic response. With all of these drawbacks, why choose this data set? I have no real answer to this, other than to note that other potential data sources are so much less accessible that the tradeoffs in data collection likely overwhelm the benefit. My original intent was to analyze more firm level data, but most firms do not choose to

[12] Agents seem to typically refuse these. The biggest notable counterexample is the contract of Ricky Williams, who used an inexperienced agent and had a very large portion of his salary in convoluted incentives. Few players do this

release contracts to the public, and in the rare case they do, there is no standard format, and any scraping effort would be substantial (software would likely be ineffective given the nonstandard formatting, requiring a costly human intelligence-based solution to get an appropriate amount of data). As such, limiting the search space and finding a usable dataset was nontrivial. A few data sources were suggested, considered, and ultimately rejected. The first potential solution was to take advantage of sunshine laws that may require public disclosure of contracts from government contractors. The immediate issue to this is that the records are typically not stored online, and requesting them would require a higher level of granularity (e.g. requesting data on named individual employees) than I would be able to provide. Most if not all of the contracts would be stored in pdfs, rendering data analysis ineffective. As such, I moved to analyze option two: using a public service such as glassdoor. The idea behind this approach was to write a web-scraper to use self-reported data to build a database. The immediate problem with this is inherent to self-reported data: there is very likely significant dishonesty and reporting bias. Employers may incentivize employees to write reviews, or remove negative reviews, making any sample highly nonrepresentative, or employees with especially high or low pay may be more likely to report their wages/salaries. Beyond this, a closer examination found that the majority of the available data was only at the level of stating salary and wage, rather than at the level of data that would permit an analysis of stickiness. These problems combined were insurmountable, so the idea of using a data source of self-reported data was ultimately abandoned.

Section Six

Let us now turn from the question of whether differential stickiness impacts firm performance to the question of whether there is different sectoral performance depending on prevailing contract structure. Naively, we would expect this to be true—some sectors have prevailing contract structures that, more or less out of tradition, ought to impact the stickiness of wages. Whether we look at the legal field, where equity arrangements are abundant, to the restaurant business, where tipping means that stickiness of wages should be effectively negligible, there ought to be different contract structures, and therefore, if the operating thesis is true, different stickiness of wages across sectors. Luckily, there is good existing research on how wage stickiness varies across sectors. Unluckily, it shows "little heterogeneity in the frequency of wage adjustment across industries and occupations."[13] Specifically, by analyzing 1996-1999 Survey of Income and Program Participation (SIPP) data, they discovered that for both salaried and wage workers, those in the service sector were significantly more likely to have their pay adjusted, and for wage workers, those in the trade or transport and communication sectors were more likely to have their pay change. This is suggestive at some level, as we may expect the service sector to have prevailing contracts with less stickiness, but is less than ideal for the purposes of a more detailed analysis.

I attempted to undergo a slightly more detailed analysis by using the same dataset, but going one level deeper into the NAICS codes, to get a more granular examination. The results were, at a preliminary level, extremely discouraging. The percentage of the codes that had statistically significant ($p<0.05$) differences in frequency of adjustment was approximately 5%. In other words, it appeared that there was little distinguishing sector level wage stickiness

[13] Barattieri, A., Basu, S., & Gottschalk, P. (2010). Some evidence on the importance of sticky wages. American Economic Journal: Macroeconomics, 6(1), 70-101. doi:10.3386/w16130

beyond random chance. At this point, given the computational level required to analyze thousands of job codes, the project was abandoned.

The preliminary negative result is interesting, in that it provides evidence that sectoral level contracts aren't homogenous. It is possible that a primary agent for differential stickiness is heterogeneity within sectors (e.g. construction foremen vs. construction workers), which would support the insiders- outsiders hypothesis. It is also possible that heterogeneity in stickiness just isn't really a thing, against our intuitive expectations.

Section Seven

In this paper, I have provided theoretical background on sticky wages, a novel hypothesis for how they may originate, some mathematical modelling to support this premise, and two avenues of empirical analysis. Key conclusions of the work include that it is possible to capture Taylor-like wage stickiness with weaker assumptions, an exploration into how the Taylor contracts model can be evolved to reflect a few different models of compensation, and an examination of NFL contracts the gives weak evidence in favor of soft contracts as a possible driver of stickiness and differential performance. While as of yet, there is not a conclusive reason to expect that legal mechanisms are a primary driver of sticky wages, there is suggestive evidence of their relevance. Formal weak contracts ought not be discounted when considering how wage rigidity results, given their prominence in the real economic world. No theory is likely able to explain sticky wages by itself, but there is valuable insight that may be gleaned by exploring this intersection of legalities and economic realities. There are substantial areas for future research, mostly noted throughout this paper. An effort to obtain more actual contracts directly may be more fruitful in seeing the impacts that legal structures may or may not have on sticky wages, and therefore the economy writ large.

Section Eight

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