The Trade-Offs from Pattern Bargaining
with Uncertain Production Costs[†]

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Abstract: Pattern bargaining is a negotiating strategy that is often employed by industry-wide unions in oligopolistic industries to set wages. The conventional wisdom is that pattern bargaining "takes labor out of competition" and therefore softens bargaining between the union and firms, resulting in higher industry wide wages.   However, this does not explain why firms agree to pattern bargaining. We introduce a model in which the agents face uncertainty about the relative product-market positions of the firms and compare the trade-offs involved in adopting different bargaining mechanisms. We show that with sufficient heterogeneity in non-labor costs, there are situations in which both the union and the firms prefer pattern bargaining. We also show that in such situations, the adoption of pattern bargaining harms consumers. This provides an explanation as to how pattern bargaining can arise in equilibrium and why there is often strong political opposition to it.

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Pattern bargaining is a widely-used, sometimes controversial negotiating strategy that is often employed by industry-wide unions to set wages. If implemented perfectly, the union picks one firm to bargain with first (the target) and negotiates a wage. It then uses this outcome as a precedent, and makes take-or-leave-it demands to the remaining firms for similar concessions.[1] Assuming that the firms agree, and they usually do, this practice results in a uniform wage rate across firms.[2] Conventional wisdom is that this practice, often attributed in the United States to the United Auto Workers and the Teamsters, provides the union with countervailing power in its relationship with the powerful firms that employ their members. It is argued that by "taking labor out of competition" pattern bargaining helps the union secure higher wages than they would obtain otherwise. Controversy over its impact on wages recently led the Howard Government in Australia to outlaw this practice under the WorkChoices legislation (which became effective on March 27, 2006). It is the contention of union leaders that the government's objective in doing so was to "irrevocably shift bargaining power in industrial relations to employers."[3]

Explanations of why pattern bargaining works and how it comes to be adopted are rare.[4] This is surprising given that this strategy clearly plays an important role in wage determination in most OECD countries, often in important industries. The "taking labor out of competition" explanation is the one most commonly given, although, as far as we know, it has never been formalized. The basic idea is simple. Ordinarily, unionized oligopolistic firms have an incentive to bargain tough since any wage

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[1] What we have in mind is an industry in which several unionized oligopolistic firms negotiate wages with the same industry-wide union and then compete with each other in the product market. Thus, the wages that are being negotiated are paid to workers with similar skills in similar occupations. The U.S. automobile industry in which the United Auto Workers negotiates wages with Ford, Chrysler and General Motors or the U.S. airlines industry in which the Air Lines Pilot Association (ALPA) negotiates terms with the major airlines both fit into this framework nicely. Pattern bargaining is also used in other settings by employers to tie-down the wages of workers with different skill sets and occupations. For example, in the U.S. Airline industry pattern bargaining links the wages of pilots, maintenance workers, and workers in other crafts. Pattern bargaining is also used widely in state and local government negotiations with public sector employees with different skill sets (e.g., firefighters and police). In this paper, we restrict attention to pattern bargaining of the former type.

[2] Related to pattern bargaining is the "me too" agreement in which some firms agree to accept the terms negotiated by other firms. For example, workers employed by Las Vegas casinos have their wages set through negotiations between their union and a multi-employer bargaining group. Casinos that are not members of the multi-employer bargaining group often sign "me too" agreements that bind them to accept those terms without additional negotiations.

[3] See the discussion of pattern bargaining and the recent changes in Australian Labor Law on the Construction Forestry Mining Energy Union web site: www.cfmeu.asn.au/construction/research/secondwave/pattern.html.

[4] See Budd (1995) for a rationale based on political considerations within the union.

concessions that they can pry from the union will provide them with a competitive edge over their product market rivals. Pattern bargaining assures such firms that if they give in to the union's wage demands, they will not have to worry that their rivals will gain an advantage by being tougher during negotiations – after all, all firms wind up paying the same wage rate. Thus, pattern bargaining is viewed as one way to soften negotiations with oligopolistic firms. The problem with this rationale is that is does not explain why the firms are willing to accept such an arrangement.

In recent work, Marshall and Merlo (2004) provide a formal resolution to the first piece of this puzzle by showing in a model with heterogeneous unionized firms that an industry-wide union prefers pattern bargaining. In their model, two firms produce substitute products and negotiate wages with the union. The firms face constant costs, but differ in labor productivity. Four different bargaining mechanisms are considered, with the Nash Bargaining Solution applied in each case. The union can bargain simultaneously over wages with both firms; they can bargain sequentially; they can use pattern bargaining that results in both firms paying the same wage; or they can use "pattern bargaining in labor costs" which results in wage rates that equalize marginal costs across the firms. In the latter three cases, the order of bargaining is important, so both orderings are considered. Marshall and Merlo derive two major results. First, they find that when firm-heterogeneity is weak, the union prefers pattern bargaining in wages; whereas when firm-heterogeneity is strong, the union prefers pattern bargaining in labor costs – thus, the union always prefers some type of pattern bargaining. Second, the union always chooses to use the efficient firm as the target. The first result is consistent with the perceived wisdom that pattern bargaining benefits union members. Marshall and Merlo argue that the second result is consistent with a stylized fact that unions almost never select the relatively unproductive firm as the target.

Though Marshall and Merlo show formally that the union prefers pattern bargaining, in their setting the firms always prefer an alternative bargaining mechanism. This is particularly true of the non-target firm. This firm should surely view the union's take-it-or-leave it wage demand as non-credible. If the firm rejects the union's wage demand, it will always be in the union's interest to reopen negotiations, effectively resulting in the same outcome that would be generated by sequential bargaining. Thus, it is

hard to understand why the firms would ever agree to pattern bargaining.[5]

In this paper, we examine the preferences over bargaining structures for all economic agents (unions, firms and consumers) to gain a better understanding of the costs and benefits of pattern bargaining. In order to do so, we develop a model that captures many of the essential features of the markets in which pattern bargaining has been so important (the US auto market serves as our primary motivator). In particular, we assume that the market is characterized by oligopolistic firms that produce substitute goods and that the firms' production costs are subject to random shocks so that their relative competitive positions may change over time. Our goal is to explain why the bargaining mechanism adopted in such industries tends to be stable over time and why pattern bargaining is often the mechanism of choice. To accomplish this, we examine the equilibrium outcome under different bargaining mechanisms and compare expected profits, union welfare and consumer surplus. For the firms, we are able to provide and explanation as to why, in certain circumstances, it might be in their interest to accept pattern bargaining. For the union, we provide an intuitive interpretation of their preferences that highlights the trade-offs they face when analyzing different bargaining mechanisms. We then combine these two sets of results to explain why there are certain situations in which the union and the firms *simultaneously* prefer pattern bargaining over other mechanisms. In such a situation, it is then natural to ask whether the adoption of pattern bargaining benefits consumers as well. This last issue, which has (to the best of our knowledge) received no attention in the literature, is important in light of the recent Australian legislation outlawing pattern bargaining.

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[5] Marshall and Merlo recognize this problem and address it in the penultimate section of their paper. Building on an insight originally due to Williamson (1968), they extend their analysis to allow for a potential entrant that must use union labor if it produces. They then show that there are entry costs such that entry would occur under sequential bargaining but not under pattern bargaining. The reason for this is that the entrant would be unable to afford the higher wages generated under pattern bargaining. Consequently, Marshall and Merlo argue that both the union and the firms would prefer pattern bargaining because it serves as an effective barrier to entry. However, given that pattern bargaining has been dominant in many industries in which domestic entry has never really been a concern (e.g., autos and steel in the U.S.); the issue of how this mechanism comes to be adopted and supported over time remains largely an open question.

To give context to our results and to highlight the intuition behind them, we use a model that is quite similar to Marshall and Merlo (MM) in that there are two unionized firms engaged in the following 3-stage game. In the first stage, the relative competitive positions of the firms (i.e., production costs) are determined by a random draw and revealed to all parties. In the second stage, wages are determined by applying the appropriate bargaining mechanism where the "bargaining mechanism" describes both the manner of bargaining (i.e., sequential versus pattern) as well as the order of negotiations (i.e., the identity of the target firm).[6] The third stage consists of Cournot competition between the firms. We also follow MM in assuming that the firms face a linear demand curve, costs are constant, the union's goal is to maximize the wage bill, and wages are determined by the Nash Bargaining Solution.

The novelty of our approach is in the manner in which firm heterogeneity, the key feature of the MM model, is handled. In MM, firm heterogeneity is completely driven by differences in labor productivity (labor is the only input). However, it is now widely accepted that even in narrowly defined industries firms differ in a variety of dimensions including, by not limited to, the technology they use, the skill mix of the workers they employ and the wages that they pay (Doms, Dunne and Troske 1997).[7] Thus, in our model we generalize the firms' costs structures by allowing for both labor and non-labor costs that may differ across firms and show that the source of firm heterogeneity plays a key role in determining the viability of pattern bargaining.[8]

The second distinct feature of our approach is the way in which the uncertainty over the firms' production costs influences the agents' preferences over bargaining mechanisms. In our model, we analyze the agents' preferences *before* production costs are determined (that is, prior to stage one). This

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[6] For reasons that we provide below (see footnote 13) we restrict attention to the two most commonly observed bargaining structures: pattern and sequential. Thus, we do not consider simultaneous bargaining or pattern bargaining in costs.

[7] In many applied areas, firm heterogeneity is now viewed as a stylized fact that must be accounted for in models. A common way to introducing this heterogeneity is to assume that costs are subject to random shocks that alter the firms' competitive positions. For example, this assumption is a crucial component of the Mortensen and Pissarides (1994) model of search generated unemployment in macroeconomics, the Hopenhayn (1992) model of industry dynamics in industrial organization and the Melitz (2003) model of monopolistic competition in international economics.

[8] The fact that different assumptions about the source of firm heterogeneity yield different conclusions has been emphasized in Creane (2007).

is important because it means that the firms are uncertain of their competitive position when they rank the bargaining mechanisms. In such a setting, the firms will want to maximize their *expected* profits and thus will pay particular attention to the *distribution* of profits generated by the different bargaining mechanisms. The implication is that the firms will prefer a mechanism that rewards them when they are relatively efficient without penalizing them too much when they are at a competitive disadvantage.

Although our model is static, we believe that our framework allows us to capture two essential features of a dynamic market in which the firms' competitive positions shift over time. The first is that firms realize that although they may have a strategic advantage over their rivals at some point in time, this may change quickly and in unpredictable ways. Evidence that this has been the case for the US auto industry is provided in Figure 1, which is based on data from Lieberman and Dhawan (2005).[9] This figure shows the efficiency of the Big 3 US automakers over 3 decades from the 1960s to the late 1990s. Note that during this time frame the identity of the most efficient firm changes 12 times while the identity of the least efficient firm changes 10 times!

