The Macroeconomic Consequences of Reciprocity in Labor Relations*

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Abstract

We develop and analyze a structural model of efficiency wages founded on reciprocity. Workers are assumed to face an explicit trade-off between the disutility of providing effort and the psychological benefit of reciprocating the gift of a wage offer above some reference level. The model provides a rationale for rent sharing—a feature that is very much present in the data but entirely absent from previous formulations of the efficiency wage hypothesis. This new, firm-internal perspective for efficiency wages has significant macroeconomic consequences: rent-sharing considerations promote wage rigidity, internal amplification and asymmetric responses to technology and demand shocks.

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1 Introduction

Reciprocity is a pervasive feature of labor relations. Workers care about fairness and are willing to reward a generous wage offer by their employer with a commensurate level of effort, even though providing effort by itself is costly and no pecuniary benefits derive from such action. Firms, in turn, understand the worker’s propensity to reciprocate and take into account the effects of compensation on productivity when setting wages. This view of labor relations is supported by a vast body of empirical evidence, ranging from survey studies by Kahneman, Knetsch and Thaler (1987) or Bewley (1999) to laboratory experiments by Fehr and Falk (1999) or Fehr and Gächter (2002), to name just a few.

Reciprocity in labor relations, under the name of partial gift exchange, was advanced by Akerlof (1982) as one of the main foundations for efficiency wages. As more recent applications by Akerlof and Yellen (1990), Collard and De la Croix (1999) or Danthine and Kurmann (2004) suggest, reciprocity may have important consequences for the labor market and be a central element behind phenomenon such as structural unemployment, wage dispersion, or endogenous propagation of exogenous shocks.

The macroeconomic literature to date, however, remains uncomfortably vague on how reciprocity affects workers’ and firms’ decision-making process. The supply of effort is almost uniformly described by a reduced-form function stipulating that work effort depends on the wage rate relative to some reference wage level. The latter is commonly assumed to be summarized by the worker’s outside option, that is, to be entirely external to the firm. As a result, the firm finds it optimal to set wages independently of its financial situation and rent sharing does not matter. In that perspective, it turns out that the gift exchange hypothesis has very similar macroeconomic consequences to the more conventional formulations of efficiency wages such as Shapiro and Stiglitz’ (1984) shirking model or Salop’s (1979) labor turnover theory.

Yet, measures of profitability appear to be significantly correlated with wages. See the microeconomic studies by Blanchflower, Garrett and Oswald (1990), Abowd et al. (2002) and many others. And the aforementioned empirical studies on reciprocity emphasize in one way or another that both workers and firms view rent-sharing as an important determinant of the supply of effort: the better (worse) the firm is doing, the more (less) the worker expects to be paid in exchange for a given level of effort.\footnote{This idea of dual entitlement is closely related to Adam’s [1963] theory of equity and Blau-Homan’s [1955, 1961] theory of social exchange. Both theories hypothesize that the rewards of an exchange (here between firms and workers) should be proportional to the perceived value of the different parties’ inputs. Numerous studies in psychology and sociology have attempted to test these theories and report overall strongly supportive results. See Akerlof and Yellen [1990] for a review of this literature.}
Why should rent-sharing considerations enter the worker’s effort decision; how should the firm optimally take them into account; and what are their macroeconomic consequences? Because the reduced-form approach adopted by the existing literature does not give us ways to seriously think about these questions, the present paper adopts a more explicit approach. It proposes a structural efficiency wage model founded on reciprocity that naturally features the firm’s profitability situation as one of the main determinants of effort. Building on Rabin’s (1993) introduction of fairness considerations into game theory, workers are assumed to face an explicit trade-off between the disutility of providing effort and the psychological benefit of reciprocating the gift of a wage offer above some reference level. Workers’ optimal behavior results in a condition for effort that is similar but not identical to Akerlof’s (1982) reduced-form effort function. Firms, modeled as monopolistic competitors, only care about net profits but take the worker’s supply of effort into account when maximizing profits because effort cannot be contracted directly.\footnote{In our formulation, only workers are prone to reciprocate; in Rabin’s setup both types of players derive utility from reciprocal behavior. We show that reciprocity can have important economic consequences even if one of the players (the firm) only cares about material payoffs. Our model allows for continuous decision choices and takes into account general equilibrium effects (Rabin’s model only offers two choices and is analyzed in partial equilibrium). As such, it can be easily integrated into a modern general equilibrium macroeconomic framework.}

The optimal supply of effort depends crucially on how generous the worker perceives a certain wage offer. Following Rabin, we define the gift of the firm in terms of the standard component of workers’ utility; and the gift of the workers in terms of net profits of the firm. Quite naturally, the wage reference in light of which a worker gauges a given wage offer and decides on his effort level is a weighted average of his outside option on the one hand and output per worker on the other. At one extreme, the reference is purely external, pointing exclusively to relevant variables outside of the firm, notably the employment and unemployment rates, the wage paid by competitors and the level of unemployment compensation. In this regard, our effort function is similar to those hypothesized in Akerlof’s (1982) partial gift exchange model, but also Shapiro and Stiglitz’s (1984) shirking model, or Salop’s (1979) labor turnover model. At the other extreme, the wage reference in our model is purely internal, emphasizing the conditions of rent sharing within the firm.

The rent sharing perspective is interesting for several reasons. First, it explains why estimations based on micro data show firm performance as a significant and quantitatively important predictor of wages, even in the long run and after controlling for skill, working conditions, local labor market attributes and union presence.
Second, the presence of rent-sharing in the reference wage contributes an important element of asymmetry in the way the economy reacts to different types of shocks. In response to a technology shocks (given flexible prices), wages and labor productivity are relatively flexible. In response to demand shocks (given fixed prices), wages and labor productivity react much less and even become countercyclical. This accords well with a number of econometric studies using structural vector autoregressions. For example, Blanchard (1989), Gamber and Joutz (1997) and Fleischman (1999) all report that conditional on demand shocks, real wages are acyclical or even slightly countercyclical.

