Trust, Strikes and Unemployment

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Abstract

Our paper examines the interactions between trust (between labor and capital), strikes, and unemployment. It is motivated by two facts. A cross-country fact: OECD countries with higher strike activity in the 1960s have experienced a larger increase in unemployment since then. A time series fact: While unemployment has typically increased since the 1970s, strike activity has decreased, often dramatically.

To think about these facts, we explore the implications a model in which firms and workers bargain under asymmetric information about the productivity of the match. In this context, strikes naturally arise as a tool used by workers to induce firms to tell the truth. We proceed in three steps. First, we characterize equilibrium unemployment and strikes under the assumption of one-shot bargaining. Second, we characterize the conditions under which firms may invest in reputation, so as to avoid or at least reduce the incidence of strikes. Third, we endogenize the technological choice of firms, allowing them to reduce bargaining problems through the choice of a more certain technology. We then use the model to offer interpretations for the two basic facts.

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Our paper examines the interactions between trust (between labor and capital), strikes and unemployment.

It is motivated by two basic facts. The first, that we documented in an earlier paper [Blanchard and Philippon 2005], is a cross country fact: Looking across the set of OECD countries, countries which had higher levels of strikes in the 1960s have typically experienced a larger increase in unemployment since then. The second is a time series fact: While unemployment has typically increased since the late 1960s, the level of strikes has decreased typically since the late 1970s, often sharply so.

The first fact is what motivated our earlier paper, as it is suggestive of a causal link from low trust to strikes and to unemployment. The second however presents a challenge to this line of explanation. One might have expected that adverse shocks would lead to both more strikes and more unemployment. Unemployment has increased, but strikes have decreased.

Our goal in this paper is thus to explore the potential interactions between trust, strikes, and unemployment, with the ultimate goal of offering potential interpretations for these two facts. We proceed in three steps:

(1) We first look at an environment in which equilibrium in the labor market exhibits both unemployment and strikes. We do so by extending a standard matching/bargaining model to allow for asymmetric information about match productivity. In such an environment, firms have an incentive to understate true productivity so as to get the workers to accept a lower wage. Strikes are then the tool used by workers to induce firms to reveal the truth. In equilibrium, the announcement by a firm that productivity is low leads with some probability to a strike, and, conditional on the strike, to the possibility of a bargaining failure and the inefficient end of the match. Changes in the economic environment, such an increase in the range of productivity, which, under full information, would have no or little effect on unemployment, lead here to strikes, and higher unemployment.

(2) Our first model captures the effects of asymmetric information on strikes and unemployment under the assumption that workers simply do not trust firms. Firms however may want to invest in reputation, and thus, in this sense, create trust. Our second step is therefore to look at the scope for and the implications of reputation in our earlier model. We derive the conditions under

which a reputational equilibrium exists, an equilibrium in which, at least for some firms, the short-term costs of telling the truth are less than or equal to the long-term benefits of reputation, namely a lower probability of strikes and bargaining failures.

We show how the equilibrium proportion of firms deciding to invest in reputation depends on two sets of parameters. It depends first on the parameters of the economic environment: A higher range of productivity for example makes it more difficult to sustain reputation, decreases the proportion of firms investing in reputation, and leads to more strikes. It also depends on a parameter which we introduce to capture what we see as intrinsic differences in trust across countries, the probability that workers will disregard the good reputation of the firm when bargaining. The higher this probability, the smaller the incentives for the firms to invest in reputation in the first place, the higher the level of strikes, and the higher is unemployment.

We then look at the effects of various changes in the economic environment on unemployment and strikes. A higher range of productivity may lead, for example, to both a higher probability of strikes in firms without reputation, and a decrease in the number of firms with reputation: Both effects amplify the direct effect of the shock on unemployment. Intrinsic differences in trust also determine the effects of such changes. A higher range of productivity may have little or no effect on unemployment in an economy with high trust, but a much larger effect in an economy with low trust.[1]

(3) This last result suggests a potential explanation for the cross-country relation between strikes in the 1960s and subsequent unemployment: In response to adverse shocks, countries with less trust have seen a larger effect on unemployment. But this does not fit the time series facts well: Strikes often increased in the 1970s, but have typically decreased since then. This leads us to explore another dimension in which firms can deal with the problem of asymmetric information, namely by adopting different technologies. One can think of various ways firms may do so, by shifting to more capital-intensive technologies and reducing the role of labor and thus of bargaining, or by reducing uncertainty and

1. The argument is similar in essence, if not in details, to the argument by Sargent and Ljundqvist [2003] that differences in labor market institutions led to a much stronger effect of turbulence on unemployment in Europe than in the United States. Sargent and Ljundqvist focus however on a different interaction—between unemployment insurance and turbulence—and on a different dimension of turbulence.

thus reducing the problem created by asymmetric information. We take the second approach. We start from the previous model, but now allow firms to choose between the existing technology, and a technology with lower expected return, but also lower uncertainty. We show the implications of this choice for strikes and unemployment. The results suggest it can provide a potential explanation for the cross country and time series facts.

The paper is organized as follows. Section 1 presents basic facts about unemployment and strikes across OECD countries since 1970. Section 2 develops the matching/bargaining model with asymmetric information. Section 3 extends the model to look at the scope for reputation. Section 4 extends the model to look at endogenous technological choice. Section 5 concludes.

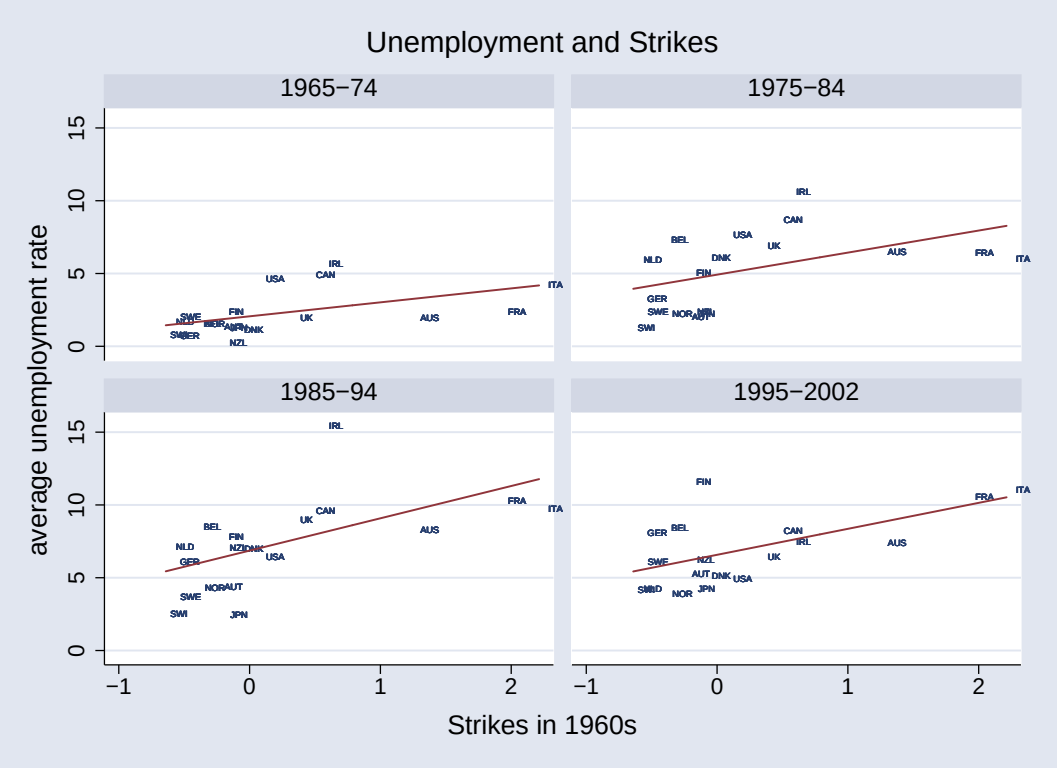
A word of warning is in order here. We see this draft more as an exploration of the issues than a convincing account of the role of trust in labor markets or its impact on unemployment. This is for at least two reasons. The first is that the draft is preliminary and incomplete. The second, which will remain even after completion, is that we believe that more is at play than disagreements about facts; in many continental European countries, the models used by unions and firms to interpret the facts are profoundly different (In Blanchard and Phillipon [2005], we focus on one such difference, namely the perceived elasticity of capital supply). These differences are important, and go beyond those formalized in this paper.