The second feature that we are trying to capture is that while bargaining structures tend to be fairly stable[10], determining the bargaining mechanism is likely to be difficult and costly since the agents are likely to have very different preferences (e.g., the firms versus the union; the efficient firm versus the inefficient firm). Thus, the agents will not want to have to re-visit this issue in each period. Instead, since the firms and the union realize that they are in a long term relationship in which the relative competitive positions of the firms change over time, they are likely to take a long-run view and try and select *up front* a bargaining mechanism that works well for all of them over time. For example, a firm may be willing to put up with a bargaining mechanism which is not ideal for them when they are the efficient firm if they know that this same mechanism will work far better for them when they are at a competitive disadvantage. In particular, the non-target firm might accept the union's take-it-or-leave-it offer if its

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[9] We are grateful to Marvin Lieberman for providing us with Figure 1.
[10] Pattern bargaining dominated the US auto industry until the late 1980s and was a stable feature of bargaining in other industries such as steel, flat glass manufacturing, rubber, and meat-packing for long periods of time. See Budd (1992, 1995) and the references listed in those papers for details.

future gain outweighs any current benefit from renegotiation. This second feature is captured by assuming that the agents rank the bargaining mechanisms prior to the realization of their production costs.

We find that in our setting there are important instances in which both the union and the firms prefer pattern bargaining over sequential bargaining, but that they have different preferences with respect to the order of the negotiations. As a result, the extent to which the union can influence the identity of the target firm plays a crucial role in determining preferences over bargaining mechanisms. We also find that the source of firm-heterogeneity plays an important role in determining the conditions under which the unions and the firms both prefer pattern bargaining. Finally, we consider the impact of bargaining structure on consumers and find that pattern bargaining can reduce consumer surplus.

The remainder of the paper divides into five sections. In Section 2, in order to gain some insight into the forces driving our results, we consider, as a baseline model, an extreme version of the Marshall-Merlo model in which the union has complete wage setting power. That is, rather than allow for negotiations, we start out by assuming that the union selects the wage paid by each firm and then the firms choose employment. In such a setting, pattern bargaining is equivalent to the union demanding the same wage from each firm; whereas we interpret a decision by the union to demand different wages as a preference for sequential bargaining. In this setting, contrary to both conventional wisdom and Marshall and Merlo (2004), the union prefers firm-specific wages rather than a uniform wage – after all, when the union has the ability to choose the price at which it supplies labor to the firms and the firms have the power to choose the number of workers to employ, the union is in exactly the same position as a monopolist in a product market that must choose whether to charge the same price to all consumers. As we know from the literature on price discrimination, the supplier always prefers to price discriminate when possible. As for the firms that demand labor, their total profits can be higher or lower with a uniform wage: they prefer the uniform wage when they are the more efficient firm but wage discrimination when they are the less efficient firm. Thus, it is clear that there are instances in which the firms will prefer a uniform wage structure.

The problem with the model analyzed in Section 2 is that, since it does not allow for wage

negotiations, it does not capture the agents' strategic considerations that are inherent in the "taking labor out of competition" argument. We therefore turn to the general model (outlined above), which uses the Nash Bargaining Solution to determine wage rates, for the remainder of the paper. In Section 3 we analyze preferences over bargaining structures and isolate two attributes of the bargaining mechanisms that influence the agents' preferences. We argue that both the ability to tailor wages to the firms inherent in sequential bargaining and the ability to "take labor out of competition" under pattern bargaining benefit the union at the expense of the firms. When firm-heterogeneity is weak, the impact of the wage discrimination aspect is small and thus the union prefers to take labor out of competition through pattern bargaining while the firms prefer sequential bargaining. But, when firm-heterogeneity is sufficiently strong, the price discrimination aspect is strong enough to reverse the agents' preferences. These trade-offs are, of course, key in determining the conditions under which we might expect the agents to adopt pattern bargaining. Another important result derived in Section 3 is the union and the firms will always have different preferences with respect to the target firm. Thus, the manner in which the target is selected also plays a key role in determining the agents' willingness to adopt pattern bargaining.

Our main results are provided in Section 4. We begin by assuming that the union has complete control over the target and show that when the firms differ only in labor productivity, the trade-offs are such that whenever the union prefers pattern bargaining, the firms prefer sequential bargaining (Proposition 1). Thus, in the MM set-up there are no parameter values such that the union and the firms simultaneously prefer pattern bargaining. However, the trade-offs are different when the firms differ in non-labor costs. In fact, we show that when the firms differ in non-labor costs, pattern bargaining is the preferred mechanism for *both* the firms *and* the unions provided that firm heterogeneity is sufficiently strong (Proposition 2). We then generalize the model by allowing the firms to have some degree of control in the selection of the target and show that these results generalize (Proposition 3 and Figure 3). We close Section 4 by considering an issue that has received surprisingly little attention in the literature – the impact of bargaining mechanism on consumer welfare – and show that when the firms differ in non-labor costs, consumer surplus is maximized by sequential bargaining (Proposition 4). Since the

consumers could be interpreted as downstream firms that use the upstream firms' output as an input, this provides us with an explanation for why pattern bargaining might be preferred by all the agents negotiating wages while consumers and downstream firms lobby the government to ban its use.

In Section 5 we discuss an extension of the basic model in which the agents negotiate over the bargaining mechanism itself. If side payments are possible, we show that this expands the conditions under which pattern bargaining is adopted; but, counter to conventional wisdom, this occurs when pattern bargaining is the preferred mechanism for the firms, not the union. We offer some concluding remarks in Section 6.

2. Wage Setting by the Union

In this section we introduce the basic model and, to provide a benchmark for later comparisons, examine the outcome when the union is allowed to set the wages. To facilitate comparisons with Marshall and Merlo (2004), we adopt many of their assumptions concerning functional forms and use much of their notation.

There are two firms (a and b) that produce a homogeneous good and face the following linear demand curve: $P = 1 - x_a - x_b$, where x_i denotes the output of firm i.[11] We assume that the workers at each firm are represented by the same industry-wide union. As for production, labor is the only input (we relax this assumption in next section) but labor productivity at each firm is initially unknown. It is common knowledge that one firm (a) will be able to produce one unit of output with each worker hired; whereas the other firm (b) will get only $t \leq 1$ units of output from each worker. Thus, if we use ℓ_j to denote employment for firm j, then we have $x_a = \ell_a$ and $x_b = t\ell_b$. Note that firm a is the efficient firm whereas firm b is relatively inefficient. The identity of the more efficient firm is determined by nature in the first stage, with each outcome equally likely (this assumption is intended to capture the flavor of a dynamic model in which the competitive ranking of the firms is uncertain and changes over time). To

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[11] We normalize the demand intercept in Marshall and Merlo (2004) to 1, and assume that the goods are perfect substitutes. The degree of substitutability plays no role in the results here or in Marshall and Merlo (2004).

ensure that both firms produce in equilibrium, we assume that t is sufficiently close to one (to be made precise below).

In this section we assume that in the second stage the union sets the wages to be paid by each firm. Following MM, we assume that the union's goal is to maximize its expected wage bill. After the wages are set, the firms compete in the product market in quantities. Thus, the two firms are engaged in a game in which nature determines the firms' productivities; these values are revealed to all players; wages are set by the union; and then the firms choose output to maximize profits.[12]

It is important to note that wages are chosen *after* the productivity measures have been determined and revealed to all parties. Thus, wage setting takes place under complete information. In addition, note that since the firms compete in output after the wages have been set, the firms effectively determine employment (as is the case in almost all labor negotiations).

Straightforward calculations yield the Cournot output, employment, profit levels and wage bill as:

(1) $\quad x_a(w_a, w_b) = \ell_a(w_a, w_b) = (1/3t)[t(1 - 2w_a) + w_b]$

(2) $\quad x_b(w_b, w_a) = t\ell_b(w_b, w_a) = (1/3t)[t(1 + w_a) - 2w_b]$

(3) $\quad \pi_j(w_j, w_i) = x_j(w_j, w_i)^2 \qquad\qquad$ for $j = a, b;\ i \neq j$

(4) $\quad \theta(w_a, w_b) \equiv w_a\ell_a(w_a, w_b) + w_b\ell_b(w_b, w_a)$.

With π_j denoting the profits earned by firm j and θ denoting the wage bill. Following MM, we restrict attention to the case in which $t \geq .5$.

As noted above, each firm is equally likely to be the efficient firm or the inefficient firm. Thus, ex ante, each firm's expected profit in any given period is $.5(\pi_a + \pi_b)$. It follows that the firms' ex ante interests are tied to *total per period profits*. As for the union, since there is always one efficient firm and one inefficient firm, their goal will be to maximize the (certain) wage bill as defined in (4).

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[12] Based on the logic of Kreps and Scheinkman (1983), we can think of quantity competition as a reduced form way of capturing the notion that prices are easier to adjust than quantities in this market. Thus, since production takes place far in advance and then prices are negotiated at the time of purchase in the auto industry, quantity competition seems like a reasonable assumption for the auto industry.

Since the union has the power to select the wages paid by each firm, there are two possibilities: the union can demand the same wage from each firm, or, the union can select firm-specific wages. With the union having all of the wage-setting power, the order in which the wages are chosen is not relevant.

Maximizing (4) over w_a and w_b subject to (1)-(2) yields the union's optimal firm-specific wages. We obtain $w_a = 1/2$ and $w_b = t/2$. Maximizing (4) subject to (1)-(2) and $w_a = w_b$ yields the union's optimal common wage. We obtain $w_u = \dfrac{t(1+t)}{4(t^2 - t + 1)}$, where the u subscript denotes that this is the uniform wage. For $t \in [.5, 1]$, we have $w_b \leq w_u \leq w_a$; thus, since each firm's profit is decreasing in its own wage and increasing in its rival's wage, the efficient firm prefers the uniform wage while the inefficient firm prefers the firm-specific wage structure. And, substituting these wages back into (1), (2) and (4) and comparing we find that the union is always better-off with the firm-specific wages.

None of these results should be surprising – they mimic standard results from the literature on price discrimination under monopoly (and do not depend upon the assumed functional forms). When the union selects a common wage, it settles on one that is between the two firm-specific wages. This benefits the efficient firm and harms the inefficient firm. And, a standard revealed preference argument is enough to ensure that the union cannot be worse off when the wages are firm-specific. Thus, viewed from this perspective, one would never expect the union to prefer a uniform wage.

As for the firms, they know that they are equally likely to be the efficient firm or the inefficient firm. Thus, they would prefer the wage structure that leads to the largest total profit. It is straightforward to show that a uniform wage leads to higher total profit. It follows that it will be the firms, *not the union,* that favor a uniform wage structure.

Since wages are not negotiated, this simple framework does not capture the forces that drive the "taking wages out of competition" argument. However, this framework does provide us with some basic intuition as to why, contrary to prevailing wisdom, an industry-wide union might prefer sequential bargaining (in which firm-specific wages are negotiated). Thus, the "taking wages out of competition"

effect, which we expect leads the union to favor pattern bargaining, is not going to be the only force that determines the union's preferences with respect to bargaining structure.

3. Using Pattern Bargaining to Take Labor Out of Competition

In this section we extend the model so that wages are negotiated. We also generalize the firms' costs structures to allow for differences in non-labor costs. We then examine the agents' preferences over bargaining mechanisms (pattern vs. sequential)[13] under the assumption that wages are determined by the Nash Bargaining Solution (NBS). The non-cooperative foundations for the NBS are well known – it is the outcome of negotiations in which the agents trade offers until an offer is accepted (Rubinstein 1982).