Third, the larger the weight of rent sharing in the wage reference, the more adjustments to shocks are in terms of employment and the less in terms of wages. On the contrary, if the reference is purely external, wages are highly procyclical and substantially more variable than employment. The intuition is straightforward. In the external perspective, the wage reference depends positively on outside earnings opportunities such as the average wage (the wage paid by other firms), the employment level (the probability of getting reemployed) and possibly other aggregates such as unemployment benefits (the compensation if not reemployed). In general equilibrium, these variables are sensitive to aggregate shocks. For example, when firms reduce employment in response to a labor demand shift, there is a general equilibrium fall of the wage reference. This makes it optimal for individual firms to lower their wages, a fact that leads to a further decrease in the reference wage and thus makes it possible for firms to propose an even lower wage without severe consequences on effort. Conversely, in the internal reference case and under the assumption that the marginal productivity of labor is decreasing, a reduction in the firm’s payroll due to a labor demand shift increases earnings per unit of labor and thus the wage reference. Optimizing along the effort dimension therefore results in firms operating along a negatively sloped wage setting curve. Furthermore, shocks to productivity not only shift the labor demand curve (as is the case in the external reference case) but also the wage setting curve. This shift neutralizes (part of) the wage fluctuation and implies that aggregate shocks potentially have a strong effect on employment while leaving real wages and productivity largely unchanged.

Fourth, our model with a reference wage depending on both rent-sharing and outside option implies that effort is procyclical. This is because workers find it more worthwhile to supply effort in times when firm productivity is high. In addition, it is optimal for firms to increase their wage more than proportionally to increases in rents and outside wage options, thus increasing their gift. We thus advance an alternative explanation to Burnside and Eichenbaum’s (1996) labor hoarding story for the procyclicality of effort. The latter provides interesting endogenous amplification to the exogenous shocks of the
model.

The rest of the paper is organized as follows. Section 2 presents our reciprocity-based efficiency wage model. Section 3 reviews the empirical evidence on reciprocity and rent sharing. Section 4 discusses the qualitative and some quantitative implications of the model from a variety of angles. Section 5 concludes.

2 A reciprocity-based model of efficiency wages

In line with all efficiency wage theories, we assume that effort per unit of labor is an input to production but firms cannot directly observe the worker’s provision of effort. Hence, in contrast with work hours, work effort cannot be paid its marginal product. Firms, however, understand that while workers find it costly to provide effort, they may derive satisfaction from reciprocating a generous wage offer with a commensurate level of effort. If workers are fairly treated and work morale is high, workers will voluntarily provide effort even in the absence of monitoring or other material incentives.

2.1 The supply of effort

Akerlof (1982) in his seminal paper, and several studies thereafter, summarized the fair wage hypothesis of efficiency wages via a simple effort function of the form

\[ e = e(w, w^r), \]

(1)

where effort \( e \) is an increasing function of the wage offer of the firm \( w \) and a decreasing function of some reference wage, \( w^r \), viewed as “fair” by the worker. While broadly in line with this general perspective, the model we outline below seeks explicit foundations for the functional form linking effort with the wage offer and the wage reference; for the measure of distance between wage offer and wage reference; and, above all, for the definition of the latter. This objective is justified by the observation, emphasized in what follows, that the ability of the efficiency wage perspective to generate significant rigidity and endogenous propagation to shocks appears very much dependent on the definition of the wage reference.

Our model is inspired by the more recent literature on reciprocity and its formalization by Rabin (1993). It leads to an equation (equation (4)) that could equally well be taken as a reduced form expression for effort supply, an alternative to the representation (1) which has form the basis of much of the literature since it was proposed by Akerlof (1982). The development of equation (4) proceeds in four steps.
Step 1: What provides satisfaction? As in Rabin (1993), we assume that workers’ preferences take the form

\[ U = u(c, e) + \lambda s(w, e). \]

The first component, \( u(c, e) \), is standard: it states that (material) utility is derived from consumption, \( c \), while effort \( e \) provides disutility (\( u_c > 0, u_{cc} \leq 0 \) and \( u_e < 0, u_{ee} > 0 \)).

The second component, \( s(w, e) \), admits that psychological satisfaction can also arise from providing effort in a work environment characterized by reciprocal behavior. The parameter \( \lambda \) determines the relative importance of reciprocity considerations. In order to focus our analysis on the supply of effort, we abstract from the utility of leisure and assume instead that workers inelastically supply one unit of labor.

Step 2: Modeling the utility derived from reciprocity. The central idea behind reciprocity is that individuals are willing to spend considerable resources to reward (punish) fair (unfair) behavior by others (the firm in our case) even though no direct material gain derives from such action. Rabin formalized this idea by defining \( s(w, e) \) as the product of the respective “gifts” of the worker and the firm

\[ s(w, e) = d(e, w)g(w, e). \]

The term \( d(e, w) \) represents the gift of the worker towards the firm. It takes the form of a level of effort beyond some reference effort level. Likewise, the term \( g(w, e) \) represents the gift of the firm. Hence, when workers perceive a wage offer as generous (i.e. \( g(w, e) > 0 \)), their utility increases if they reciprocate with a gift of higher effort (i.e. \( d(e, w) > 0 \)).

With this definition of preferences, workers face a trade-off between the material disutility of providing effort and the satisfaction derived from reciprocating kind behavior by the firm. Under reasonable assumptions, this trade-off results in a positive effort level. Precisely, optimal effort is such that the marginal disutility of providing effort equals the marginal “psychological” benefit of reciprocating the gift of the firm with a gift of effort\(^3\)

\[ u_e = \lambda d_e g(w, e). \] (2)

We label this equation the “Effort Condition” (EC). It spells out the amount of effort a worker is willing to supply in response to a certain wage offer.

Step 3: Measuring the gift of the worker. To make \( d(e, w) \) and \( g(w, e) \) explicit, we need to specify the functional forms for material utility and profits. We assume that the utility from consumption and effort takes the form \( u(c, e) = c - e^\theta \) with \( \theta > 2 \); and

\(^3\)The typical worker in this model is assumed to be one of a continuum who does not take into account the impact of his own individual effort on the firm’s output and on the gift of the firm. Hence, \( g_e = 0 \).
the production function takes the form \( f(en) = A(en)^\alpha \) with \( 0 < \alpha < 1 \). Since our model is static, we assume that consumption equals wage income (there is no savings).