1 Basic facts

Figure 1 plots the relation between strike intensity in the 1960s and unemployment in subsequent periods across 19 OECD countries.

The rationale and the details of construction for the strike intensity variable are given in Blanchard and Philippon [2005]. In short, the variable is constructed as the maximum of two normalized measures of strike intensity, days lost in strikes per worker, and the proportion of workers involved in strikes, both variables from the CEP-LSE data set. The variable used in the graph is the average of this variable over 1960 to 1967. The rationale for choosing the average over that period is to use a measure of labor conflicts that predates the general increase in unemployment—which took place from the early 1970s on. The

reason for stopping in 1967 rather than, say, 1970, is that, in the late 1960s, many European countries, especially France, Germany, and Italy, were affected by social and political unrest, for reasons largely unrelated to the quality of labor relations. Also, as Spain and Portugal were dictatorships in the 1960s and strikes were illegal, the two countries are excluded from the graph.



The figure shows a clear relation between strike intensity and the unemployment rate. Countries with high strike intensity in the 1960s have experienced a larger increase in unemployment since then.

If one thinks of higher strike intensity as reflecting, at least in part, lower trust between labor and capital, this correlation is suggestive of a causal link from trust to the effects of adverse shocks on unemployment. And this potential interpretation is strengthened by the high negative correlation between strike intensity in the 1960s, and a measure of trust between labor and capital today. This is shown in Figure 2, taken from Blanchard and Phillipon. The variable on the vertical axis is constructed as the country average of the answers to a 1999 World Economic Forum survey of firms on the degree of cooperation

in labor relations within the firm. The variable on the horizontal axis is the same measure of strike intensity as in Figure 1. The countries with poor labor relations today are typically countries with high strike intensity in the 1960s.

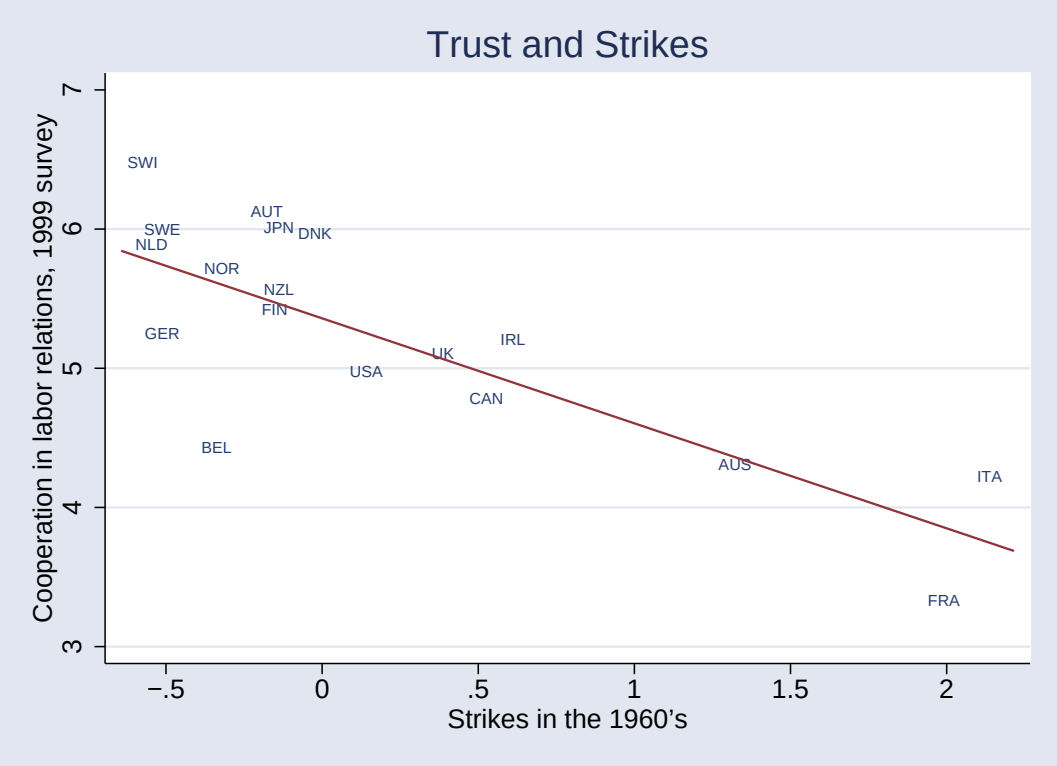
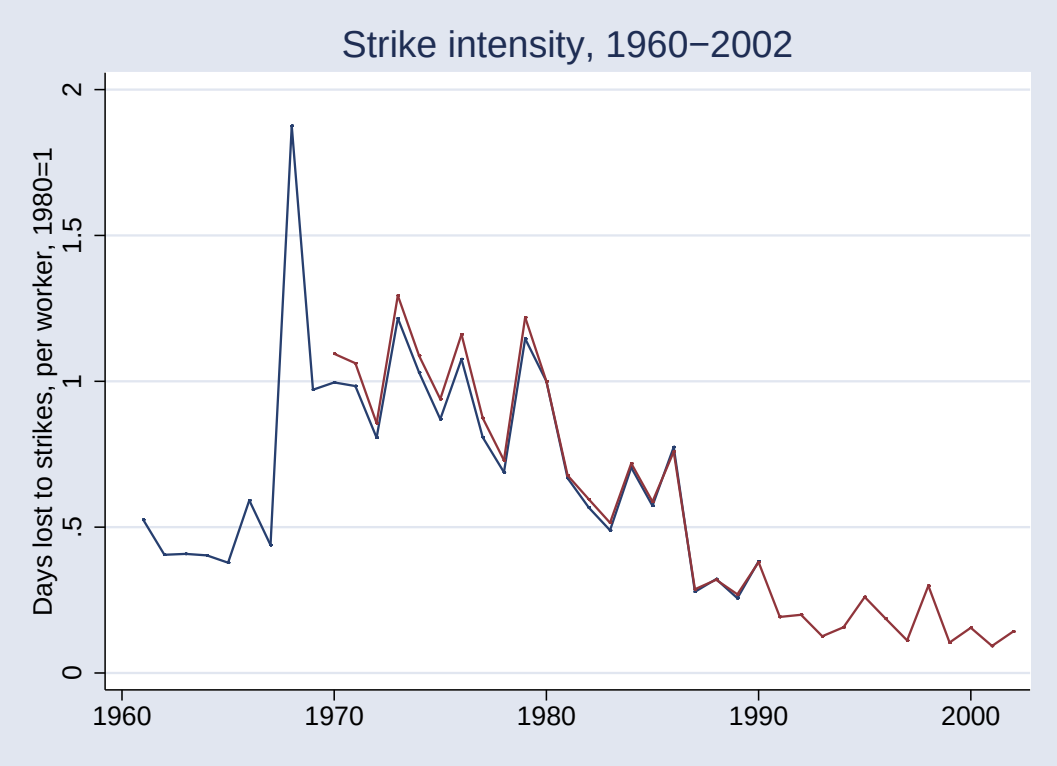