To be precise about the cost structure, we now assume that firm a gets one unit of output per worker and faces a non-labor cost that is normalized to zero; whereas firm b gets t units of output per worker and faces a non-labor cost of c per unit of output. As in Section 2, the probability that any given firm is selected as firm a is equal to ½. With this cost structure, the Cournot output levels are given by

(1') $\qquad x_a(w_a, w_b) = \ell_a(w_a, w_b) = (1/3t)[t(1 - 2w_a + c) + w_b]$

(2') $\qquad x_b(w_b, w_a) = t\ell_b(w_b, w_a) = (1/3t)[t(1 + w_a - 2c) - 2w_b]$

Profits and the wage bill are still given by (3) and (4), respectively.

To recap the structure of the model, the agents are involved in a game in which for a given bargaining mechanism, nature determines the firms' production costs in the first stage; these values are revealed to all players; the union and firms then apply the bargaining mechanism to determine wages in the second stage; and then, finally, in the third stage, the firms engage in quantity competition in the product market. As in Section 2, the assumption that the firms' production costs are random is meant to capture a dynamic setting in which the competitive positions of the firms change over time. When a

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[13] We restrict attention to the two bargaining mechanisms most commonly observed: pattern and sequential bargaining. Marshall and Merlo also consider simultaneous bargaining and "pattern bargaining in costs." As they show, simultaneous bargaining is always dominated, so that it cannot emerge in equilibrium. Similarly, "pattern bargaining in labor costs" always results a smaller joint surplus for the union and the firms than both sequential bargaining and pattern bargaining in wages. Thus, it cannot arise as an equilibrium outcome. We discuss this point in more detail in footnote 26 below.

given firm evaluates a bargaining mechanism, its goal will be to find the bargaining mechanism that maximizes their expected profits.

When wages are negotiated, the order of bargaining may matter, so we have (potentially) four cases to consider. Since all four cases are algebra intensive, we sketch the solution method in the text and relegate the details to Appendix A where all analytic solutions are provided. We begin with pattern bargaining with firm j as the target, which we denote by P(j). As is standard, we use backwards induction. If the union fails to reach an agreement with firm j, firm i becomes a monopolist in the product market. Let w_i^m denote the wage negotiated by firm i when it is a monopolist and let $\ell_i^m(w_i^m)$ and $x_i^m(w_i^m)$ denote this firm's labor demand and output at this wage. Then, according to the NBS, w_i^m maximizes the product of the union's wage bill and the firm's profit; that is w_i^m maximizes $w\ell_i^m(w)[x_i^m(w)]^2$ over w. Turn next to the original negotiations between the union and firm j. The wage bill evaluated at w_i^m serves as the union's threat point during these negotiations, whereas firm j's threat point is zero (since it does not produce if no agreement is reached). Since under pattern bargaining it is understood that both firms will end up paying the same wage, then using (3)-(4) and a straight-forward application of the NBS, the wage that the union settles on when using firm j as the target solves

$$(5) \qquad \max_{w} \quad \{\theta(w,w) - w_i^m\ell_i^m(w_i^m)\}x_j(w,w)^2$$

We use $w^{p(j)}$ to denote this wage, with the super-script denoting that this wage emerges under pattern bargaining with firm j as the target. The solutions for w_i^m and $w^{p(j)}$ are provided in the Appendix A.

Turn next to sequential bargaining under the assumption that the union negotiates with firm j first, which we denote by S(j). Let $w_j^{s(j)}$ denote the wage that comes out of these initial negotiations – note that the super-script refers to the bargaining structure (sequential bargaining with firm j as the target)

while the sub-script signifies that this is the wage paid by firm j. Then, when firm *i* negotiates with the union, the NBS solution wage that emerges solves

(6) $$\max_{w} \quad \{w_j^{s(j)} \ell_j(w_j^{s(j)}, w) + w\ell_i(w, w_j^{s(j)}) - w_j^{s(j)} \ell_j^m(w_j^{s(j)})\} x_i(w, w_j^{s(j)})^2$$

Note that if the union fails to reach an agreement with firm *i*, firm *j* becomes a monopolist in the product market, but must still pay the (already) negotiated wage of $w_j^{s(j)}$. This explains why the union's threat point is given by $w_j^{s(j)} \ell_j^m(w_j^{s(j)})$. Let $w_i^{s(j)}(w_j^{s(j)})$ denote the solution to (6). As before, the super-script refers to the bargaining structure; whereas the sub-script signifies that this is the wage to be paid by firm *i*. It is important to note that $w_i^{s(j)}$ is increasing in $w_j^{s(j)}$ with a slope less than one. The reason for this is straight-forward: an increase in firm *j's* wage increases the surplus to be split by firm *i* and the union which triggers an increase in firm *i*'s wage. However, w_i does not increase by the full increase in w_j since this would completely undo the competitive advantage just gained by firm *i* (there is also a stability argument that restricts the slope to be below one).

Finally, we turn the initial negotiations between firm *j* and the union in order to describe how $w_j^{s(j)}$ is determined. If the union and firm *j* fail to reach an agreement, firm *j* does not produce (and therefore earns nothing) while firm *i* becomes a monopolist and the union and firm *i* settle on a wage of w_i^m. This implies that the union's threat point is given by $w_i^m \ell_i^m(w_i^m)$ and $w_j^{s(j)}$ solves

(7) $$\max_{w} \quad \{w\ell_j(w, w_i^{s(j)}(w)) + w_i^{s(j)}(w)\ell_i(w_i^{s(j)}(w), w) - w_i^m \ell_i^m(w_i^m)\} x_j(w, w_i^{s(j)}(w))^2$$

Note that in negotiating over its own wage, firm *j* takes into account how the outcome will affect the bargaining between firm *i* and the union. This is the aspect of wage bargaining in oligopolistic industries that pattern bargaining is meant to eliminate. The analytic solutions for $w_j^{s(j)}$ and $w_i^{s(j)}(w_j^{s(j)})$ are provided in Appendix A.

With the wages determined, we can use (3) and (4) to calculate the union's wage bill and the firms' profits. In addition, summing these values allows us to determine the surplus to be split between

the agents (producer surplus). To assess the preferences over the different bargaining mechanisms for the agents, we restrict attention to the case in which $.5 \le t \le 1$.[14] This leaves us with a model that is quite similar to the one analyzed by Marshall and Merlo and allows for a direct comparison of our results. The two novel features of our approach are the assumptions that firms differ in non-labor costs ($c > 0$) and that there is uncertainty about production costs so that the firms' rank the bargaining mechanisms based on expected profits.

To facilitate comparison with MM, we proceed in two steps. First, as a benchmark, we set $c = 0$ so that the firms differ only in labor productivity and analyze the agents' preferences. We then eliminate differences in labor productivity by setting $t = 1$ and analyze the model for $c > 0$.

As MM demonstrate, with the firms differing only in labor productivity, the order of bargaining does not matter when sequential bargaining is used. Thus, we have three bargaining mechanisms to consider, P(j) with j = a,b and S $\equiv$ S(a) = S(b): pattern with the efficient firm (a) as the target, pattern with the inefficient firm (b) as the target and sequential bargaining.

We start with the union's preferences, which follow from Figure 2a. The first result is not surprising: under pattern bargaining, the union always prefers to bargain with the more efficient firm first: $\theta(w^{p(a)}, w^{p(a)}) \ge \theta(w^{p(b)}, w^{p(b)})$ for $t \in [.5,1]$. This follows from the fact that the efficient firm generates a larger surplus and can therefore afford to pay a higher wage than its counterpart. This result generalizes to situations in which the firms differ in non-labor costs as well – it is always in the interest of the union to use the more efficient firm as the target. The second result that is evident from Figure 2a is that when the degree of firm-heterogeneity is weak ($.7338 \le t \le 1$), the union prefers pattern over sequential bargaining regardless of which firm is used as the target. When firm-heterogeneity is moderate ($.5785 \le t$

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[14] We make this assumption to facilitate comparison to Marshall and Merlo (2004) who restrict attention to $t > \frac{1}{2}$. However, it is possible to show that there is an interior equilibrium in which both firms produce for any t greater than (roughly) 1/3. The *explicit expression* for $w_a^{s(a)}$ derived from the first order condition is not defined at $t = \frac{1}{2}$ -- but it is straightforward to verify that at $t = \frac{1}{2}$ there exists a w that satisfies the first order condition ($w = \frac{1}{4}$). This wage is the explicit solution to the first order condition when the limit is taken as t approaches $\frac{1}{2}$. It is not difficult to check that the equilibrium is well behaved (i.e., stability conditions are satisfied) for $t \in (1/3,1/2]$. Intuitively, we want to restrict t such that the union would prefer to have both firms produce. The qualitatively nature of our results do not change by expanding the range of t – in fact, pattern bargaining becomes more likely for low t.

≤ .7338), the union still prefers pattern bargaining to sequential, as long as the target is the efficient firm. It is only when the firms differ dramatically in labor productivity (.5 ≤ t ≤ .5785) that the union prefers to bargain sequentially.

Marshal and Merlo (2004) provide intuition for the union's preference ordering. However, we offer a somewhat different explanation for these results. As we showed in Section 2, the ability to tailor wages to the firms, which is a characteristic of sequential bargaining, benefits the union at the expense of the firms. However, the "taking labor out of competition" aspect of pattern bargaining results in higher average wages in the industry. This follows from the fact that firms are more willing to agree to a wage increase when they know that their rival's wage will rise by the same amount that their wage will rise (and, as we saw above, with sequential bargaining any increase in w_j leads to an increase in w_i of *smaller* magnitude). Thus, sequential bargaining benefits the union by allowing for a firm-specific wages but harms the union by generating lower average wages. The benefit from wage discrimination is not particularly important when the firms are similar, so that with weak heterogeneity the latter force dominates and the union prefers pattern bargaining. The advantages from a firm-specific wage structure grow as the firms become less alike, and this effect dominates when firm-heterogeneity is strong. As a result, when the firms are quite dissimilar, the union prefers sequential bargaining.

We turn next to the firms. As we noted above, the firms' prefer the bargaining mechanism that maximizes *expected* profits, which, given our set-up, is equivalent to maximizing total industry profits. The firms' aggregate profits (Π) for each of the bargaining mechanisms are depicted in Figure 2b. The first result worth noting is that with pattern bargaining, the firms always prefer the inefficient firm to be the target. So, even if we restrict our attention to pattern bargaining, there is disagreement between the union and the firms over the nature of the bargaining process – they have different preferences over the target. When we include sequential bargaining, the possibility of agreement seems even more remote. Figure 2b indicates that when firm-heterogeneity is weak (.7267 ≤ t ≤ 1), the firms prefer sequential bargaining over any form of pattern bargaining. Note, however, that when firm-heterogeneity is moderate

or dramatic ($.5 \leq t \leq .7267$), the firms actually prefer pattern bargaining. More specifically, their first choice is always pattern bargaining with the *inefficient* firm as the target – that is, P(b). The fact that the firms prefer that the weak firm serves as the target should not be surprising – since the inefficient firm generates a smaller surplus, using it as the target results in a lower wage and higher profits.