Given these specifications and continuing in the spirit (but not the letter) of Rabin, we now propose a measure of the gift of the worker. It is the difference between realized output per worker, on the one hand, and a weighted average (with weight \( \mu \) and \( 1 - \mu \), respectively) of output per worker under the maximum possible effort level, \( e_{\text{max}} \), and output per worker in the case of minimum possible effort, \( e_{\text{min}} \), on the other. Given our specification of utility, we naturally derive
\[
e_{\text{min}} = \arg \max_e (w - e^\theta) \Rightarrow e_{\text{min}} = 0 \quad \text{and} \quad e_{\text{max}} = \arg \min_e (w - e^\theta) \Rightarrow e_{\text{max}} = w^{1/\theta}.
\]

Since \( An^{\alpha-1}e^\alpha \) represents output per worker if effort is \( e \), the gift of the worker to the firm writes
\[
d(e, w) = An^{\alpha-1}e^\alpha - \{\mu[An^{\alpha-1}w^{\alpha/\theta}] + (1 - \mu)[0]\} \quad = \quad An^{\alpha-1}[e^\alpha - \mu w^{\alpha/\theta}].
\]

Note (from (2) that the only dimension of \( d(e, w) \) that matters is the impact of the worker’s effort on the measured gift, that is \( d_e \). Rabin’s formulation has the property that, because the gift is measured in units of output, a larger effort level could actually result in a decreased gift in the face of an adverse technology shock. There is some plausibility in this: a worker may understand that, in bad times when productivity is low, an extra display of zeal will not be valued by the firm as much as in good times. In the robustness section, however, we test an alternative specification where this effect is absent and the gift of the worker is measured directly in terms of effort, as in
\[
d(e, w) = G(e - \mu w^{1/\theta}).
\]

**Step 4: Measuring the gift of the firm.**

In Rabin’s approach, the gift of the firm is similarly measured as the difference between the utility from consumption under the actual wage offer and the utility that would follow under a reference wage, the latter being a weighted average (with weight \( \varphi \) and \( 1 - \varphi \), respectively) of the maximum and the minimum possible wage, \( w_{\text{max}} \) and \( w_{\text{min}} \). The firm cannot pay more than \( y/n \) or it would go bankrupt. We assume that \( w_{\text{max}} = (y/n)^\nu, \nu < 1 \). The parameter \( \nu < 1 \) is introduced for two reasons. One is practical: while the firm could technically pay a maximum wage of \( y/n \), it will be impossible for the firm to extend a positive gift, and thus elicit a positive effort level, in the extreme case where \( \varphi = 1 \), if \( \nu = 1 \). Yet, it will turn out to be very convenient to convey intuition for our results by analyzing the cases where \( \varphi = 0 \) or 1. Furthermore, a maximum wage lower than \( y/n \) is representative of more general formulations where the production process requires the use of other factor of production than labor, or in the presence of fixed costs. For reasons that will be clear later on, it turns out
to be important to introduce some curvature in the phrasing of the problem and thus represent a maximum wage lower than $y/n$ via an exponent $\nu$ lower than 1, rather than by deducting a fixed cost per worker from $y/n$.

A worker always has the option to refuse a wage offer and “quit”. In this case, his expected remuneration can be measured by $\bar{w}\bar{n}b(1-\bar{n})$, with $\bar{w}$ denoting the wage if hired by another firm, $\bar{n}$ the probability of reemployment and $b$ the level of unemployment benefits which is relevant if the worker is not re-hired. Since we consider a continuum of identical firms, $\bar{w}$ and $\bar{n}$ also represent the aggregate level of wages and employment, respectively (with full employment being normalized to 1). These assumptions are fully in line with the original formulation of Akerlof [1982]. To avoid an asymmetric impact of variations in the parameter $\nu$, the outside option is raised to the same power as the maximum wage. This could be representative of a situation where there are costs to job search.

We thus assume that the minimum acceptable wage to the worker is $[\bar{w}\bar{n}b(1-\bar{n})]^{\nu}$. If the wage is lower, the worker is better off quitting (not accepting the wage offer). With these assumptions, the gift of the firm towards the worker takes the form:

$$g(w, e) = w - \left\{ \varphi \left( \frac{y}{n} \right)^{\nu} + (1 - \varphi)\left[ \bar{w}\bar{n}b(1-\bar{n}) \right]^{\nu} \right\},$$ (3)

while the EC can be expressed as

$$Qe^\theta = \frac{y}{n} \left[ w - \left\{ \varphi \left( \frac{y}{n} \right)^{\nu} + (1 - \varphi)\left[ \bar{w}\bar{n}b(1-\bar{n}) \right]^{\nu} \right\} \right]$$ (4)

with $Q = \theta/\lambda\alpha$.

Our formulation of the EC thus integrates two very different perspectives on what make workers willing to supply effort. Consider first the case $\varphi = 0$. In this perspective, the wage reference is purely external - it depends only on the worker’s outside option - , and the EC subsumes various versions of the efficiency wage hypothesis. In his original paper, Akerlof [1982] motivated it as a result of a gift exchange postulating that the wage reference would correspond to what the worker could earn outside his current employment relationship. But the same condition could also be viewed as the reduced-form consequence of the shirking model of Shapiro and Stiglitz [1984] or of the turnover model of Salop [1979]. In both cases a real wage in excess of the reference wage is what induces the worker to provide effort, because being fired, respectively quitting, is thus made costly to him/her and, in both cases, the natural reference is external because the alternative is precisely being fired or quitting.

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4 We emphasize that while the $\nu$ parameter is useful to analyze the case where $\varphi = 1$, none of our results will ultimately depend on the specific value taken by $\nu$.

5 The external perspective is closely related to Keynes’ [1936] relative wage theory. Indeed, Keynes
The opposite case is $\varphi = 1$. Here what matters is not the conditions of remuneration outside the firm. In contrast, the issue of rent sharing between the firm and its workers is at the center of attention—a perspective that is very much related to the idea of reciprocity and the notion of equitable payoffs. In this firm-internal reference view, workers view the salary offer in light of the firm’s output per employee, $y/n$. The closer the actual $w$ is to $y/n$, the more favorable to the worker is the sharing of the rent and the more generous the typical workers is of his effort; conversely, the farther away from the maximal wage offer the actual compensation is, the larger the rent appropriated by the firm and the lower the forthcoming level of effort (ceteris paribus).