Figure 3 shows however one of the challenges faced by this interpretation. It plots the evolution of two measures of strike intensity for the same set of countries since the early 1960s. Both are based on numbers of days lost in strikes. The first measure, from CEP-LSE is available from the early 1960s to 1990. The other, constructed by Lesch [2005], is available from 1970 to 2003. The figure yields a clear conclusion. Leaving aside 1968, strike intensity went up in the 1970s, but has considerably decreased since. If this reflected improved trust, one might have expected unemployment to decrease as well. But, as is well known, unemployment, after increasing in the 1970s and 1980s, has remained high since then.

The strong positive cross-country relation, and the negative time series relation,



are what motivate our exploration of the relation between trust, strikes and unemployment.

2 Asymmetric information, strikes and unemployment

Our modeling strategy is to embed a model of bargaining under asymmetric information in an otherwise standard matching/search model of the labor market (along the lines of Pissarides 2000). In that context, strikes are the device used by workers to induce firms to tell the truth.

We start by describing bargaining. We then describe the macroeconomic closure, and characterize the equilibrium, and the determinants of strikes and unemployment.

2.1 Bargaining

Once a firm and a worker have matched, the initial productivity of the match is revealed to the firm.

Productivity, y, can take one of two values, high (y^h) with probability p, or low (y^l) with probability $(1-p)$. Average productivity, $(p\ y^h + (1-p)\ y^l)$ is denoted by $\bar{y}$.

Associated with the two levels of productivity are the surpluses associated with the match, $S(y^h)$ and $S(y^l)$, $S(y^h) \geq S(y^l)$. The relation of the surplus to productivity depends on the rest of the model and will be derived later. Both $S(y^h)$ and $S(y^l)$ are assumed positive: The surplus is positive even if productivity is low. The average surplus is denoted $\bar{S}$.

Let U denote the value for the worker of being unemployed and V the value for the firm of having a vacancy. Let $J(y)$ and $W(y)$ be respectively the values for the firm and for the worker of being in a match with productivity y. Then, by definition:

$$(J(y) - V) + (W(y) - U) = S(y) \tag{1}$$

Bargaining determines the values of $J(y)$ and $W(y)$ given $S(y), V$ and U. We formalize bargaining as follows:

- The firm makes an offer $W(y)$.
- The worker either accepts the offer, with probability $(1-s)$, or rejects the offer (strikes), with probability s (The probability of strike is endogenous and will be determined in equilibrium.)
- If the worker accepts the offer, the match takes place.
- If the worker rejects the offer, the match ends with probability γ; the worker and the firm get U and V respectively. With probability $(1-\gamma)$, the worker makes a counter-offer W^c. If the firm accepts the offer, the match takes place. If the firm rejects the offer, the match ends.

This structure of bargaining is clearly specific, but captures what we want, namely the role of asymmetric information and the potential role of strikes. Asymmetric information gives an incentive for firms to announce that productivity is low even when it is high, and get workers to accept a lower W. By using the threat of a strike if the firm announces low productivity, workers can induce the firm to tell the truth. This comes however with an efficiency cost, a positive probability of an inefficient end to the match.

We now derive the bargaining outcome. We focus on the separating equilibrium, where the firm tells the truth about productivity. Under that condition, we can solve for the equilibrium backwards:

The counteroffer by the worker will clearly be such as to extract all the surplus from the match. Thus:

$$W^c(y) = S(y) + U$$

and, by implication

$$J^c(y) = V$$

The lowest initial offer by the firm the worker will accept is therefore;

$$W(y) = \gamma\ U + (1-\gamma)W^c(y) = U + (1-\gamma)S(y) \tag{2}$$

and by implication

$$J(y) = V + \gamma\ S(y) \tag{3}$$

The firm gets a share γ of the surplus, the worker a share $(1-\gamma)$. The parameter γ therefore captures the bargaining power of the firm.

The condition that the firm tells the truth imposes an additional (truth telling) constraint: If productivity is high, the value for the firm of telling the worker that productivity is high must be at least equal to the value of telling the worker that productivity is low:

$$\begin{aligned} S(y^h) - W(y^h) + U + V \quad \geq \quad & (1-s)(S(y^h) - W(y^l) + U + V) \\ & +s(1-\gamma)(S(y^h) - W^c(y^l) + U + V) + s\gamma\ V \end{aligned}$$

The LHS gives the value to the firm of telling the worker that productivity is high. The RHS gives the expected value of telling the worker instead that productivity is low. The first term represents the value to the firm if the worker accepts the offer $W(y^l)$, something that happens with probability $(1-s)$. The second term represents the value to the firm if the worker strikes and makes the counteroffer $W^c(y_l)$, something that happens with probability $s(1-\gamma)$. The third term represents the value to the firm if the strike leads to the end of the match, something which happens with probability $s\gamma$.

Using the equations for $W(y)$ and $W^c(y)$ above, the constraint can be rewritten to give the equilibrium probability of a strike. Assuming the earlier condition holds as an equality (there is no reason for workers to choose a higher strike

probability than the minimum required to induce truth telling):

$$s = \frac{1-\gamma}{\gamma} \frac{S(y^h) - S(y^l)}{S(y^h)} \tag{4}$$

The probability of a strike when the firm announces that productivity is low is an increasing function of $S(y^h) - S(y^l)$: Given that the firm gets a share of the surplus, the higher the difference between the surplus in the high and the low productivity states, the larger the value to the firm of announcing low productivity when productivity is in fact high, and so the higher the probability of a strike required to deter the firm from not telling the truth.