The explanation for the firms' preferences is similar to that given for the union. The firm-specific wage structure, which is inherent in sequential bargaining, harms the firms; but the ability to take labor out of competition through pattern bargaining also harms the firm (due to the higher average wages). When the negative aspects from sequential bargaining are dominate, the firms prefer pattern bargaining; otherwise, they prefer sequential bargaining. If the firms are similar, the impact of wage discrimination is small and the firms prefer sequential bargaining. As the difference between the firms grows, the impact of price discrimination increases and the firms eventually switch and prefer pattern bargaining.

It is clear from Figures 2a and 2b that no common bargaining mechanism is the first choice for both sides. For $t < .5785$, the union prefers S while the firms prefer P(b). For $t > .7267$ the firms prefer sequential bargaining but the union prefers P(a). Finally for $t \in (.5785, .7267)$, both sides prefer pattern bargaining, however they disagree as to the identity of the target. As is clear from our discussion so far, the manner in which the target firm is selected is crucial in determining the preferences of the agents over bargaining structures. We take up this issue and discuss it at length in the next section.

To complete this section, we now consider the case in which the firms differ only in non-labor costs. Thus, we set $t = 1$ and allow c to vary. With $c > 0$, the outcome from sequential bargaining now depends on which firm is used as the target. Thus, we now have four different mechanisms to consider: S(a), S(b), P(a) and P(b). The additional case makes the analogs to Figures 2a and 2b excessively complex. It is therefore easier to follow the ensuing discussion by referring to the description of the agents' preference orderings provided in Appendix B.

We begin with the union's preferences. As is clear from the orderings of the wage bills, the union prefers pattern bargaining over sequential bargaining for all c. Thus, when the firms differ only in non-

labor costs, the "taking labor out of competition" effect associated with pattern bargaining always dominates the advantages from the firm-specific wage structure associated with sequential bargaining. This result is consistent with the conventional wisdom about pattern bargaining: the union prefers pattern bargaining. The orderings also indicates that, as in the Marshall-Merlo framework (and for the same reasons), the union always prefers to bargain with the efficient firm first (regardless of the bargaining mechanism).

Turning to the firms, we find that their preferences are consistent with the case of productivity differences discussed above (see Appendix B). That is, they prefer sequential bargaining when firm heterogeneity is weak ($c \leq .263$) but prefer pattern bargaining when firm heterogeneity is strong ($c \geq .263$). The intuition follows that in previous sections – for the firms there are both positive and negative aspects of sequential bargaining. The positive aspect is that it results in lower average wages. The negative aspect, which dominates when the firms are sufficiently heterogeneous, is that they are harmed by the price discrimination inherent in sequential bargaining. We also see that, as before and for the same reasons, the firms always prefer that the inefficient firm carry out their negotiations first.

Comparing labor versus non-labor cost uncertainty, it appears that the preference orderings are remarkably similar. However, in both cases the ability to influence the selection of the target firm plays an important role in determining the agents' overall preferences for the bargaining mechanism and this is an issue that we have yet to address. We now turn to this issue and show that the two models yield very different outcomes regardless of how the target is selected.

4. Main Results

In many instances the union has complete control over the target. This has always been the case in the auto industry with the UAW selecting the order of negotiations. Thus, we start this section by making the simplifying assumption that the union has the ability to select the target – thus, firm *a* is always selected. With the union selecting the target, we need only compare the payoffs under S and P(a).

For the union, P(a) is extremely beneficial. In fact, when the firms differ only in labor

productivity, Figure 2a indicates that P(a) dominates S for all $t > .5785$. However, Figure 2b indicates that the firms are unwilling to accept P(a) for all t in this range. Moreover, when the firms *are* willing to accept P(a) (for $t < .5291$), the union always prefers S. Thus, we have our first result:

<u>Proposition 1</u>: When the union selects the target and the firms differ only in labor productivity, one side of the market *always* prefers sequential bargaining over pattern bargaining.

Proposition 1 is somewhat surprising given the preference orderings of the agents. After all, there are parameter values such that *all* agents prefer pattern bargaining to sequential bargaining (this occurs when t is moderate; that is, $.5785 \leq t \leq 1$). The problem is that the agents disagree about the target. When the firms differ only in labor productivity, this disagreement over the target is strong enough that it becomes impossible to get the agents to agree to pattern bargaining.

The situation changes considerably when the firms differ in non-labor costs. To see this, note that the union always prefers P(a) to S(a) and the firms prefer P(a) to S(a) whenever $c \geq .2646$. Thus, all agents will prefer pattern bargaining if the firms are sufficiently different. Summarizing:

<u>Proposition 2</u>: When the union selects the target and the firms differ only in non-labor costs, the union and the firms prefer pattern bargaining if firm heterogeneity is sufficiently strong ($c \geq .2646$).

Proposition 2 indicates that differences in non-labor costs alter the trade-offs from pattern bargaining in a significant manner, resulting in situations in which all agents simultaneously prefer the same type of pattern bargaining. This occurs in spite of the fact that the *union* is in as strong a position as possible, having complete control over the target; and suggests that, counter to conventional wisdom, there maybe important instances in which the *firms* are willing to accommodate the union by accepting their most preferred bargaining mechanism. We consider Proposition 2 our most important result in that this is the first example (that we are aware of) in which both the firms and the union prefer pattern bargaining in the absence of potential entry.

To investigate the generality of Propositions 1 and 2 we now turn to the general case in which the firms also have some control over the target. To be as general as possible, we assume that if pattern bargaining is being used, then with probability $q \in [0,1]$ nature assigns the union the power to determine the identity of target firm. We therefore use q as a measure of the union's ability to influence the selection of the target. Varying q allows us to consider all possible types of pattern bargaining. It also allows us to investigate the manner in which the union's ability to influence the selection of the target affects the preferences of the agents over the bargaining mechanism.[15]

It follows that in the first stage, the agents know that if pattern bargaining is chosen the efficient firm will be selected as the target with probability q. As a result, the expected payoff to the union under pattern bargaining is $q\theta^{p(a)} + (1-q)\theta^{p(b)}$; whereas under sequential bargaining the union expects to earns $q\theta^{s(a)} + (1-q)\theta^{s(b)}$. The payoff for the firms is calculated in an analogous fashion.

As above, we start with the case in which the firms differ only in labor productivity. In this case, it should be clear that for $t \geq .7267$ and $t \leq .5785$, either the firms or the union will prefer sequential bargaining. In the former case, the firms prefer S even when they get to choose target firm with probability one; whereas in the latter case it is the union that insists on S regardless of q.

For $.5785 \leq t \leq 7267$, the union will prefer P only if q is sufficiently high; whereas the firms will prefer P only when q is sufficiently low. Let q_U denote the value of q that equates the expected wage bill with pattern bargaining to the expected wage bill with sequential bargaining, and define q_F as the value of q that equates expected total profit with pattern bargaining to expected total profits with sequential bargaining. Clearly, a value of q such that both the union and the firms prefer P over S exists iff $q_U \leq q_F$. However, for *all* t in this range $q_U > q_F$, so that there is *no* value for q such that both the union and the firms prefer pattern bargaining. Thus, we conclude that in the Marshall-Merlo framework there does not exist a set of parameters such that all agents will simultaneously prefer pattern bargaining to sequential

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[15] We note that values of $q \in (0,1)$ are consistent with a commonly observed phenomenon associated with pattern bargaining in that the target firm and its characteristics change over time (i.e., sometimes the most efficient firm serves as the target while at other times the union bargains with a mid-level firm first).

bargaining. This makes it difficult to understand how pattern bargaining would ever emerge as an equilibrium outcome when the firms differ only in labor productivity. We conclude that Proposition 1 generalizes as follows.

Proposition 3: When the firms differ in labor productivity, then regardless of the manner in which the target firm is selected (q), one side off the labor market *always* prefers sequential bargaining over pattern bargaining.

We now turn to the case in which firm heterogeneity is driven by differences in non-labor costs. Proposition 2 tells us that in this case with the union selecting the target we get pattern bargaining if firm heterogeneity is sufficiently strong ($c \geq .2646$). Suppose instead, that the firms have complete control over the target ($q = 0$), so that the inefficient firm is always selected. The preference orderings in Appendix B indicate that the union would prefer pattern bargaining as long as the firms are not too different ($c < .3127$). The firms, on the other hand, prefer pattern bargaining whenever $c > .2630$; otherwise, they prefer sequential bargaining. This implies that all agents will agree to pattern bargaining for all $c \in [.2630, .3127]$.[16]

Extending the analysis to allow for all possible q, it follows for $c \in [.2646, .3127]$ the agents will all prefer pattern bargaining *regardless of the identity of the target firm* – a surprisingly strong result. Figure 3 shows the values for c and q such that all agents prefer pattern bargaining. Comparing Figure 3 with Proposition 2 indicates that our qualitative results generalize – pattern bargaining is the preferred mechanisms of all agents if the firms are sufficiently different.[17]

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[16] It is worth noting that the equilibrium wage solutions provided in Appendix A are sufficient to allow for consideration of the general model in which the firms differ in both labor productivity and non-labor costs. We have examined this model and the results are qualitatively identical to those described in this section. The key result remains: for a significant portion of the parameter space the trade-offs are such that all agents prefer pattern bargaining to sequential bargaining. Thus, as long as the firms differ in non-labor costs, pattern bargaining can emerge in equilibrium even when side payments are not possible.

[17] The contrast between the cases in which $c \in [.2630, .2646]$ and $c \geq .3127$ is worth highlighting. In the former case, we get pattern bargaining only if q is sufficiently low. This is due to the fact that for these values of c, the union always prefers pattern bargaining (regardless of the target) while the firms prefer pattern bargaining only if they have sufficient control over the target. In contrast, in the latter case, we only get pattern bargaining if q is

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We close this section by turning to an issue that has received surprisingly little attention in the literature – the impact of bargaining structure on consumer welfare.[18] Since the good is homogenous, consumers prefer the bargaining structure that leads to the lowest output price. This means that all they are interested in is aggregate output – the distribution of output is not important. We have argued above that sequential bargaining always leads to lower average wages. Thus, this is also the bargaining structure that results in higher total output. It follows that consumers always prefer sequential bargaining over pattern bargaining regardless of the order of the negotiations (for the precise preference ordering, see Appendix B).[19] We summarize this result in Proposition 4.[20]

Proposition 4: When the firms differ in non-labor costs, consumer surplus is maximized by sequential bargaining.

In the introduction we noted that the Howard Government in Australia recently adopted legislation aimed at outlawing pattern bargaining and that union leaders argued that the main goal of this legislation was to shift bargaining power towards firms. However, the fact that we find that sequential bargaining generates greater consumer welfare than pattern bargaining provides an intriguing alternative explanation for the Howard Government's actions – the Workchoices legislation could have been an attempt to protect consumer's interests. In addition, since consumers can be interpreted as downstream firms, our analysis also offers an explanation as to why some firms would voluntarily agree to pattern bargaining while downstream firms in other industries would lobby against it. We also note that, regardless of the government's motivation in outlawing pattern bargaining, Proposition 3 suggests that this action may have benefited Australian consumers.