2.2 Firm’s optimal policy

We now turn to the firm’s optimization problem. As discussed above, firms cannot directly observe effort. They understand, however, that workers reciprocate according to the EC in (4). The firm’s manager thus makes the first move in the form of a wage offer which is the result of his estimating (correctly, according to (4)) how the offer will be perceived by the worker and how the worker will react to the gift of the firm thus manifested.\(^6\)

Specifically, firms solve
\[
\max_{w,n} \psi f(\epsilon n) - wn
\]
subject to the effort condition in (4). The term $\psi$ represents the inverse of the markup (i.e. the real marginal cost) that firms apply in monopolistic competition; and $f(\cdot)$ is the production function.\(^7\) The ensuing first order conditions are
\[
w = \psi \left( f_n + f_e \frac{\partial e}{\partial n} \right) \quad \text{(5)}
\]
\[
n = \psi f_e \frac{\partial e}{\partial w} \quad \text{(6)}
\]

\(^{1936, \text{page 14}}\) notes in his explanation of involuntary unemployment that "...individuals who consent to a reduction in money wages relatively to others will suffer a relative wage reduction in real wages, which is sufficient justification for them to resist it. On the other hand, it would be impracticable to resist every reduction of real wages due to changes in the purchasing power of money, which affects all workers alike."

\(^6\) Note that the behavior of the firm is entirely rational. Contrary to Rabin’s, our formulation of the problem is thus asymmetrical with a rational firm optimizing in a context where workers display reciprocal behavior.

\(^7\) In perfect competition, marginal cost must equal the price level and hence $\psi = 1$. In the comparative statics exercises below, we explicitly refer to a monopolistic product market where firms charge prices above marginal cost, i.e. $\psi < 1$. 

9
Given the nature of the production function, we can rewrite \( f_e = f_n n/e \) and express condition (5) as

\[
w = \psi f_n (1 + \varepsilon_{e,n}), \tag{7}\]

where \( \varepsilon_{e,n} \equiv \partial e/\partial n * n/e \) is the elasticity of effort with respect to the firm’s labor input. This equation determines the labor demand. Since \( \varepsilon_{e,n} > 0 \), the marginal condition requires equating the wage rate to the marginal product of labor (modified by the real marginal cost) augmented by the elasticity of effort to employment; i.e. firms understand that hiring more labor reduces output per worker and thus the workers’ wage reference. For a given wage, taking the derived effort function into account thus leads to a form of overemployment in the sense that firms hire more labor than in a standard set-up.\(^8\)

While we find this reasoning of interest in its own right, it is not the main point of our contribution and we will report plausibly small deviations from the implications of a standard employment condition in our calibrated exercises to follow.

Similarly, we can combine conditions (5) and (6) to obtain

\[
\varepsilon_{e,w} - \varepsilon_{e,n} = 1. \tag{8}\]

where \( \varepsilon_{e,w} \equiv \partial e/\partial w * w/e \) is the elasticity of workers’ effort with respect to the wage. We refer to this equation as the Modified Solow Condition (MSC). If \( \varepsilon_{e,n} = 0 \), the MSC would reduce to Solow’s [1979] original condition \( \varepsilon_{e,w} = 1 \): the wage rate is optimal if at the margin a 1% increase in wage implies a 1% increase in effort. The marginal wage increase then exactly pays for itself in terms of increased output. This condition is omnipresent in current efficiency wage models. In our set-up, however, the traditional Solow condition no longer holds. This is because a marginal wage increase has an additional (negative) effect on effort coming from the induced decrease in employment and the consequent rise in \( y/n \). Thus, ceteris paribus, the last wage increase warranted in a standard efficiency wage context would not pay for itself here. Again we will report plausibly small deviations from the standard Solow condition in our calibrated exercises that follow.

\(^8\)This result mirrors Stole and Zwiebel (1996) who develop a model of intrafirm bargaining where workers are assumed to enjoy a fixed amount of bargaining power and labor productivity is taken to be the firm’s threat point in the wage negotiation. An increase in labor therefore reduces the negotiated wage, a fact that leads firms to hire more labor. We thank Etienne Wasmer for pointing out this similarity. Contrary to Stole and Zwiebel, however, our model does not impose that workers have explicit bargaining power. Rather, workers have indirect bargaining power in the sense that firms internalize the effort consequence of a low salary. Furthermore, Stole and Zwiebel’s equilibrium is one where unemployment is absent and the wage equals the one obtained in a Walrasian labor market without bargaining.
Combining (7) with the MSC (8), we obtain, after rearranging (see the appendix for details), a new expression for the labor demand:

\[ w = \frac{(\theta - 1) - 1}{(\theta - 1)} \frac{\alpha}{\alpha} \left( \frac{y}{n} \right) + \frac{1 - \alpha}{(\theta - 1)} \nu \varphi \left( \frac{y}{n} \right). \]  

(9)

Likewise, the effort function (4) can be combined with the MSC (8) to eliminate the effort variable

\[ w = \tilde{\theta} \varphi \left( \frac{y}{n} \right)^\nu + \tilde{\theta} (1 - \varphi) \left( \tilde{w} \tilde{n} b(1 - \bar{n}) \right)^\nu, \]  

(10)

where \( \tilde{\theta} = (\theta - 1 - \nu)/(\theta - 2) > 1 \) and \( \tilde{\theta} = (\theta - 1)/(\theta - 2) > 1 \). We call this expression the wage setting curve. It replaces the labor supply equation of standard Walrasian models and stipulates that the wage necessary to elicit optimal effort is increasing in both the firms’ productivity \( y/n \) and the workers expected outside earning options \( \tilde{w} \tilde{n} b(1 - \bar{n}) \). The firm’s optimal behavior along the effort dimension thus naturally results in some form of rent-sharing that is not due to the bargaining power of trade unions. Rather workers in the present context enjoy an indirect form of bargaining power because of the sequential nature of our labor market (firms set wages and employment, workers respond with effort) and the fact that firms cannot contract on effort.