The positive probability of a strike, and of a subsequent end to the match, implies that some matches will not take place despite the fact that they have positive surplus. The average deadweight loss due to asymmetric information is given by:

$$\bar{D} = (1-p)\ s\ \gamma S(y^l) \tag{5}$$

It is useful for later to compute the average value of a match to a worker and to a firm, pre-bargaining. Denote them by $\bar{W^e}$ and $\bar{J^e}$. They are given by:

$$\begin{aligned} \bar{W^e} &= p\ W(y^h) + (1-p)[(1-s)W(y^l) + s(1-\gamma)W^c(y^l)) + s\ \gamma U] \\ \bar{J^e} &= p[V + \gamma S(y^h)] + (1-p)[(1-s)(V + \gamma S(y^l))] \end{aligned}$$

Or, using the equations above:

$$\bar{W^e} = \{U + (1-\gamma)\bar{S}\} \tag{6}$$

$$\bar{J^e} = \{V + \gamma\bar{S}\} - \bar{D} \tag{7}$$

In each case, the term in curly brackets is the value of the match, absent strikes. For the worker, the value of the match, pre-bargaining, is equal to the value of the match in the absence of strikes. In contrast, for the firm, the value of the match, pre-bargaining, is equal to the value of the match in the absence of strikes, minus the deadweight loss implied by the positive probability of a strike if productivity is low. In other words, the (partial equilibrium) incidence of the deadweight loss falls fully on the firm, not on the worker.

2.2 Macroeconomic closure

The macroeconomic closure follows closely the standard matching/bargaining model:

- There is a mass of workers of size 1, with u workers unemployed, and $(1-u)$ workers employed. The mass of vacancies is equal to v, and is endogenously determined.
- Matches are determined by a constant returns matching function $m(u,v)$. Defining $\theta \equiv v/u$, so θ measures the tightness of the labor market, the matching rate for vacancies, $q(\theta) \equiv m/v = m(1/\theta, 1)$ is a decreasing function of θ. The matching rate for the unemployed is in turn equal to $\theta q(\theta)$ and is an increasing function of θ.
- Once a firm and a worker have matched, the productivity y of the match is drawn from the distribution described earlier. It remains constant until, with probability λ per unit of time, a new productivity is drawn from the same distribution, and, with probability δ per unit of time, the match becomes unproductive and ends.

From these assumptions, it follows that the surplus associated with a match with productivity y is given by:

$$rS(y) = (y - r(U+V)) - \delta S(y) + \lambda(\bar{S} - \bar{D} - S(y))$$

The first term in parentheses on the RHS gives the flow value of the match, productivity net of the opportunity cost. The second gives the capital loss associated with the end of the match, times the probability that such a change takes place. The third gives the expected capital gain or loss associated with a new draw for productivity, times the probability that such a change takes place. As we saw earlier, the expected value of the new surplus, pre-bargaining is equal to the expected surplus, net of the expected deadweight loss coming from the positive probability that a strike takes place.

Define $\Delta \equiv y^h - y^l$. It follows from the equation above that $S(y)$ is given by:

$$S(y^h) = \bar{S} + (1-p)\ \Delta/(r+\delta+\lambda) \quad (8)$$

$$S(y^l) = \bar{S} - p\ \Delta/(r+\delta+\lambda) \quad (9)$$

where $\bar{S}$, the average surplus from a match is given by:

$$\bar{S} = (\bar{y} - r(U+V) - \lambda\bar{D})/(r+\delta) \tag{10}$$

These equations imply a simple relation between differences in productivity and differences in the associated surplus:

$$S(y^h) - S(y^l) = \Delta/(r+\delta+\lambda) \tag{11}$$

Let b the flow utility associated with being unemployed, and c be the flow cost of having a vacancy. The equations for the value of being unemployed, and for the value of a vacancy, are given in turn by:

$$rU = b + \theta q(\theta)(\bar{W}^e - U) \tag{12}$$

$$rV = -c + q(\theta)(\bar{J}^e - V) \tag{13}$$

where, from above, $\bar{W}^e$ and $\bar{J}^e$ are the pre-bargaining values of a match to the worker and to the firm respectively.

Finally, free entry implies that the value of a vacancy V must be equal to zero.

2.3 A characterization of the equilibrium

We can now derive the equilibrium level of labor market tightness, and by implication, the equilibrium level of unemployment and strikes in the economy.

From equations (7), (13), and the free entry condition:

$$\frac{c}{q(\theta)} = \gamma\bar{S} - \bar{D} \tag{14}$$

This is a familiar relation, linking the degree of tightness to the average surplus from a match. The difference with the standard case is the presence of the deadweight loss due to asymmetric information and strikes. The higher the surplus, or the lower the deadweight loss, the tighter the labor market.

Using equations (6), (10), (12) and the free entry condition, the average surplus is in turn given by:

$$\bar{S} = \frac{\bar{y} - b - \lambda\bar{D}}{r + \delta + (1-\gamma)\theta q(\theta)} \tag{15}$$

This is again a familiar relation, giving the surplus as the properly discounted value of productivity net of flow utility of being unemployed. The difference is again the presence of the deadweight loss, coming from the fact that changes in productivity in the future may lead to a strike and the inefficient end of the match.

From equations (4), (5), and (11), the average deadweight loss is given by:

$$\bar{D} = (1-p)(1-\gamma)\ \frac{S(y^l)}{S(y^h)}\ \frac{\Delta}{r+\delta+\lambda}$$

where $S(y^h)$ and $S(y^l)$ are given by equations (8) and (9).

Together, these equations determine the equilibrium degree of tightness, and by implication, the other variables in the model. In particular, unemployment is given by:

$$\dot{u} = (\delta + \lambda(1-p)\gamma s)\ (1-u) - \theta q(\theta)(1-(1-p)\gamma s)u$$

The equation reflects the fact that some separations are due to bargaining failures in response to changes in the productivity of existing matches, and some hirings do not lead to a match, again due to a bargaining failure. For $\dot{u} = 0$ (as we are limiting ourselves to look at steady states), the unemployment rate is thus given by:

$$u = \frac{\delta + \lambda(1-p)\gamma s}{\delta + \lambda(1-p)\gamma s + \theta q(\theta)(1-(1-p)\gamma s)}$$

For given tightness, asymmetric information leads to larger outflows and thus to higher unemployment.

The system is easy to solve numerically, and we shall turn to simulations later (after we have extended the model to allow for reputation). But, if Δ is small relative to $\bar{y} - b$, a convenient approximation is available and allows for simple comparative statics. In that case, $S(y^h)/S(y^l)$ is approximately equal to one, and so:

$$\bar{D} \approx (1-p)(1-\gamma)\ \frac{\Delta}{r+\delta+\lambda}$$

The deadweight loss only depends on exogenous parameters.

Combining equations (14) and (15) gives an implicit characterization of equilibrium tightness:

$$\frac{c}{q(\theta)} = \gamma \frac{\bar{y} - b - \lambda \bar{D}}{r + \delta + (1-\gamma)\theta q(\theta)} - \bar{D}$$

where $\bar{D}$ depends now on exogenous parameters. Note that the LHS is increasing in θ, and the RHS decreasing in θ, so the equilibrium is unique.

Comparative statics yield standard results. Of interest here are the parameters which affect the deadweight loss, in particular Δ: An increase in Δ, which we can think of as coming for example from an increase in the uncertainty of demand facing firms, an increase in "turbulence"), leads to an increase in strikes, to an increase in the deadweight loss, and thus to a decrease in labor market tightness. The increase in strikes also leads to an increase in bargaining failures, and thus to an increase in separations. Thus, the unemployment rate increases on two counts, higher unemployment duration and higher flows. Note that, absent asymmetric information, and given our assumption that the surplus is positive even under low productivity, none of this would happen: The increase in Δ would have no effect on unemployment.