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sufficiently high. This is due to the fact that when the firms are sufficiently heterogeneous the firms always prefer pattern bargaining but the union will only prefers pattern bargaining when it has sufficient control over the target.

[18] In our working paper, Creane and Davidson (2007), we also examine the relationship between bargaining structure and total welfare.

[19] For the same reason consumers prefer that the inefficient firm be the target firm.

[20] The relationship between bargaining structure and consumer surplus is slightly more complicated in the Marshall-Merlo framework. In particular, if firms are sufficiently heterogeneous, then in the Marshall-Merlo setting consumers may prefer pattern bargaining. See the discussion preceding Proposition 6 below (along with footnote 25) and our working paper (Creane and Davidson 2007) for details.

5. Bargaining over the Bargaining Mechanism

In this section, we consider an extension of the model that allows the agents to negotiate over the bargaining mechanism itself. We do this because we believe that to truly understand pattern bargaining, we must examine conditions under which it emerges endogenously from a setting in which the agents negotiate not only over the wage rates but the bargaining mechanism as well. The results in Section 4 indicate that there are cases in which pattern bargaining is the preferred mechanism for all agents. Thus, we would expect it to emerge as the equilibrium outcome in those cases. However, it is also interesting to ask whether there are other cases in which one side of the market is so strongly invested in pattern bargaining that it might be able to use concessions in other dimensions to persuade the other agents to accept this mechanism.

However, modeling the process of bargaining over the bargaining mechanism is difficult because there are three players: the two firms and the unions.[21]   Three player bargaining games are not well understood, and it unclear how pattern bargaining would be implemented in such a three-player environment in the absence of unanimity.   Fortunately, this issue does not cause any problems in our setting, since the two firms have identical preferences over the bargaining mechanism (due to our assumption that the firms rank the mechanisms before production costs are determined).   In a more general model, this difficult issue would have to be dealt with.

With this in mind, we are now in position to describe the type of negotiating environment we have in mind. Ideally, there would be a two-stage process in which the agents first negotiate over the bargaining mechanism and then engage in the static game analyzed in Sections 3 and 4. For consistency, we continue to assume that the identity of the target firm is determined as in Section 4 above. Thus, we envision a setting in which there is a new stage 0 in which the bargaining mechanism is determined.

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[21] In many European markets, firms co-ordinate their bargaining efforts by allowing a single entity to represent them in their negotiations with a common industry-wide union. In such cases, bargaining is carried out at the industry level and there are only two players to model. However, such coordinated behavior is explicitly outlawed in the United States by anti-trust laws.

We begin with the easiest case in which side-payments are not possible and introduce (what we consider to be) the most natural structure for the initial stage of the game. We assume that in stage 0, knowing how the target will be selected, the agents simultaneously announce their choice as sequential (S) or pattern (P). However, it is impossible to implement pattern bargaining if all agents do not agree to adopt it. Thus, we assume that if *all agents* select P, then pattern bargaining is adopted; otherwise, sequential bargaining is the outcome.

This is the easiest case because it requires unanimity across the agents about the bargaining structure and in Section 4 we have already identified cases in which there is agreement about pattern bargaining. It follows immediately from Propositions 1 and 3 that without side-payments, pattern bargaining cannot emerge as an equilibrium outcome in the MM framework. In contrast, Proposition 2 and Figure 3 indicate that with sufficient heterogeneity in non-labor costs, equilibrium will be characterized by pattern bargaining. We summarize these results in Proposition 5.

Proposition 5: If the agents bargain over the bargaining mechanism and side payments are not possible, then when the firms differ only in labor productivity, equilibrium is characterized by sequential bargaining for productivity difference (*t*). If the firms differ in non-labor costs, then equilibrium is characterized by pattern bargaining provided that the firms are sufficiently heterogeneous ($c \in [.2646, .3127]$).[22]

For completeness, we now consider the case in which side payments can be used to influence the bargaining mechanism. There are at least two good reasons to do this. First, this exercise allows us to examine which agents' interest are most invested in the implementation of pattern bargaining. After all, given the structure of our game, in the absence of side payments *all* agents must agree to pattern bargaining for it to be adopted. When side payments are possible, one side may be willing to bribe the other to accept this bargaining structure. Another reason to consider this case is that there are other issues

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[22] As indicated in Figure 3, for all c > .2630 there exists a range of values for *q* such that equilibrium is characterized by pattern bargaining.

that are often included as part of a newly negotiated contract. If these other issues do not affect the firms'

marginal costs of production, then they may be represented as lump sum transfers in our model. Agents

may be willing to make concessions in these other dimensions if by doing so they can influence the

selection of the bargaining mechanism. That is, concessions in these other dimensions would be

equivalent to side payments in our model and any payment made by one agent to the other that does not

affect the firms' marginal costs of production would qualify. So, for example, any contribution made by

the firms in the auto industry to the UAW's "job fund" would qualify; as would a signing bonus paid to

all union members who vote "yes" on a new proposed contract. Another example would be an agreement

to change the pension formula that results in a more favorable retirement package for workers.[23]

With side payments possible, we would expect the bargaining mechanism that maximizes the

joint surplus of the union and the firms (that is, $\mathrm{E}(\pi_e + \pi_i + \theta)$) to emerge in equilibrium. As

Proposition 5 indicates, in the absence of side payments the MM framework yields very different results

from the model in which the firms differ in non-labor costs. In contrast, when side payments are possible

the two models yield qualitatively similar predictions. Therefore, for succinctness, we focus attention on

the model with cleaner results: the MM framework. At the end of the section, we describe how the results

are modified when firms differ in non-labor costs. Interested readers are referred to our working paper,

Creane and Davidson (2007), in which a complete characterization for both models is provided.

There are two cases to consider since there are two potential sources of disagreement between the

union and the firms: the mechanism and the target. In the first case, we assume that side payments can be

used to influence both the bargaining mechanism and the selection of the target. In the second case, we

assume that the agents are unable to contract on the target. In the first case, we expect that negotiations

will result in the mechanism that maximizes the joint surplus of the union and the firms. Figure 2c shows

how this producer surplus (PS) varies with the bargaining mechanism when the firms differ in labor

productivity. When firm-heterogeneity is weak to moderate ($.6502 \leq t \leq 1$), Figure 2c indicates that the

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[23] We thank Paula Voos for suggesting these examples.

PS is largest with sequential bargaining. Thus, in this case, even with side payments, pattern bargaining cannot arise in equilibrium. Figure 2c also indicates that when firm-heterogeneity is strong ($.5 \leq t \leq .6502$) producer surplus is largest when the firms get their preferred outcome: P(b). This suggests that pattern bargaining is likely to emerge when it is the outcome desired by the *firms,* not the unions. This result runs counter to the conventional wisdom which suggests that pattern bargaining benefits the union.

The explanation for the relationship between bargaining structure and producer surplus can be explained as follows. As with the firms and the union, there are two forces at work. Since sequential bargaining leads to lower average wages, one should expect sequential bargaining to generate a greater surplus – lower wages imply greater output and a larger surplus to be shared.[24] However, with sequential bargaining the *inefficient* firm winds up paying a lower wage rate than it would under pattern bargaining. This implies that under sequential bargaining, the *inefficient* firm has a greater market share and thus, a greater fraction of total output is produced inefficiently. Consequently, even though sequential bargaining leads to lower average wages, total output can be lower with sequential bargaining.[25] When the firms are similar, the first effect dominates and producer surplus is higher with sequential bargaining. As firm-heterogeneity become more pronounced, the loss in output from inefficient production grows, so that producer surplus eventually becomes larger with pattern bargaining.[26] Summarizing, we have:

Proposition 6: Suppose that the firms differ in labor productivity and that side payments can be used to influence both the bargaining mechanism and the target firm, then if the firms are sufficiently homogenous ($.6502 \leq t$), sequential bargaining is the equilibrium outcome. Otherwise, equilibrium is characterized by pattern bargaining with the inefficient firm as the target.

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[24] The efficient wage (the one which maximizes producer surplus) is always less than either the pattern or sequential bargaining wages due to double marginalization.

[25] This is precisely why the relationship between the bargaining mechanism and consumer surplus is slightly more complicated in the Marshall-Merlo framework.

[26] As we discussed in footnote 13, we do not consider pattern bargaining in costs since it leads to a smaller joint surplus than sequential bargaining and/or pattern bargaining in wages. The reason for this is that pattern bargaining in costs combines the worst aspects of the other two mechanisms (in terms of generating a large joint surplus) – by softening negotiations it leads to higher average wages than sequential bargaining and by equalizing marginal costs across firms it results in a less efficient distribution of production than pattern bargaining in wages.

If side payments cannot be used to influence the selection of the target, then the value of q becomes important. To see this, consider what occurs in the two extreme cases. First, assume that the union always has the power to select the target (i.e., $q = 1$). Given the union's preference, if pattern bargaining is selected in stage one, then the efficient firm will be the target. However, Figure 2c indicates that producer surplus with sequential bargaining always exceeds its value under pattern bargaining when the efficient firm is the target. Thus, when $q = 1$ and side payments can only be used to determine the mechanism, sequential bargaining is the only outcome now. That is, for pattern bargaining to arise in this case, side payments must be able to influence *both* the mechanism *and* the target. Note that in this case, if $t > .5786$, then since the union prefers P(a), we would expect side payments to flow from the firm to the union. That is, if they could, the firms would bribe the union in order to obtain sequential bargaining.

Now turn to the other extreme in which firms select the target ($q = 0$). As we know, the firms select the inefficient firm as the target. Given this, the values of producer surplus in Figure 2c indicate that if $t \in (.6502, 1)$, S is the equilibrium outcome. Moreover, the side-payments go from the union to the firm if $t > .7267$. Thus, when $q = 0$ and t is sufficiently high, *the union would be willing to bribe the firms in order to obtain sequential bargaining*. Finally, if $t \in (.5, .6502)$, P(b) is the equilibrium outcome. Note that, by Proposition 6, allowing the firms to select the target raises producer surplus.

Extending the analysis to the intermediate cases in which $q \in (0,1)$ is straightforward, since we simply take a weighted average of the payoffs. For $t \in (.6502, 1)$, both sides prefer sequential bargaining for all q. If $t \in (.5, .6502)$, then the outcome depends on whether, given t, producer surplus with sequential bargaining exceeds $q \cdot PS^{p(a)} + (1 - q) \cdot PS^{p(b)}$ where the super-script P(j) indicates pattern bargaining with firm j as the target. Since for any $t < .6502$, producer surplus with the efficient firm as the target is strictly greater than producer surplus with sequential bargaining, there always exists a q arbitrarily close to 0 such that producer surplus with pattern bargaining is greater than with sequential bargaining.

Proposition 7: Suppose that the firms differ in labor productivity and that side payments can be used to influence the bargaining mechanism but not the target, then if the firms are sufficiently

homogenous (.6502 ≤ *t*), sequential bargaining is the equilibrium outcome.   In addition, when the firms are sufficiently heterogeneous, (*t* ≤ .6502) there exists a *q** ∈ (0, 1) such that for *q* > *q** there is sequential bargaining; otherwise equilibrium is characterized by pattern bargaining with the inefficient firm as the target.