2.3 Equilibrium

With homogenous firms and workers, equilibrium implies that wages and employment are the same for everyone; i.e. \( w = \tilde{w} \) and \( n = \tilde{n} \). Hence, the wage setting curve (10) becomes

\[ w = \tilde{\theta} \varphi \left( \frac{y}{n} \right)^\nu + \tilde{\theta} (1 - \varphi) \left( \tilde{w} \tilde{n} b(1 - \bar{n}) \right)^\nu. \]  

(11)

Taking the wage setting equation into account, the effort condition becomes

\[ Q e^\theta = \frac{y}{n} \left[ (\tilde{\theta} - 1) \varphi \left( \frac{y}{n} \right)^\nu + (\tilde{\theta} - 1)(1 - \varphi) \left( \tilde{w} \tilde{n} b(1 - \bar{n}) \right)^\nu \right] \]  

(12)

In equilibrium, \( y = c \) (no savings). The equilibrium values of \( w, n, e, y \) are implied by the solution to the system formed by equations (11) and (12), the labor demand curve (9), and the production function. The difference between the resulting employment level and the total amount of labor supplied determines the level of unemployment.

3 Empirical evidence on reciprocity and rent sharing

The main qualitative feature of our model is that reciprocity in labor relations naturally leads to rent sharing. Both the notion of reciprocity in labor relations and the
rent-sharing dimension of labor contracts receive strong support from a broad range of laboratory experiments and field surveys. Micro-based estimates also document that rent-sharing is an important contributor to wage dispersion. This section briefly reviews the evidence.

The most important finding of the experimental literature on reciprocity is that many individuals are willing to spend considerable resources to reward (punish) fair (unfair) behavior by others even though no direct material gain derives from such action. One experiment close to our efficiency wage model is conducted by Fehr and Falk (1999). Individuals are either assigned the role of a worker or a firm manager. The results show that if effort cannot be contracted in advance, the average wage chosen by the firm is considerably higher than the reservation wage of the worker, even though competitive bidding should push the equilibrium remuneration down to the worker’s reservation wage. Workers in the experiment often try to underbid in order to obtain a job, but managers consistently refuse. This choice turns out to be rational because hired workers on average reciprocate the favor of a high wage with high effort (even though providing effort is costly), thus increasing the firm’s profit relative to a low-wage / low-effort policy.

The hypothesis that reciprocity is an important element of labor markets also receives strong support from field studies such as Levine (1993), Campbell and Kamlani (1997) and Bewley (1999) who survey U.S. company managers and labor leaders about wage policy. Most respondents in these studies report favoring layoffs over wage cuts, even in times of high unemployment, because the negative effect of wage cuts on work morale, and thus on productivity, would outweigh the associated cost savings.

Furthermore, managers generally dismiss the shirking theory of efficiency wages. Rather than promoting a high effort level, the threat of punishment if caught shirking (in the form of firing or of a wage penalty) creates a negative workplace atmosphere that is counterproductive. Bewley concludes from his inquiry that Akerlof’s (1982) partial gift exchange hypothesis of efficiency wages is the explanation for wage rigidity that is most consistent with empirical evidence. Interestingly, the idea that explicit incentives may crowd out the positive effects of reciprocity on work effort is consistent with an experiment by Fehr and Gächter (2002). Their setup is similar to the one of by Fehr and Falk discussed above, but with the addition that firm types can make the worker-type pay a fine if the latter is caught shirking (which occurs with a fixed probability). Except for very low wage offers, worker types in this setting provide much lower effort than in the original experiment where no verification of shirking is allowed.

Other experiments that simulate similar worker-employer relationships are Fehr, Kirchsteiger and Riedl [1998] or Gächter and Falk [2002]. See Fehr and Gächter [2000] for a general survey.
Turning now to rent sharing, an experiment by Fehr, Gächter and Kirchsteiger (1996) yields clear evidence that individuals understand the negative (suboptimal) effect of inadequate rent sharing on effort. In their experiment, firms are assigned different levels of profitability and make (costly) wage offers to workers. Workers are then given the choice in a randomly determined order to accept wage offers. Once workers accept an offer, they observe the profitability of their firm and decide on the level of (costly) effort they want to provide. The results are striking: workers consistently offer high effort in return for a high wage. Firms, in turn, offer wages that are increasing in the level of profitability assigned. Thus, firms in this laboratory setting pay pure job rents, in accord with the evidence from micro-estimates just discussed.

The view that rent-sharing results from firms’ concern for workers’ perception of what is fair is largely confirmed by survey studies. On the worker side, Kahneman, Knetsch and Thaler (1986) interview a randomly selected sample of individuals about their perception of fairness of alternative firm actions in different profit situations. They report that a substantial proportion of individuals consider the principle of dual entitlement to be an important standard of fairness: workers are entitled to a reference salary, while firms are entitled to a reference profit. Accordingly, a wage reduction is more likely to be judged unfair if it results in a gain for the firm than if it permits averting a loss.

Similarly, when asked more specifically about the determinants of work morale, Bewley’s respondents offer that work morale has little to do with outside earnings opportunities but largely depends on firm-internal references such as established pay traditions, the difference between current and past wages, and the compensation of peer workers in the same firm. Substantial reductions in pay are possible only in situations of great financial distress when wage reductions are the only way to prevent the firm from going bankrupt or laying off a large fraction of its workforce. A similar picture emerges from surveys on U.S. firms by Levine (1993) and Campbell and Kamiani (1997).

With respect to the importance of the outside wage option, Bewley (2002, page 7) asserts in his summary discussion that "...employees usually have little notion of a fair or market value for their services and quickly come to believe that they are entitled to their existing pay, no matter how high it may be.” A similar issue of incomplete information may also explain why workers do not focus more on outside earning opportunities. As Bewley continues "...workers do not use pay rates at other firms as reference wages, for they know too little about them. Exceptions to this statement may occur when workers are represented by an active union that keeps them informed about what other firms

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10See Bewley (2002) for a summary.
Moreover, most of the managers in Bewley’s survey responded that they do not take into consideration underbidding by job applicants, thus closing off an indirect channel through which external references could possibly affect average firm pay. On these grounds, Bewley rejects the empirical relevance of Keynes’s relative wage theory and the external view in general.12