This first model captures the idea that asymmetric information leads to strikes and to unemployment. But it does not allow us to think about trust, or about variations in trust across countries or over time. To do so, we need to extend our model and think about the role of reputation. We do so in the next section.

3 Introducing trust

In our model, as in actual economies, firms engage in repeated bargaining, and may therefore want to establish a reputation for telling the truth. Under some circumstances, such a reputational equilibrium may exist and workers will trust firms when they announce productivity; under other others, it may not, and trust will not be present. This gives a way of thinking about trust, as an endogenous outcome depending on the economic environment.

Probably more is at work however in explaining differences in trust across countries. In some countries, establishing a reputation for telling the truth may be harder for firms than in others; workers may not trust firms even if they have

been truthful in the past, thus decreasing the incentives for firms to tell the truth in the first place. We can think of such differences as leading to exogenous differences in trust across countries.

In this section, we characterize the proportion of firms who invest in reputation in equilibrium, as a function of the economic environment and as a function of exogenous differences in trust.

As before, we start by focusing on bargaining, then turn to the macroeconomic closure, and a characterization of the equilibrium.

3.1 Bargaining

- Assume that firms can invest in reputation—tell the truth about productivity—or not. Let ρ denote the reputation of the firm: $\rho = g$ if the firm invests in reputation, $\rho = b$ if the firm does not. Reputation is match specific, and ends with the end of the match (a δ shock).
- Productivity is observable after bargaining, so that the worker can observe ex-post whether the firm has told the truth or not.
- If the firm has not told the truth, bargaining takes place from then on (every time there is a λ shock) according to the one-shot bargaining game described in the earlier section.
- If the firm has told the truth, the firm keeps its reputation. However, even when the firm has a good reputation, there is a probability α, $0 \leq \alpha \leq 1$ every time bargaining takes place (every time there is a λ shock), that it takes place according to the one-shot bargaining game described in the earlier section.

  We think of the parameter α as capturing exogenous differences in trust. If $\alpha = 0$, a firm that has invested in reputation will always be trusted by the worker. If $\alpha = 1$, a firm that which has invested in reputation will still never be trusted by the worker. Thus, it will have no incentive to invest in reputation, and the equilibrium will be identical to that described in the previous section.

We now need to index variables not only by the state of productivity, but also by the reputation of the firm. Thus, we denote by $S(y, \rho)$ the surplus of a match if current productivity is y, $(y = y^h, y^l)$, and current reputation is ρ, $(\rho = g, b)$ (For a given productivity, the surplus of a match will typically depend

on reputation, as this determines the likelihood of strikes and bargaining failures in future bargaining rounds.) We denote by $\bar{S}(\rho) \equiv p\ S(y^h, \rho) + (1-p)\ S(y^l, \rho)$ the average surplus if reputation is ρ.

We use a similar notation to denote the components of the surplus which go to the worker and to the firm, $W(y, \rho)$ and $J(y, \rho)$ respectively, the average value of these two components, $\bar{W}(\rho)$ and $\bar{J}(\rho)$, and the average value of these two components pre-bargaining, $\bar{W}^e(\rho)$ and $\bar{J}^e(\rho)$.

To describe the outcome of bargaining, start from the situation where firms have a reputation $\rho = g, b$, but bargaining still follows the one-shot bargaining game described earlier:

In this case, the derivation of the relation of $W(y, \rho)$ and $J(y, \rho)$ to $S(y, \rho)$ follows the same logic as before. Working backwards: The counteroffer by the worker will be such as to extract all the surplus from the match. Thus:

$$W^c(y, \rho) = S(y, \rho) + U, \qquad J^c(y, \rho) = V$$

The lowest initial offer by the firm the worker will accept is therefore given by:

$$W(y, \rho) = U + (1-\gamma)S(y, \rho), \qquad \text{so } J(y, \rho) = V + \gamma\ S(y, \rho) \tag{16}$$

The truth-telling condition gives the minimum strike probability which induces firms to tell the truth:

$$s(\rho) = \frac{1-\gamma}{\gamma}\ \frac{S(y^h, \rho) - S(y^l, \rho)}{S(y^h, \rho)} \tag{17}$$

The average deadweight loss is in turn given by:

$$\bar{D}(\rho) = (1-p)\ s(\rho)\ \gamma\ S(y^l, \rho) \tag{18}$$

Now consider the choice by a firm to invest in reputation. For the firm to invest in reputation—to tell the truth— it must be that the benefits of telling the truth exceed the costs. The condition therefore takes the form:

$$[S(y^h, g) - W(y^h, g) + U + V] + \frac{\lambda}{r + \delta + \lambda}\ \bar{J}^e(g) \geq$$

$$[S(y^h, g) - W(y^l, g) + U + V] + \frac{\lambda}{r + \delta + \lambda} \bar{J}^e(b)$$

The issue of whether the firm will tell the truth obviously arises only if productivity is high and the firm has a good reputation. The benefits from telling the truth are given by the RHS, the benefits from not telling the truth by the LHS. Not telling the truth increases the part of the surplus going to the firm today, but at the cost of a bad reputation (and thus strikes and potential bargaining failures) in future bargaining.

$\bar{J}^e(g)$ and $\bar{J}^e(b)$, the pre-bargaining values of a match to the firm are in turn given by:

$$\begin{aligned} \bar{J}^e(g) &= (1-\alpha)\gamma\bar{S}(g) + \alpha(\gamma\bar{S}(g) - \bar{D}(g)) = \gamma\bar{S}(g) - \alpha\bar{D}(g) \\ \bar{J}^e(b) &= \gamma\bar{S}(b) - \bar{D}(b) \end{aligned}$$

The pre-bargaining value of a match to the firm is equal to a fraction of the expected surplus minus the expected deadweight loss. Even if the firm has a good reputation, workers do not trust the firm with probability α, and thus the expected deadweight loss is equal to $\alpha\bar{D}(g)$. If the firm has a bad reputation, workers do not trust the firm with probability 1, and thus the expected deadweight loss is equal to $\bar{D}(b)$.

Using these equations as well as the equations for $W(y^h, g)$ and $W(y^l, g)$ above in the truth-telling constraint gives:

$$(1-\gamma)(S(y^h, g) - S(y^l, g)) \leq \frac{\lambda}{r + \delta + \lambda} [\gamma(\bar{S}(g) - \bar{S}(b)) - \alpha\bar{D}(g) + \bar{D}(b)] \quad (19)$$

Other things equal, an increase in α—a decrease in trust—makes it less likely that the constraint will be satisfied. To draw further implications, we need however to solve for the various surplus terms in the equation, and so we turn to the macroeconomic closure.