Proposition 7 indicates that pattern bargaining can still arise in equilibrium, but only when the firms have sufficient influence on the selection of the target.

To summarize our results in the Marshall-Merlo framework, Proposition 5 indicates that without side payments, pattern bargaining cannot emerge as an equilibrium outcome. Propositions 6 and 7 indicate that when side payments are possible, equilibrium may be characterized by pattern bargaining, but only when the inefficient firm is used as the target. Moreover, from Figures 2a and 2b, pattern bargaining only emerges in equilibrium when it is the preferred bargaining mechanism of the firms.

Results quite similar to those reported in Propositions 6 and 7 hold when the firms differ in non-labor costs. To begin with, the existence of side payments makes it more likely that equilibrium will be characterized by pattern bargaining -- without side payments pattern bargaining can only arise when *c* > .2630, with side payments the condition becomes *c* > .1965. In addition, pattern bargaining *usually* arises when it is the firms' preferred bargaining mechanism. The one significant difference is that when the firms cannot contract over the identity of the target it is *possible* to have pattern bargaining emerge when it is in the *union's* interest, not the firms'. This is consistent with the conventional wisdom that it the union's interest that is most served by the adoption of pattern bargaining.   Thus, there are at least two reasons to prefer a model in which firms differ in non-labor costs to the Marshall-Merlo framework. First, it provides an explanation of how pattern bargaining can arise in equilibrium without side payments. Second, when side payments are possible, it provides an explanation of how pattern bargaining can arise endogenously when it is support by the union and opposed by the firms.[27]

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[27] In our working paper, Creane and Davidson (2007), we highlight a third reason to prefer the model with difference in non-labor costs: it provides an explanation for the controversy that surrounds the use of pattern

6. Conclusion

Pattern bargaining is a common negotiating strategy that is not well understood. The conventional wisdom is that this strategy is used by industry-wide unions to soften bargaining and secure higher wages. This intuition was confirmed in a recent paper by Marshall and Merlo (2004) in which they show that unions prefer this bargaining mechanism to simultaneous and/or sequential bargaining. However, this does not explain why the firms are willing to accept such an arrangement. Building on the insights of Marshall and Merlo, we have presented an extension of their model with uncertainty and examined the preferences of the agents with respect to the bargaining mechanism. We have shown that when comparing sequential and pattern bargaining, there are competing forces at work for both the union and the firms. For the union, pattern bargaining is advantageous because it softens the negotiations with the firms by "taking labor out of competition," resulting in higher industry wages. On the other hand, sequential bargaining allows the union to exploit difference across the firms by demanding different wages much in the same way that a monopolist would charge different prices to consumers with different levels of willingness to pay. When firms are similar, the benefits from wage discrimination are small and the union prefers pattern bargaining. The benefits tied to wage discrimination are much more important when the firms are sufficiently different, so that with sufficient firm-heterogeneity, the union actually prefers sequential bargaining.

In our model the relative competitive positions of the firms are uncertain due to random shocks to either labor productivity or non-labor costs. The firms may therefore prefer pattern bargaining because it allows the relatively more efficient firm to pay a lower wage than it would with sequential bargaining and this can lead to higher expected profits. On the other hand, pattern bargaining softens negotiations and results in higher average wages. As a result, we find that when firm-heterogeneity is strong, the firms

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bargaining. This can be explained as follows. In the MM set-up, we find that whenever the use of side payments results in the adoption of pattern bargaining, this results in an increase in consumer surplus. Thus, in the MM set-up, without side payments pattern bargaining will never be adopted, and with side payments all agents will gain by its adoption. When the firms differ in non-labor costs, Proposition 4 makes it clear that consumers (and downstream firms) always prefer sequential bargaining. Thus, there will always be some agents who oppose the adoption of pattern bargaining.

actually prefer pattern bargaining. This is precisely the opposite of the way in which the union's preferences are linked to the degree of firm-heterogeneity, implying that it may not be possible to find situations in which all agents prefer pattern bargaining to sequential.

Using the Marshall-Merlo framework (linear demand and constant costs), we show that when the firms differ only in labor productivity, the trade-offs are such that without side-payments, pattern bargaining cannot arise in equilibrium (Propositions 1, 3 and 5). Moreover, when side payments are possible, pattern bargaining can be an equilibrium outcome, but only when it is the *firms'* most preferred mechanism (from Propositions 6 and 7 and Figures 2a and 2b). In contrast, when the firms differ in non-labor costs, the trade-offs are different and pattern bargaining can emerge in equilibrium even when side payments are ruled out (Propositions 2 and 5 and Figure 3). We also showed that sequential bargaining is the mechanism that maximizes consumer surplus (Proposition 4). Thus, there are cases in which the union and the firms both prefer pattern bargaining while consumers (who could be downstream producers) would oppose it. This provides a new explanation for recent legislation in Australia aimed at eliminating pattern bargaining.

Appendices

A. Analytic Solutions

For concreteness, we provide analytic solutions to the general model in which the firms differ in both labor productivity and non-labor costs. Thus, following the notation in the text we have $x_a = \ell_a$ and $x_b = t\ell_b$, firm a's non-labor costs are zero, and firm b incurs a non-labor cost of c per unit of output. This implies that in the Cournot equilibrium output and employment are given by

(A.1) $x_a = \ell_a = (1/3t)[t(1 - 2w_a + c) + w_b]$

(A.2) $x_b = t\ell_b = (1/3t)[t(1 + w_a - 2c) - 2w_b]$

Profits and the union's wage bill are still given by (3) and (4), respectively.

Case 1: Pattern Bargaining with Firm a as the Target

With a common wage, the wage bill becomes

(A.3) $\theta = (w/3t^2)[t^2(1 + c) + t(1 - 2c) - 2w(1 - t + t^2)]$

When it bargains with firm a, it is straightforward to show that the union's threat point is $(3/32)(1 - c)^2$. Thus, the wage maximizes

(A.4) $\left\{ \left(\dfrac{w}{3t^2} \right)[t^2(1 + c) + t(1 - 2c) - 2w(1 - t + t^2)] - \dfrac{3(1 - c)^2}{32} \right\}^{1/2} \left\{ \dfrac{w(1 - 2t) + t(1 + c)}{3t} \right\}$

If we let $H = \left\{ \left(\dfrac{w}{3t^2} \right)[t^2(1 + c) + t(1 - 2c) - 2w(1 - t + t^2)] - \dfrac{3(1 - c)^2}{32} \right\}$, the first-order-condition is

$\dfrac{H^{-1/2}}{3t^2} \left\{ \dfrac{w(1 - 2t) + t(1 + c)}{3t} \right\}[t^2(1 + c) + t(1 - 2c) - 4w(1 - t + t^2)] = H^{1/2} \dfrac{1 - 2t}{3t}$; which reduces to

(A.5) $A_1 w^2 + B_1 w + C_1 = 0$

where $A_1 \equiv 4(2t - 1)(1 - t + t^2)$; $B_1 = -2t(1 + c)(t^2 - t + 1) - (3/2)[t^2(1 + c) + t(1 - 2c)](2t - 1)$; and

$C_1 = (t/2)(1 + c)[t^2(1 + c) + t(1 - 2c)] + (9/32)t^2(1 - c)^2(2t - 1)$

We can use the quadratic formula to get the wage, which we denote by $w^{p(a)}$.

Case 2: Pattern Bargaining with Firm b as the Target

The wage bill is still given by (A.3) and the union's threat point is obtained by setting $c = 0$. So, in this case, the wage must maximize

(A.6) $\quad \left\{ \left(\dfrac{w}{3t^2} \right) \left[t^2(1+c) + t(1-2c) - 2w(1-t+t^2) \right] - \dfrac{3}{32} \right\}^{1/2} \left\{ \dfrac{w(t-2) + t(1-2c)}{3t} \right\}$

The first-order condition is given by

$\dfrac{H^{1/2}}{6t^2} \left\{ \dfrac{w(t-2) + t(1-2c)}{3t} \right\} [t(1+c) + t(1-2c) - 4w(1-t+t^2)] = H^{1/2} \dfrac{2-t}{3t} \ .$

After substituting for H we obtain

(A.7) $\quad A_2 w^2 + B_2 w + C_2 = 0$

where $\quad A_2 \equiv 4(2-t)(1-t+t^2)$; $\ B_2 = -2t(1-2c)(t^2 - t + 1) - (3/2)(2-t)t[t(1+c)+1-2c]$; and

$\qquad C_2 = (t^2/2)\{(1-2c)[t(1+c)+1-2c] + (9/16)(2-t)\}$

We can use the quadratic formula to get the wage, which we denote by $w^{p(b)}$.

Case 3: Sequential Bargaining with Firm a Going First

We start by looking at the bargaining between the union and firm b with w_a fixed. The wage bill is now given by

(A.8) $\quad \theta(w_b|w_a) = (1/3t^2)[w_a t^2(1-2w_a + c) + w_b t(1-2c+2w_a) - 2w_b^2]$

If the union fails to reach an agreement with firm b, firm a becomes a monopolist and the union's wage bill is $(w_a/2)(1-w_a)$, so, this is the union's threat point. So, w_b maximizes

$\qquad \left\{ \left(\dfrac{1}{3t^2} \right) \left[w_a t^2(1-2w_a+c) + w_b t(1+2w_a-2c) - 2w_b^2 \right] - \dfrac{w_a}{2}(1-w_a) \right\}^{1/2} \left\{ \dfrac{t(1+w_a-2c)-2w_b}{3t} \right\}.$

If we let $G = \left\{ \left(\dfrac{1}{3t^2} \right) \left[w_a t^2(1-2w_a+c) + w_b t(1+2w_a-2c) - 2w_b^2 \right] - \dfrac{w_a}{2}(1-w_a) \right\}$, then the first-order

condition is given by $\dfrac{G^{-1/2}}{6t^2} \left\{ \dfrac{t(1+w_a-2c)-2w_b}{3t} \right\} [t(1+2w_a-2c) - 4w_b] = \dfrac{2G^{1/2}}{3t}$. Simplifying and

substituting for G yields $16w_2^2 - 2t[5 + 8w_1 - 10c]w_2 + t^2[(1-2c)^2 + 5w_1(1-2c) + 4w_1^2] = 0$. The

quadratic can now be applied to obtain

(A.9) $\quad w_b(w_a) = (t/8)(1 - 2c + 4w_a)$

We can now turn to the union's negotiations with firm a. Plugging (A.9) back into (A.8) yields

the wage bill as a function of w_a -- we obtain

(A.10) $\quad \theta(w_a) = (1/32)[(1-2c)^2 + 16w_a - 16w_a^2]$

Using (A.9), firm a's profits become

(A.11) $\quad \pi_a(w_a) = \left[\dfrac{3 + 2c - 4w_a}{8}\right]^2$

If the union fails to reach an agreement with firm a, firm b is a monopolist and so the union's threat point

is (as with pattern bargaining) $(3/32)(1-c)^2$. This means that w_a maximizes

$$\left\{\left(\frac{1}{32}\right)[(1-2c)^2 + 16w_a - 16w_a^2] - \frac{3(1-c)^2}{32}\right\}^{1/2}\left\{\frac{3 + 2c - 4w_a}{8}\right\}.$$

If we let $Z = \left\{\left(\dfrac{1}{32}\right)[(1-2c)^2 + 16w_a(1-w_a)] - \dfrac{3(1-c)^2}{32}\right\}$, then the first-order-condition reduces to

$[3 + 2c - 4w_a](1 - 2w_a) = 16Z$; which can be simplified to

(A.12) $\quad A_3 w_a^2 + B_3 w_a + C_3 = 0$

Where $A_3 \equiv 32$; $B_3 = -4(9 + 2c)$; and $C_3 = 8 + 2c - c^2$. We can use the quadratic formula to get the

wage, which we denote by $w_a^{s(a)}$. Substituting this value into (A.9) yields $w_b^{s(a)}$.