The final evidence in favor of rent-sharing in general comes from a rich set of micro-econometric studies about the sources of wage dispersion. Starting with Slichter (1952), a long line of studies – from Dickens and Katz (1987), Krueger and Summers (1988) for the U.S.; Blanchflower, Oswald and Garrett (1990), Nickell and Wadhwani (1990), Holmlund and Zetterberg (1991) or Hildreth and Oswald (1997) for European labor markets; and Christofides and Oswald (1992) or Abowd and Lemieux (1993) for Canada – document that wages for apparently identical jobs differ significantly across industries, and that these differences are remarkably robust over time and across countries. Based on the evidence, they argue that these wage differentials cannot be attributed entirely to differences in skill or working conditions. Rather, differences in compensation depend to a substantial part on the firm’s ability to pay, even in sectors where unions do not play an important role.13

Murphy and Topel (1990) challenge the rent-sharing view and argue instead that high-wage individuals get sorted into high-performance firms because of unobserved abilities. The recent availability of large firm-worker matched panel data makes it possible

11 The incomplete information story appears consistent with the above reviewed micro-evidence about wage differentials. As noted, a large part of wage differentials is left unexplained by observable worker or firm characteristics. Assuming that workers cannot evaluate unobservable firm-worker specific factors at other firms, this observation could explain why pay rates at other companies are not used to evaluate the own personal wage.

12 Bewley’s observation that unions act as an information source accords with studies by Agell and Lundborg [1995, 1999] and Agell and Bennmarker [2003] who survey managers of Swedish companies about wage determination. In line with Bewley, many of their respondents indicate that wage claims are affected by profits and the firm’s ability to pay. However, and in contrast to the responses of U.S. companies, Swedish managers gave larger support to the view that firm-external information such as unemployment and wages at other firms also matter for wage determination. Agell and Bennmarker try to assess whether this difference can be explained by the greater importance of labor unions in Sweden compared to the U.S. They find a significant positive correlation between union density and the appreciation of the external reference perspective, thus lending further support to the view that incomplete information is part of the explanation for why workers focus on internal rather than external wage references.

13 As a rough measure of how much industry profits matter for wage dispersion, Blanchflower et al. for example report a Lester’s range of approximately 25% of the mean wage. Lester’s range is defined as four standard deviations of the firm performance variable (i.e. profits) times the elasticity of wages with respect to the firm performance variable.
to assess the relevance of rent-sharing versus the sorting argument. Abowd and Kramarz (2000) thus decompose wage data for France and Washington State, respectively, into observed worker characteristics plus unobserved worker and unobserved firm effects. Their estimates show that the two effects are about equally important in explaining wage disparity. Abowd, Creecy and Kramarz (2002) further report that the correlation between the two effects is slightly negative, a result that contradicts the sorting argument. Finally, Abowd, Kramarz, Margolis and Troske (2001) find that the unobserved firm effect is strongly and positively correlated with different firm productivity measures, thus corroborating the rent-sharing hypothesis. The latter finding is confirmed by Arai (2003) who uses firm-worker matched data from Sweden. Arai’s estimates of the wage-profit relation are sizable and stable across unionized vs. non-unionized workers, blue-collar vs. white-collar workers, and for manufacturing and non-manufacturing sectors. Interestingly, Arai also introduces controls for worker supervision but finds no significant change in the wage-profit relation, thus providing further evidence against the shirking hypothesis.

In sum, rent sharing is in accord with many observations on labor markets. While not the only theory leading to some form of rent-sharing, reciprocity in labor relations features prominently in light of the reported evidence.

4 Wage, employment and effort in the cycle

We now turn to an analysis of the properties of the reciprocity-based efficiency wage model. It turns out that the adjunction of a rent sharing dimension to the gift exchange model significantly alters its properties. A first glimpse for why this is so is as follows. It is clear from the wage setting curve (11) that the amount of wage rigidity the model generates depends on how the wage reference elements react to different exogenous shocks. In partial equilibrium, the external component $\bar{w}b^{(1-\bar{n})}$ of the reference wage belongs to the “ceteris paribus”. As long as it stays relatively fixed, the standard version of the model (with an external reference) is capable of generating strong wage rigidity. This was the argument made by Yellen [1984] among others. In general equilibrium, however, aggregate wages and employment become endogenous variables and they may be highly variable. Danthine and Donaldson (1990) indeed showed that, once imbedded in a general equilibrium model (in a real business cycle context), the external reference efficiency wage model failed to generate sluggish wage movements. The internal reference component potentially behaves very differently in general equilibrium. In particular, in the absence of changes in the technology and barring major movement in $e$, the concavity of
the production function implies that labor productivity $y/n$ is countercyclical. The wage setting curve (11) indicates that this constitutes a strong impediment in the ability and willingness of firms to decrease their wage in the face of a negative shock. Obviously, this intuition has to be confirmed in general equilibrium and in situations of both demand and supply shocks. We turn to such an analysis.

4.1 Comparative statics

We first compute a benchmark equilibrium. This equilibrium is calibrated as follows. First, we target a realistic level for equilibrium unemployment, say 5%, or $n = 0.95$. Doing this implies that one parameter, in our case $\lambda$, becomes a function of the other parameters. We calibrate $b$ the unemployment benefits to be a plausible ratio $\rho = 0.5$ (a replacement ratio of 50%) of the benchmark equilibrium wages. $b$ is then kept constant at that level in all our comparative static exercises. Furthermore, on grounds of plausibility or following previous studies, we set $\theta = 3$ (recall that we have a constraint $\theta > 2$), $\psi = 0.9$ (a markup of 11%), $\alpha = 0.66$ and normalize $A = 1$. As we have no guidance for the parameters $\nu$ and $\varphi$, we select a benchmark value and perform robustness checks. The selected benchmark values are $\nu = 0.75$ and $\varphi = 0.5$. This set of parameter values imply a labor income share of roughly $wn/y = 0.58$, which is close to the average labor income share observed in the US over the post-World-War-II period. The reader is referred to the appendix for the details of the computation. Our benchmark calibration is summarized in Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>0.95</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.66</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.9</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.5</td>
</tr>
<tr>
<td>$\theta$</td>
<td>3</td>
</tr>
<tr>
<td>$\nu$</td>
<td>0.75</td>
</tr>
</tbody>
</table>

We perform two sets of comparative statics exercises. First, we compute the general equilibrium responses to a productivity shock $A$, under the equilibrium description provided above, that is, in effect assuming that prices are completely flexible. Under this hypothesis, the equilibrium is supply-determined, aggregate demand absorbs the supply of output forthcoming at the equilibrium levels of effort and employment, and the markup remains unchanged. Second, we consider a change in demand $y$ under the implicit assumption that prices are completely fixed. That is, we mimick a Keynesian situation, where the equilibrium is fully demand-determined and firms have to adjust their output to exactly match the reduction in demand. Effective labor also adjusts to the new cost-minimizing level while the markup $1/\psi$ necessarily deviates from its optimal
(flexible price) level as the price of effective labor adjusts.14

Table 2a displays the general equilibrium responses of our reciprocity-based model to a decrease in the productivity variable $A$ by 1%, given flexible prices. Table 2b reports the results for the second set of comparative statics relating to a negative 1% shock in demand $y$, under the assumption that prices are completely fixed.