3.2 Macroeconomic closure

The macroeconomic closure is the same as before. Thus, going through the same steps gives the values of the surplus as a function of current productivity and

reputation:

$$(r+\delta)\bar{S}(g) = \bar{y} - rU - \lambda\alpha\bar{D}(g) \quad (20)$$

$$(r+\delta)\bar{S}(b) = \bar{y} - rU - \lambda\bar{D}(b) \quad (21)$$

and

$$S(y^h,\rho) = \bar{S}(\rho) + (1-p)\ \Delta/(r+\delta+\lambda) \quad (22)$$

$$S(y^l,\rho) = \bar{S}(\rho) - p\ \Delta/(r+\delta+\lambda) \quad (23)$$

The new key variable determined in equilibrium is the share of firms that do not invest in reputation, which we call μ. While for most parameter values, this equilibrium value is equal either to zero (in which case all firms invest in reputation) or to one (in which case no firm invests in reputation and the equilibrium is the same as in the previous section), it may be strictly between zero and one. The reason is that an increase in the share of firms investing in reputation makes it less attractive for a firm to invest in reputation. For a range of parameter values, if all other firms invest, it is not worth for a firm to invest; if no other firm invests, it is worth investing. In this case, the equilibrium μ is strictly between zero and one.

Recall that the value of the surpluses above depends on U, the value of being unemployed. Given μ, U is implicitly defined by:

$$rU = b + \theta q(\theta)(\mu\bar{W}(b) + (1-\mu)\bar{W}(g) - U)$$

As search is random, the worker has probability μ of matching with a firm with bad reputation, probability $(1-\mu)$ of matching with a firm with good reputation. Using equation (16), we can rewrite as this relation as:

$$(r+\theta q(\theta))U = b + \theta q(\theta)(1-\gamma)(\mu\bar{S}(b) + (1-\mu)\bar{S}(g)) \quad (24)$$

The free entry condition takes the form:

$$\frac{c}{q(\theta)} = \gamma[\mu\bar{J}^e(b) + (1-\mu)\bar{J}^e(g)]$$

Using equations for $\bar{J}^e(b)$ and $\bar{J}^e(g)$ above, we can rewrite this relation as:

$$\frac{c}{q(\theta)} = \gamma[\mu\bar{S}(b) + (1-\mu)\bar{S}(g)] - [\mu\bar{D}(b) + (1-\mu)\alpha\bar{D}(g)] \tag{25}$$

And, finally, the unemployment rate is given by:

$$u = \frac{(\delta + \lambda(1-p)\ \gamma\ [\mu\ s(b) + (1-\mu)\ \alpha\ s(g)))}{(\delta + \ \lambda(1-p)\ \gamma\ s) + \theta q(\theta)\ (1-(1-p)\gamma\ [\mu\ s(b) + (1-\mu)\ \alpha s(g)])} \tag{26}$$

3.3 A characterization of the equilibrium

The equilibrium is characterized by equilibrium values for tightness, θ, and the share of firms who invest in reputation, $(1-\mu)$. More precisely, the equilibrium is characterized by values for the four surpluses $S(y,\rho)$, the two average surpluses $\bar{S}(\rho)$, the two average deadweight losses $\bar{D}(\rho)$, the two probabilities of a strike $s(\rho)$, the value of being unemployed U, the tightness coefficient θ, the share of firms with reputation $(1-\mu)$, implied by equations (17) to (25). The unemployment rate is then determined by equation (26).

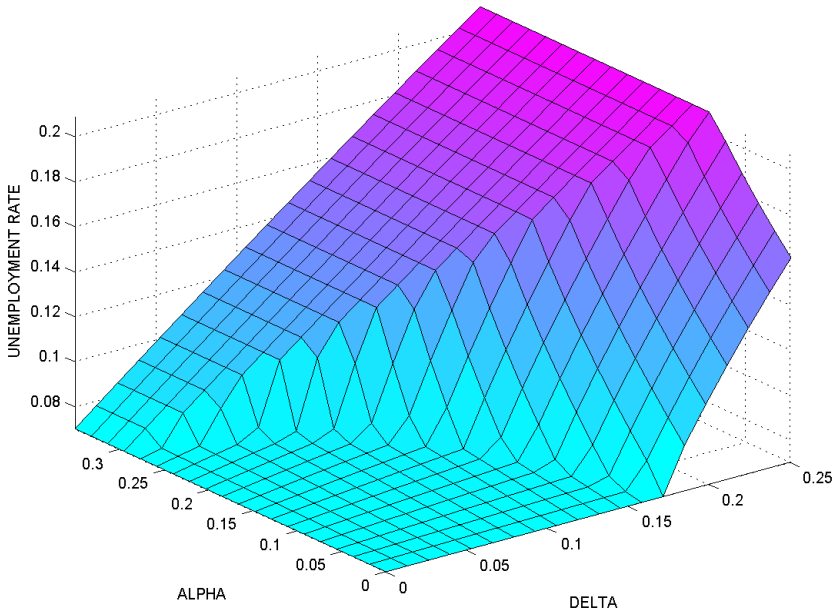
While the system is largely recursive and allows for some analytical comparative statics, it is more revealing to use numerical simulations. We choose the following values for the parameters:[2]

- We think of the time period as the year. We choose the interest rate to equal 4%.
- We normalize average productivity, $\bar{y}$, to unity. We choose unemployment benefits b equal to 0.2, implying a flow surplus for match of 0.8. We choose δ, the probability that matches end for exogenous reasons, equal to 5%. We assume the matching function to be Cobb-Douglas, with exponents equal to 0.5 for both vacancies and unemployment. We choose γ, the parameter that determines the proportion of the surplus going to the firm, equal to 0.25.

  Given these parameters, we then choose the multiplicative constant in the matching function and the flow cost of entry c, to satisfy the free entry condition at an unemployment rate, in the absence of asymmetric information, equal to 7%.

2. The calibration is very rough and can surely be improved. The plan is to use the quarter as the time period, and use empirical evidence more carefully.

- We have little empirical guidance as to the choice of the remaining coefficients. We choose λ to equal 0.5, implying a new productivity draw in existing matches every two years on average. We choose p, the probability of high productivity, equal to 0.3.
  This leaves us with two central parameters, Δ and α. These are the two parameters we vary in the simulations below. We allow Δ, the range of productivity, to increase from 0.0 to 0.25, and α, the probability that workers ignore the reputation of the firm, from 0.0 to 0.35.

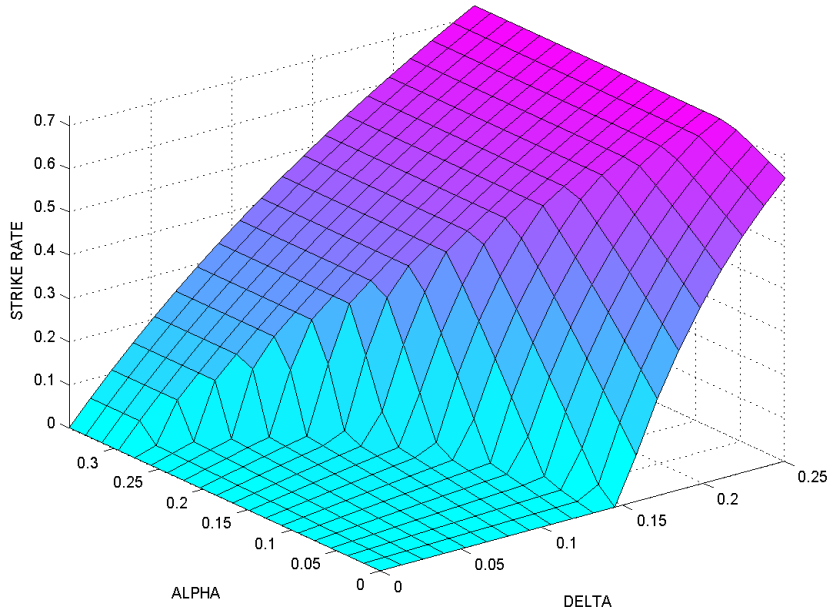


The simulation results are presented in figures 4 to 6, showing respectively the implications for unemployment, strikes, and the proportion of firms with bad reputation.