Case 4: Sequential Bargaining with Firm *b* Going First

We start by looking at the bargaining between the union and firm a with w_b fixed. The wage bill

is now given by

(A.13) $\quad \theta(w_a | w_b) = (1/3t^2)\{w_b[t(1-2c) - 2w_b] + w_a t[2w_b + t(1+c)] - 2t^2 w_a^2\}$

If the union fails to reach an agreement with firm a, firm b becomes a monopolist and the union's wage

bill is $(w_b / 2t^2)[t(1 - c) - w_b]$, so, this is the union's threat point. Thus, w_a maximizes

$$\left\{ \left(\frac{1}{3t^2} \right) \left[w_b[t(1 - 2c) - 2w_b] + w_a t[2w_b + t(1 + c)] - 2t^2 w_a^2 \right] - \frac{w_b}{2t^2}[t(1 - c) - w_b] \right\}^{1/2} \left\{ \frac{t(1 + c - 2w_a) + w_b}{3t} \right\}$$

If we let $M = \left\{ \left(\frac{1}{3t^2} \right) \left[w_b[t(1 - 2c) - 2w_b] + w_a t[2wb_2 + t(1 + c)] - 2t^2 w_a^2 \right] - \frac{w_b}{2t^2}[t(1 - c) - w_b] \right\}$, then the

first-order condition can be written as $[t(1 - 2w_{a1} + c) + w_2][2w_2 + t(1 + c) - 4tw_1] = 12t^2 M$. If we

now substitute for M and simplifying we obtain

$$16t^2 w_a^2 - 2t[5t(1 + c) + 8w_b]w_a + t^2(1 + c)^2 + 5t(1 + c)w_b + 4w_b^2 = 0$$

Applying the quadratic formula yields

(A.14) $w_a(w_b) = (1/8t)[t(1 + c) + 4w_b]$

We are now ready to look at the bargaining between firm b and the union. Using (A.14) the

union's wage bill as a function of w_b is given by

(A.15) $\theta(w_b) = \frac{1}{32t^2}\left\{ t^2(1 + c)^2 + 16w_b t(1 - c) - 16w_b^2 \right\}$

and firm b's profits are

(A.16) $\pi(w_b) = \left\{ \frac{t(3 - 5c) - 4w_b}{8t} \right\}^2$

So, from (A.15) and (A.16), w_b maximizes

$$\left\{ \frac{1}{32t^2}\{ t^2(1 + c)^2 + 16w_b[t(1 - c) - w_b] \} - \frac{3}{32} \right\}^{1/2} \left\{ \frac{t(3 - 5c) - 4w_b}{8t} \right\}$$

If we let $K = \left\{ \frac{1}{32t^2}\{ t^2(1 + c)^2 + 16w_b[t(1 - c) - w_b] \} - \frac{3}{32} \right\}$, then the first order condition reduces to

$[t(1 - c) - 2w_b][t(3 - 5c) - 4w_b] = 16t^2 K$. After substituting for K and simplifying we get

(A.17) $A_4 w_b^2 + B_4 w_b + C_4 = 0$

where $A_4 \equiv 32$; $B_4 = -4t(9-11c)$; and $C_4 = t^2\{8-18c+9c^2\}$. We can use the quadratic formula to get the wage, which we denote by $w_b^{s(b)}$. Substitution of this value into (A.14) then yields $w_a^{s(b)}$.

With the wages determined, (3), (4), (A.1) and (A.2) can be used to determine profits and the wage bill under each of the bargaining mechanisms.

B. Preference Orderings when the Firms Differ in Non-Labor Costs

In all cases, we must have $c \leq .342$. With this in mind, for the union we have

$$\theta^{p(a)} \geq \theta^{p(b)} \geq \theta^{s(a)} \geq \theta^{s(b)} \qquad \text{if } c \leq .2702$$

$$\theta^{p(a)} \geq \theta^{s(a)} \geq \theta^{p(b)} \geq \theta^{s(b)} \qquad \text{if } .2702 \leq c \leq .3127$$

$$\theta^{p(a)} \geq \theta^{s(a)} \geq \theta^{s(b)} \geq \theta^{p(b)} \qquad \text{if } .3127 \leq c$$

Turn next to the firms. We obtain

$$\Pi^{s(b)} \geq \Pi^{s(a)} \geq \Pi^{p(b)} \geq \Pi^{p(a)} \qquad \text{if } c \leq .2052$$

$$\Pi^{s(b)} \geq \Pi^{p(b)} \geq \Pi^{s(a)} \geq \Pi^{p(a)} \qquad \text{if } .2052 \leq c \leq .2630$$

$$\Pi^{p(b)} \geq \Pi^{s(b)} \geq \Pi^{s(a)} \geq \Pi^{p(a)} \qquad \text{if } .2630 \leq c \leq .2646$$

$$\Pi^{p(b)} \geq \Pi^{s(b)} \geq \Pi^{p(a)} \geq \Pi^{s(a)} \qquad \text{if } .2646 \leq c$$

For Consumer Surplus (CS) we have

$$CS^{s(b)} \geq CS^{s(a)} \geq CS^{p(b)} \geq CS^{p(a)} \qquad \text{for all } c$$

References

Budd, J. (1992). The determinants and extent of UAW pattern bargaining. *Industrial and Labor Relations Review* 45(3): 523-39.

Budd, J. (1995). The internal union political imperative for UAW pattern bargaining. *Journal of Labor Research* 16(1): 43-55.

Creane, A. (2007). Productivity information in vertical sharing agreements. *International Journal of Industrial Organization* 25(4), 821–841.

Creane, A. and C. Davidson (2007). Pattern bargaining as an equilibrium outcome. Michigan State University Working Paper.

Doms, M.; T. Dunne and K. Troske (1997). Wages, workers, and technology. *Quarterly Journal of Economics* 112(1): 252-90.

Hopenhayn, H. (1992). Entry, exit and firm dynamics in long-run equilibrium. *Econometrica* 60(5): 1127-50.

Kreps, D. and J. Scheinkman (1983). Quantity precommitment and Bertrand competition yield Cournot outcomes. *Bell Journal of Economics* 14(2): 326-37.

Lieberman, M. and R. Dhawan (2005). Assessing the resource base of Japanese and U.S. auto producers: A stochastic frontier production function approach. *Management Science* 51(7): 1060-75.

Marshall, R. and A. Merlo (2004). Pattern bargaining. *International Economic Review* 45(1): 239-55.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate productivity. *Econometrica* 71(6): 1695-1725.

Mortensen, D. and C. Pissarides (1994). Job creation and job destruction in the theory of unemployment. *Review of Economic Studies* 61(3): 397-415.

Rubinstien, A. (1982). Perfect equilibria in a bargaining model. *Econometrica* 50: 97-109.

Varian, H. (1985). Price discrimination and social welfare. *American Economic Review* 75(4): 870-75.