Table 2a: Changes in endogenous variables following a 1% technology shock (Various $\varphi$)

<table>
<thead>
<tr>
<th>Value of $\varphi$</th>
<th>$y$</th>
<th>$n$</th>
<th>$w$</th>
<th>$e$</th>
<th>$\psi$</th>
<th>$y/n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-2.10</td>
<td>-0.79</td>
<td>-1.32</td>
<td>-0.88</td>
<td>0</td>
<td>-1.32</td>
</tr>
<tr>
<td>0.5</td>
<td>-2.27</td>
<td>-1.15</td>
<td>-1.10</td>
<td>-0.78</td>
<td>0</td>
<td>-1.14</td>
</tr>
<tr>
<td>1</td>
<td>-2.97</td>
<td>-2.97</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2b: Changes in endogenous variables following a 1% demand shock (Various $\varphi$)

<table>
<thead>
<tr>
<th>Value of $\varphi$</th>
<th>$y$</th>
<th>$n$</th>
<th>$w$</th>
<th>$e$</th>
<th>$\psi$</th>
<th>$y/n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1</td>
<td>-0.95</td>
<td>-1.59</td>
<td>-0.55</td>
<td>-1.54</td>
<td>-0.05</td>
</tr>
<tr>
<td>0.5</td>
<td>-1</td>
<td>-1.46</td>
<td>-0.31</td>
<td>-0.04</td>
<td>-0.86</td>
<td>0.47</td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
<td>-2.19</td>
<td>0.91</td>
<td>0.71</td>
<td>-0.30</td>
<td>1.21</td>
</tr>
</tbody>
</table>

The second row of Table 2a shows the properties of the benchmark economy in the case of a supply shock when $\varphi = 0.5$. The 1% decrease in $A$ translates into a strong decrease in output (-2.27%) as the direct effect of the fall in productivity is completed by a decrease in both employment (-1.15%) and effort (-0.78%). The real wage decreases by a little less than 1.1%. In the case of a demand shock (Table 2b, 2nd row), by construction output adjusts to the new level of demand (it falls by exactly 1%) and the markup decreases (-0.86%). The required decrease in output is achieved through a more than proportionate fall in employment (-1.46%). This is because effort barely reacts (-0.04%) and thus, the concavity of the production function implies that labor needs to fall by more than output to satisfy the decreased production needs. The resulting increase in productivity amounts to 0.47%. Wages, in turn, react only modestly (-0.31%).

One striking aspect of these results is how they differ in function of the source of shocks. In both cases we are witnessing a depressed economic activity, but besides the fact that the amplification mechanism in the case of a productivity shock is significantly more powerful, the following differences are worth noticing. The ratio of the change of employment to the change in output is $\Delta n/\Delta y = 0.51$ in the case of a productivity shock.14

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14 As is standard in the New Keynesian literature, we consider demand shocks that are sufficiently small for profits of the monopolistically competitive firms to remain positive.
shock, almost three times as large (1.46) in the case of a demand shock (recall that, unconditionally, the variability of employment is about equal to the variability of output over the business cycle). Conversely wages, although relatively sluggish in both cases, are more reactive in the case of a productivity shock ($\frac{\Delta w}{\Delta y} = 0.49$) than in the case of a demand shock ($\frac{\Delta w}{\Delta y} = 0.31$). The difference is interesting because it seems consistent with a number of recent econometric studies using structural vector autoregressions to investigate the cyclicity of macroeconomic aggregates to supply and demand shocks. Based on different identification schemes, Blanchard (1989), Gamber and Joutz (1997) and Fleischman (1999) all report that conditional on demand shocks, real wages are acyclical (or even slightly countercyclical). Effort is strongly pro-cyclical in the case of a productivity shock; it is acyclical in the case of a demand shock. Finally and less surprisingly, productivity is pro-cyclical with productivity shocks, but countercyclical with demand shocks.

Another message of Tables 2a and 2b relates to the influence of the parameter $\varphi$, that is, of the relative importance of the internal vs. the external component in the reference wage. Recall that the case $\varphi = 0$ corresponds to the situation (privileged by Akerlof early on) where workers have a purely external vision of the reference wage. The case $\varphi = 1$ is the one where circumstances outside the firm do not matter and only the sharing of the rent between firm owners and workers appears to be relevant. Reading the two tables from top to bottom, one sees that whatever the source of the shock, a stronger emphasis on the internal reference perspective systematically strengthens the employment effect of the shock and, in the case of a technology shock, the amplification mechanism, that is the impact of the shock on economic activity. At the opposite, the more prevalent is the external perspective, the larger the labor market response is in terms of prices (wages) rather than quantity (employment). In fact, for $\varphi = 0$, the wage reaction to both types of shock is larger than the employment reaction. This generalizes and confirms the message of Danthine and Donaldson (1990) that reciprocity coupled with the external reference vision proposed by Akerlof is not a strong source of rigidity in general equilibrium.

Yet another lesson from Tables 2a and 2b is in the dramatic difference between the two perspectives on the behavior of effort. Whatever the shock type, the external reference induces a pro-cyclical reaction of effort. In contrast, for $\varphi = 1$, effort somewhat surprisingly does not respond to a technology shock while a demand shock induces a strongly counter-cyclical effort response. As a result, the benchmark economy, in which the two perspectives are equally weighted ($\varphi = 0.5$), displays a procyclical effort under technology shocks and a countercyclical effort under demand shocks.
4.2 Generating intuition: a further look at the extremes

In order to build intuition for these results, it is useful to probe further the two extreme cases $\varphi = 0$ and $\varphi = 1$. We first compare, in the two cases, the wage responses to variations in $n$ implied by the wage setting curve.