Figure 4 shows that unemployment is increasing in both α and Δ. It shows three distinct regions:

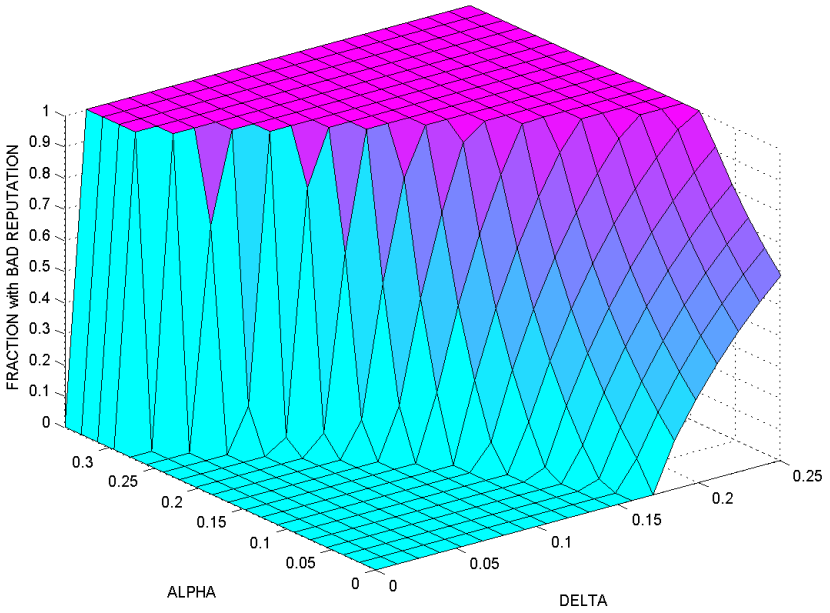
- When α and Δ are small, all firms invest in reputation, and while (if α is strictly positive) there are still some strikes, they are rare and the resulting bargaining failures have little effect on unemployment. In that region, increases in Δ or increases in α, so long as they do not lead firms to give up on reputation, have little effect on unemployment.

- When α and Δ are large, no firm invests in reputation, workers rely on strikes to get firms to tell the truth, and the effect of either higher α or higher Δ is to increase the probability of strikes, increase bargaining failures, and increase the unemployment rate.
- For intermediate values of α and Δ, the effect of an increase in α or Δ is not only to increase strikes directly, but also to lead some firms to give up on reputation. Thus, the effect of a small increase in Δ on unemployment can be quite dramatic. For $\alpha = 0.1$ for example, an increase in Δ from 0.1 to 0.2 leads to an increase in unemployment from 7% to 16%.



Figures 5 and 6 show what happens to strikes and to the proportion of firms with bad reputation. The general picture for strikes is qualitatively similar to that for unemployment: Few strikes when α and Δ are sufficiently low to induce firms to invest in reputation, chronic strikes when α and Δ are high so firms do not invest in reputation, and an intermediate region where small increases in Δ can lead to large increases in strikes.

The strike rate appears high. For $\alpha = 0.3$ and $\Delta = 0.1$, which together imply an unemployment rate of 12%, so 5% over the benchmark value, the associated value of $\bar{s}$ is 0.3: 30% of the bargains end up in strikes when the firm announces



that productivity is low. It may indeed be too high (as the only mechanism through which trust affects unemployment is through strikes and bargaining failures). It is hard however to know what to relate $\bar{s}$ to in the data. A better measure may be the proportion of bargains that end up with inefficient terminations, namely $(1-p)\gamma\bar{s}$. Given our parameters, a strike rate of 0.3 implies that 6% of the bargains end in such a way. Yet another measure is the proportion of separations which result from bargaining failures as opposed to the natural end of a match. Given our parameters, and a strike rate of 0.3, this proportion, which is given by $\lambda(1-p)\gamma\bar{s}/(\lambda(1-p)\gamma\bar{s}+\delta$ is equal to 37%.

The three graphs naturally suggest an interpretation for the cross country facts presented in Section 1. Increased competition in goods markets, both internal and external, have led to more variation in profitability, an increase in Δ. In countries with high trust (low α), the effects on unemployment have been limited. In countries with low trust (high α), the effects on unemployment have been much larger.

The main challenge to this explanation is however the second part of the evi-

dence presented in Section 1. Our model implies, with respect to changes in Δ, a close positive relation between strikes and unemployment. The facts however are that, while unemployment increased, strikes have decreased, at least since the 1980s.

One potential reconciliation is that other shocks have taken place, for example an increase in the cost of entry by firms, an increase in c. Such shocks may lead to both more unemployment, and because increased duration makes unemployment now more painful, to less strike activity. While, in our model, such shocks can lead to such a negative correlation, they appear unable to explain the large observed decrease in strikes. (A more plausible change, namely an increase in unemployment benefits, makes unemployment less painful, and thus leads to both more strikes and more unemployment.)

This leads us to consider an alternative explanation, namely that, in response to the initial shocks, firms have shifted to a technology which decreases the likelihood of strikes and of costly bargaining failures.

4 Endogenous technology

Faced with strikes and bargaining failures, firms are likely to explore various options. One, which we just examined, is to reduce strikes by investing in reputation. Another, which we now examine, is to change their technology or their activity so as to reduce either the likelihood or the cost of bargaining failures.

One potential direction is to reduce the role of labor in production, and thus reduce the stakes involved in bargaining with labor. This type of choice has been explored, in a similar context, by Caballero and Hammour [1998] and Caballero [2006], who explore the idea that an increase in bargaining power by workers in Europe in the 1970s may have led firms to shift to more capital intensive techniques in the 1980s and the 1990s, resulting in higher unemployment, and a lower labor share. Another direction is to reduce the uncertainty associated with their activities, for example by choosing products with more stable demand over new products, or more established technologies over new technologies. This is the direction we explore here.

We do this in a very simple way. Within the model we have developed, we now allow firms, when they open a vacancy, to choose between two technologies:

- One is the risky technology introduced earlier, with average productivity $\bar{y}$ and range Δ.
- The other is a riskless technology, with productivity $k < \bar{y}$ for the duration of the match (that is until a δ shock takes place).

The value to the firm of a match using the riskless technology is given by:

$$\begin{aligned} J^k &= \gamma S^k \\ &= \gamma \frac{k - rU}{r + \delta} \end{aligned}$$

while the value of a match using the risky technology is given by:

$$\begin{aligned} \bar{J}^e &= \gamma[\mu\ \bar{J}^e(b) + (1-\mu)\ \bar{J}^e(g)] \\ &= \gamma[\mu\ \bar{S}(b) + (1-\mu)\ \bar{S}(g)] - [\mu\ \bar{D}(b) + (1-\mu)\ \alpha\ \bar{D}(g)] \end{aligned}$$

where μ now denotes the proportion of firms who do not invest in reputation among those firms who choose the risky technology.