Williamson, O. (1968). Wage rates as a barrier to entry: The Pennington case in perspective. *Quarterly Journal of Economics* 82: 55-116.
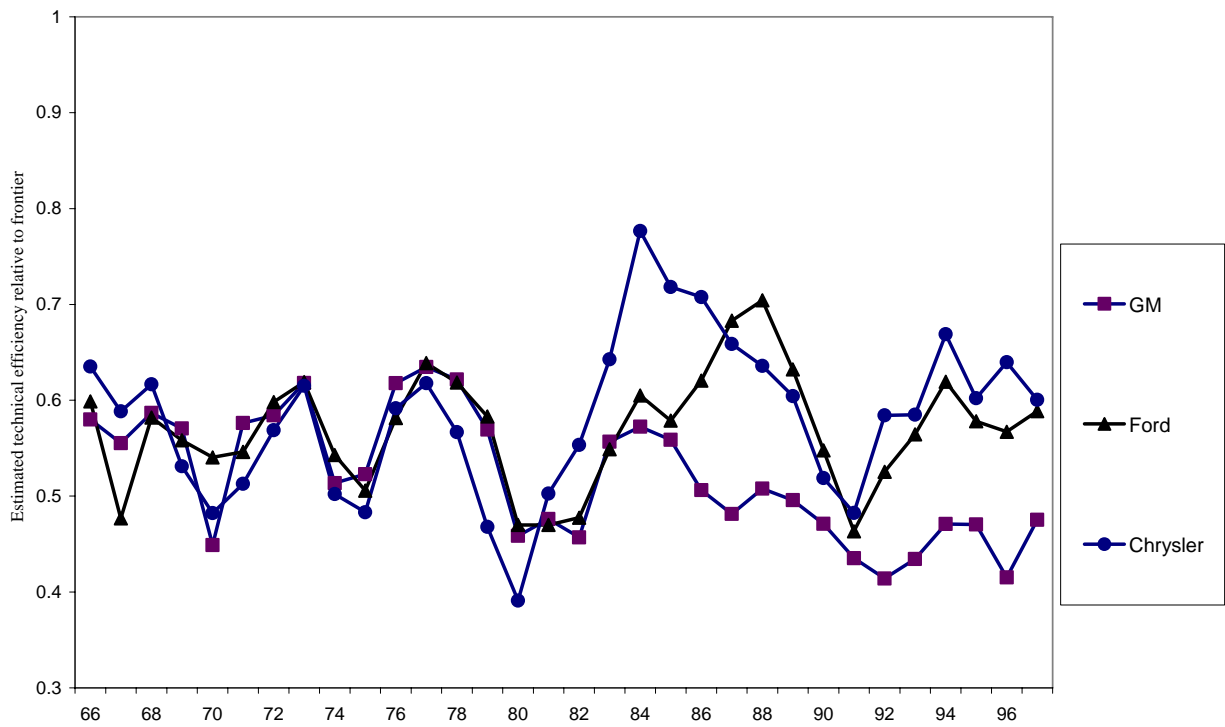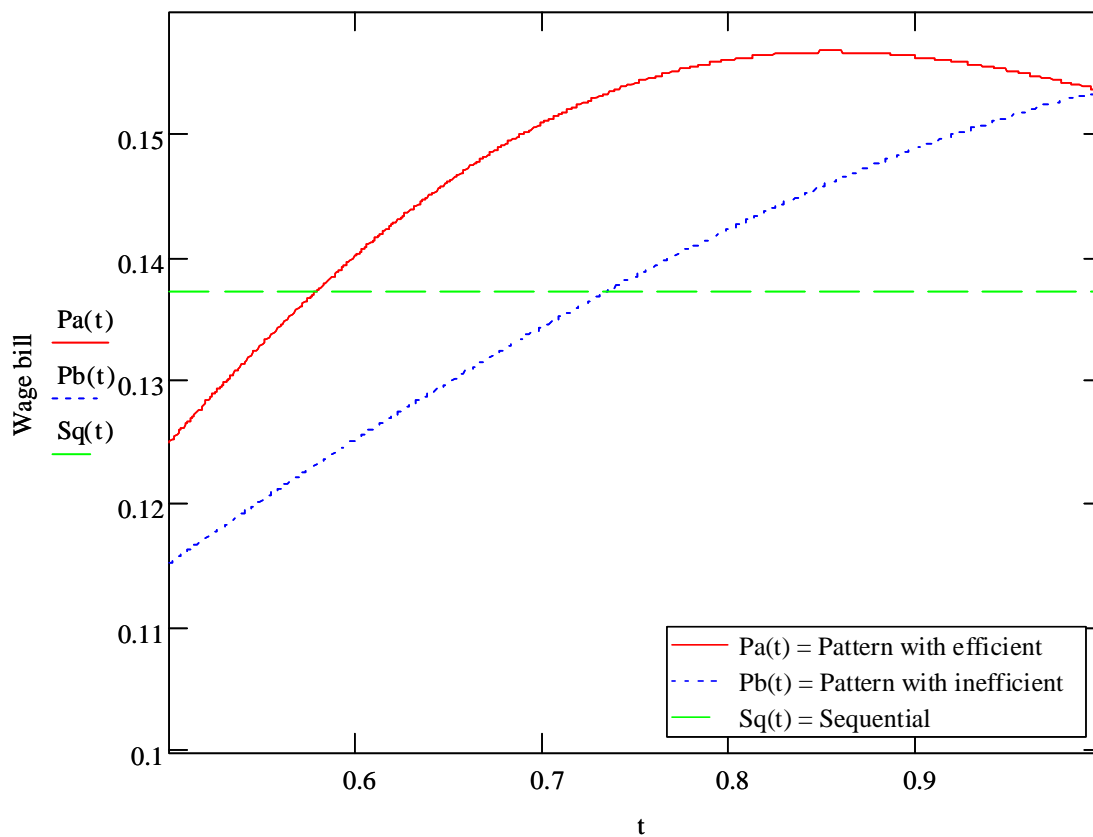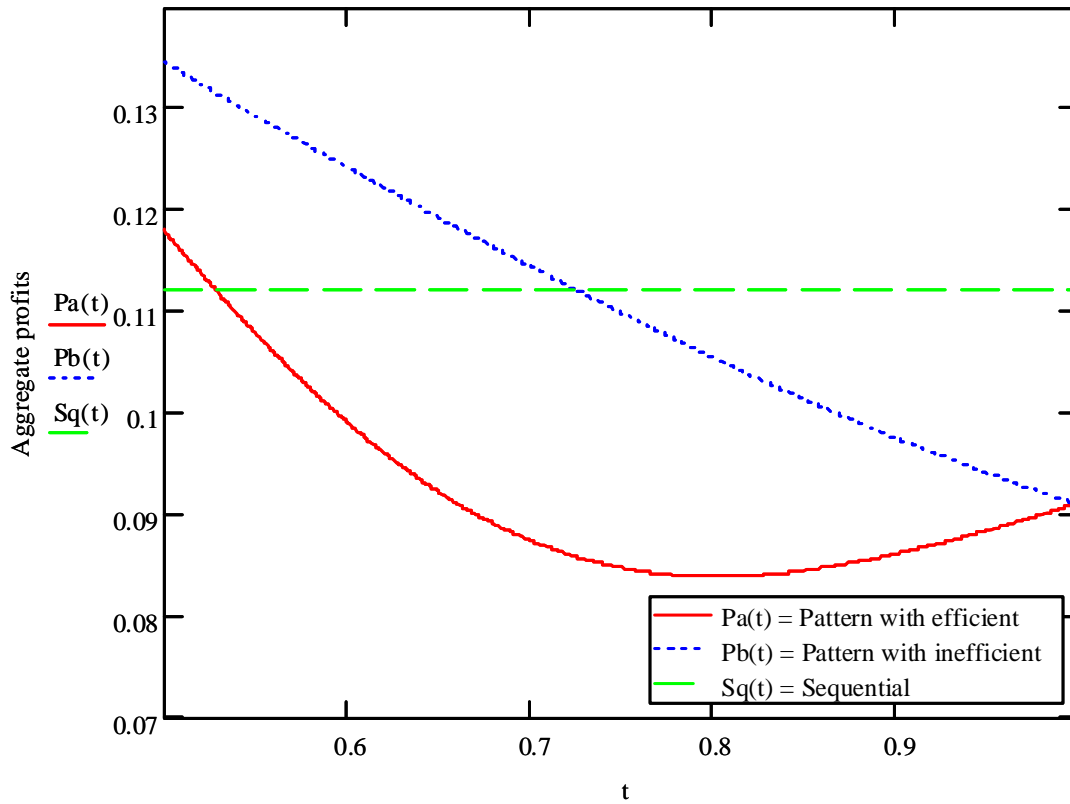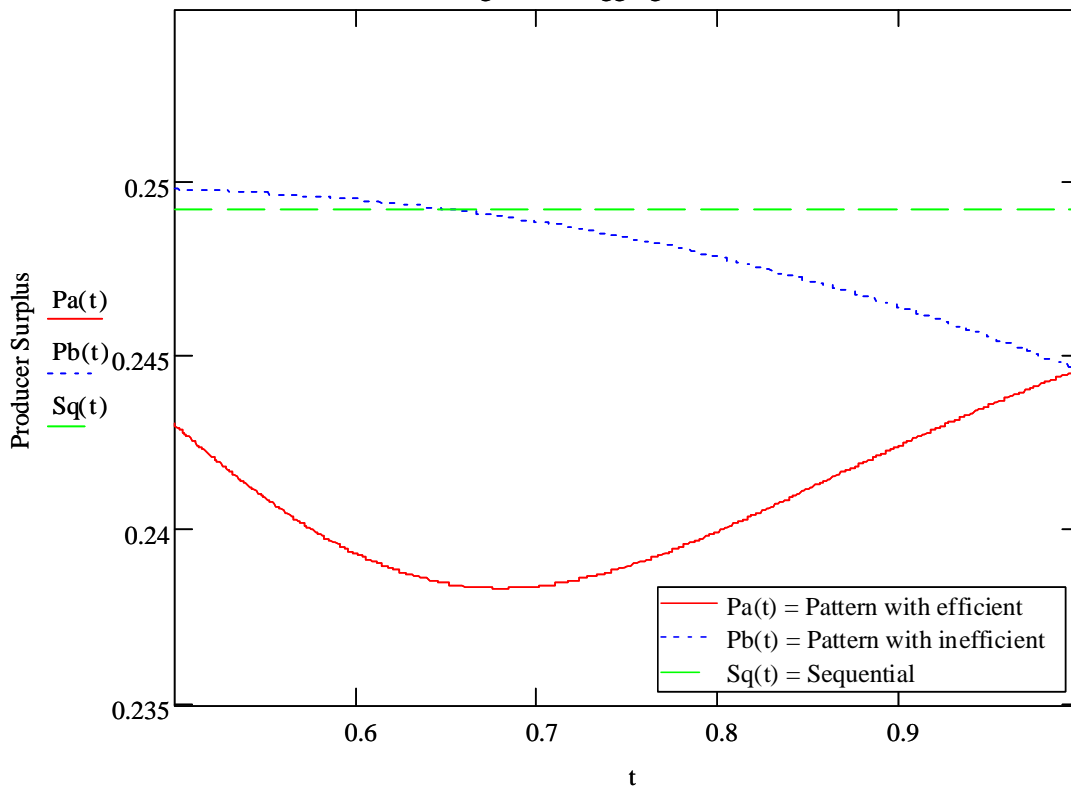
Figure 1 - Technical Efficiency by Firm and Year

Firm b's productivity parameter

Figure 2a - Wage Bill

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Firm b's productivity parameter

Figure 2b - Aggregate Profits

Firm b's productivity parameter
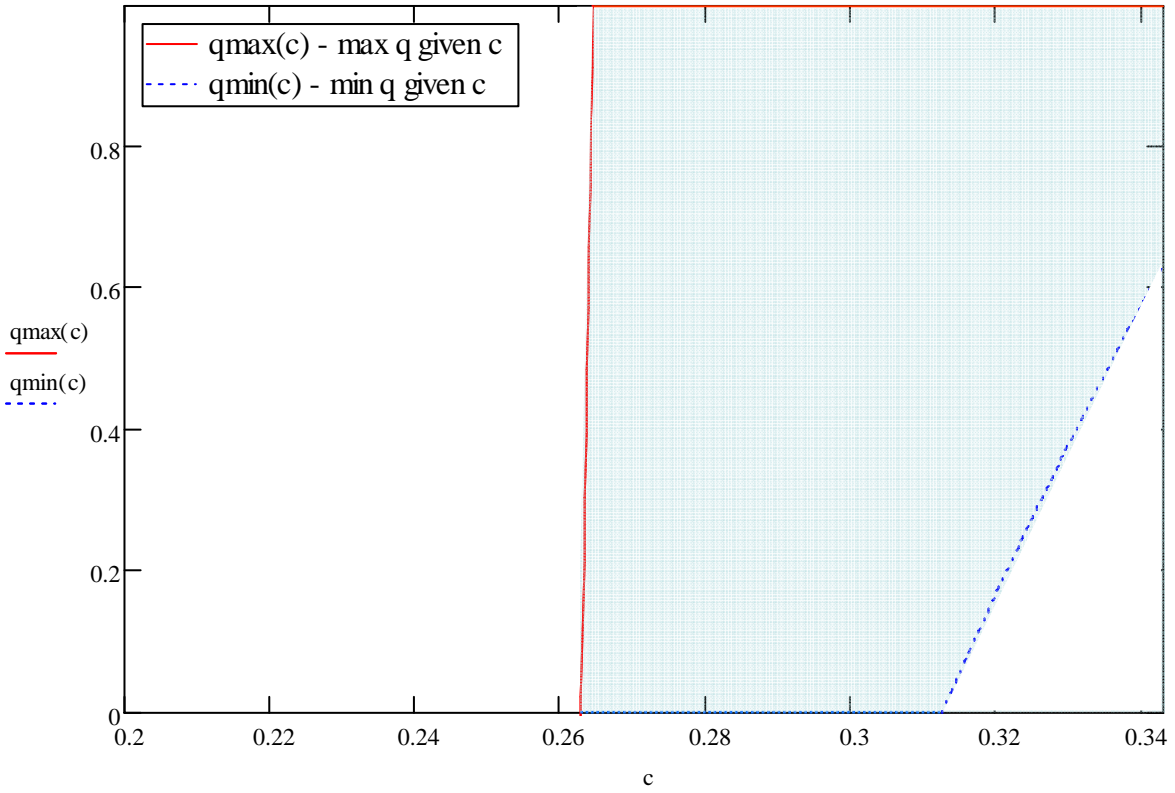
Figure 2c - Producer surplus (wage bill + aggregate profits)

Figure 3 - Critical q for pattern bargaining