Let ϕ be the proportion of firms that choose the riskless technology. The equations of the model are the same as before except for three equations, which reflect the three potential types of firms: those with riskless technology, those with risky technology and good reputation, and those with risky technology and bad reputation:

The value of being unemployed is now given by:

$$(r + \theta q(\theta))U = b + \theta q(\theta)(1-\gamma)(\phi S^k + (1-\phi)(\mu \bar{S}(b) + (1-\mu)\bar{S}(g)))$$

The free entry condition is now given by :

$$\frac{c}{q(\theta)} = \gamma[\mu \bar{S}(b) + (1-\mu)\bar{S}(g)] - [\mu \bar{D}(b) + (1-\mu)\alpha \bar{D}(g)]$$

if the firm chooses the risky technology, and by:

$$\frac{c}{q(\theta)} = \gamma S^k$$

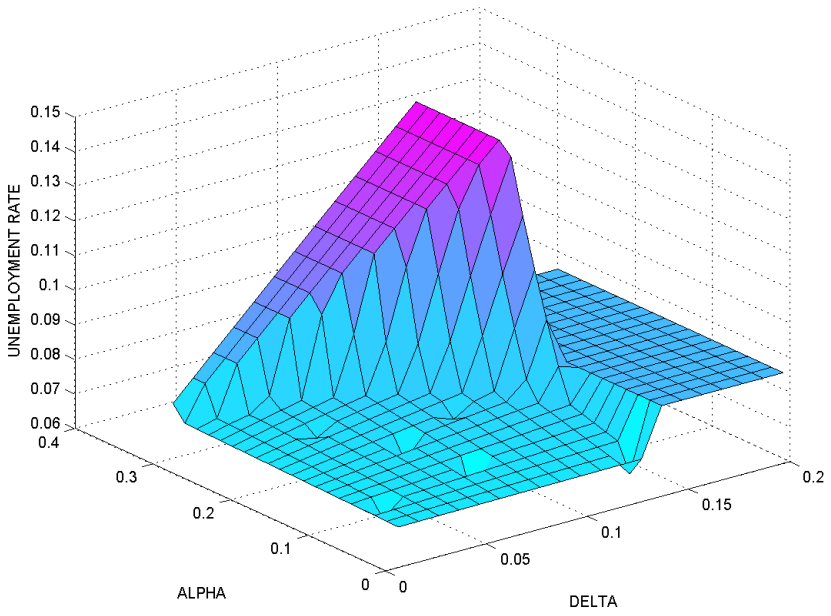
if it chooses the riskless technology.

Finally, the unemployment rate is given by:

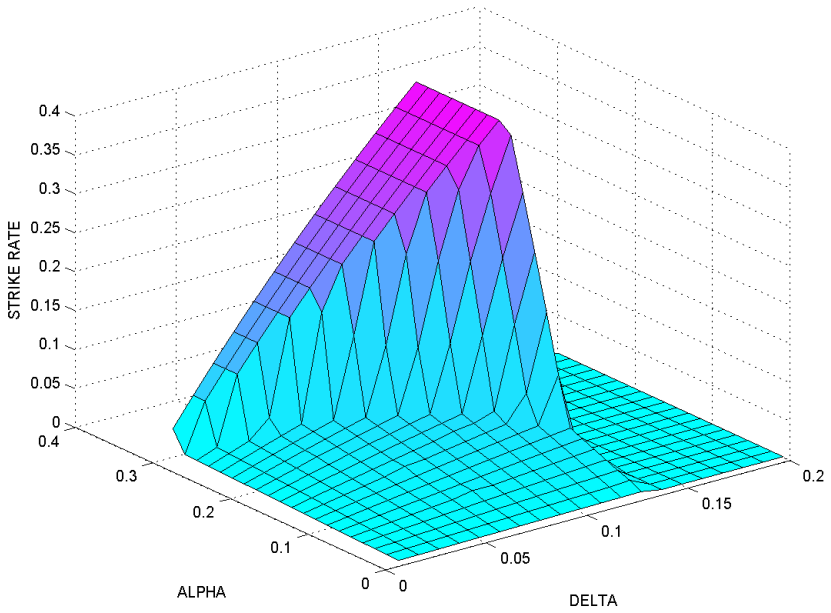
$$u = \frac{(\delta + \lambda(1-p)\gamma(1-\phi)\ [\mu\ s(b) + (1-\mu)\ \alpha\ s(g)))}{(\delta + \lambda(1-p)\gamma s) + \theta q(\theta)\ (1-\phi)(1-(1-p)\gamma\ [\mu\ s(b) + (1-\mu)\ \alpha\ s(g)])}$$

The equilibrium is defined as before, with one additional endogenous variable, ϕ, the proportion of firms that adopt the riskless technology.

The main implications of this extension are shown again through a simulation. For this simulation, we assume that $k = 0.75$, so the productivity of the riskless technology is equal to only 75% of the expected productivity of the risky technology. Other parameters are the same as before. Figures 7 and 8 show the behavior of unemployment and strikes as a function of α and Δ.



Consider what happens to unemployment and strikes for a very low value of α, a high degree of trust. As Δ increases, firms are first able to maintain reputation; unemployment and strikes are both low. As Δ becomes too large, firms shift to the riskless technology: The lower surplus leads to longer equilibrium unemployment duration, and thus higher unemployment. The unemployment rate increases from about 7% when $\Delta = 0$ to 10.5%.



Consider next what happens to unemployment and strikes for an intermediate value of α, say 0.25. As Δ increases, firms are first able to maintain reputation. Then, an increasing proportion of firms give up on reputation, but all firms still choose the risky technology. The result is a sharp increase in both strikes and in unemployment. At Δ becomes even larger, all firms shift to the riskless technology. Strikes disappear, and unemployment falls because of the decreased flows. (The large drop in unemployment (when α is high) when firms shift to the riskless technology in the last section reflects the disappearance of inefficient separations. To the extent that our model overpredicts strikes and bargaining failures—an issue we raised in the previous section—it may also overpredict the size of this effect.) But, because the surplus is lower with the riskless technology, unemployment is higher than it was before the increase in Δ. Thus, the overall increase in Δ results in higher unemployment and lower strikes.

Consider finally what happens to unemployment and strikes for a higher value of α. In that case, the increase in Δ leads very quickly all firms to give up on reputation, and leads to a steady increase in strikes and in unemployment. As Δ keeps increasing, firms shift to the riskless technology. Strikes disappear, and unemployment falls, but to a higher level than before the increase in Δ.

5 Conclusion

We presented two facts about unemployment and strikes in the OECD over the last 40 years. First, a strong positive relation across countries between strikes in the 1960s and subsequent unemployment. Second, a negative time series correlation between strikes and unemployment since the early 1970s.

We have developed a model, based on bargaining under asymmetric information, to explore interpretations for these two facts. We have looked at the role and scope for reputation, and for endogenous technological choice, by firms.

The model is in many ways too primitive. The calibration is too rough. The model also has implications for other variables such as the nature of separations, productivity, and the labor share that we have not explored. But, as it stands, it suggests a potential story both for why countries with less trust suffered a larger increase in unemployment, and why strikes have eventually decreased while unemployment remained high.

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