For $\varphi = 0$, the wage setting curve (11) reduces to

$$w = \tilde{\theta}(w^n b(1-n))^\nu.$$

For a given level of unemployment benefits $b$, there is a direct relationship between $w$ and $n$ that does not depend on other variables. Shocks that shift the labor demand move the equilibrium along this wage setting curve and thus, the elasticity of $w$ with respect to $n$ therefore provides a good measure of wage rigidity. With $\nu = 1$ and setting $b = \rho w$, this elasticity equals\footnote{This elasticity measure would not be constant over the cycle as $n$ and $b/w$ vary. Rather, it should be considered as an approximation around the steady state value of $n$ (and $b = \rho w$).}

$$\frac{\partial w}{\partial n} w = -\frac{n}{(1-n)} \log \rho.$$

Given that unemployment is between 5% and 10% in most industrialized economies and the replacement ratio $\rho$ varies between 0.35 and 0.65, we can easily compute this measure.

As Table 3 shows, even in the "most favorable" scenario ($n = 0.9$ and $\rho = 0.65$), labor demand shifts impact wages almost four times as much as employment.

**Table 3: Wage employment elasticity when $\varphi = 0$**

<table>
<thead>
<tr>
<th></th>
<th>$\rho = 0.35$</th>
<th>$\rho = 0.65$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = 0.9$</td>
<td>9.45</td>
<td>3.88</td>
</tr>
<tr>
<td>$n = 0.95$</td>
<td>19.95</td>
<td>8.19</td>
</tr>
</tbody>
</table>

The intuition for the absence of wage rigidity in the purely external case is straightforward. In this perspective, the only reason for firms to hold their wages constant is when all other firms keep theirs constant. But even if they were to do so, the decrease in employment that follows a negative shock, in and of itself, decreases the wage reference. The result is that firms find it optimal to decrease their own wage and as all of them are in the same situation, nothing prevents both the wage offers and the wage reference from adjusting flexibly.

By contrast, suppose the wage reference in (11) were to be a function of firm-internal measures of productivity only, and not of economy-wide aggregates, $\varphi = 1$. The wage
setting curve (combined with the production function) then becomes (again setting \( \nu = 1 \))
\[
w = \tilde{\theta}Ae^{\alpha n^{\alpha-1}},
\]
which yields the following elasticity of \( w \) with respect to \( n \)
\[
\frac{\partial w}{\partial n} \frac{n}{w} = (\alpha - 1).
\]
For a given level of technology \( A \) and effort \( e \), this wage is negative and small in absolute value (for our calibration of \( \alpha = 2/3 \), it equals 1/3). The wage setting curve is fundamentally different from the one obtained in the external case. First, everything else constant, firms accompany higher employment with lower wages. This is because employment affects output per worker \( y/n \), and thus the reference wage, negatively. Second, there is no longer an independent relationship between \( w \) and \( n \) as was the case for \( \varphi = 0 \). Any shift in labor demand that is due to exogenous changes in \( A \) and/or general equilibrium effects on \( e \) alters the productive situation of the firm and thus output per worker \( y/n \). Whenever the labor demand curve shifts because of a change in \( y/n \), the wage setting curve shifts in the same direction.

To build a more precise intuition on how these differences in wage setting carry through in general equilibrium, we need to consider the effects of technology and demand shocks on the full system of equations. Table 4 regroups these equations for the two extreme cases.\(^{16}\)

<table>
<thead>
<tr>
<th></th>
<th>( \varphi = 0 )</th>
<th>( \varphi = 1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>( Qe^\theta = \frac{y}{n} \tilde{\theta}w )</td>
<td>( Qe^\theta = \frac{y}{n} \tilde{\theta}w )</td>
</tr>
<tr>
<td>WS</td>
<td>( w = \tilde{\theta} \left( \frac{y}{n} \right)^\nu )</td>
<td>( w = \tilde{\theta} \left( \frac{y}{n} \right)^\nu )</td>
</tr>
<tr>
<td>LD</td>
<td>( w = \frac{(\theta-1)\alpha\psi y}{n} )</td>
<td>( w = \frac{(\theta-1)\alpha\psi y}{n} )</td>
</tr>
</tbody>
</table>

Note first that the wage setting curve (WS) is indeed the only dimension along which the two extreme cases differ. Apart from slightly different slope coefficients, the effort condition (EC) and the labor demand (LD) are identical.

Now consider the comparative statics with respect to a negative technology shock when \( \varphi = 0 \). Assuming for the moment that \( e \) remains at its equilibrium level, the firm needs to decrease both \( n \) and \( w \) for the labor demand (LD) and the wage setting curve (WS) to hold. This is because the WS stipulates a positive relationship between \( w \) and \( n \),

\(^{16}\)The EC for both cases as well as the labor demand equation for the \( \varphi = 1 \) case are obtained by using the wage setting curve to substitute for \( (w^n b^{1-n})^\nu \) and \( (y/n)^\nu \), respectively.
and because a counterfactual increase in the two variables and with it a further drop in $y/n$ (by the concavity of the production function) would violate the LD condition. This latter point also explains why firms decrease $n$ by a relatively small amount (compared to $w$) so as not to completely neutralize or even reverse the negative effect of $A$ on $y/n$. Finally turning to effort, the EC implies that workers decrease $e$ because both $y/n$ and the wage reference are lower. This in turn amplifies the negative effect the drop in $A$ has on $y$, $n$ and $w$.

The same sequence of effects applies for the demand shock and explains the symmetric response to the two types of shocks under the external reference case: for a given $e$, the firm decreases $n$ to meet the required drop in $y$. The lower employment level triggers a fall in the wage reference and thus $w$, $e$ and $y/n$ all decrease as implied by the WS, LD and EC curves. In addition, the EC and the WS imply that the drop in $w$ is relatively larger than the drop in $y/n$. As a result, real marginal cost $\psi$ also falls (by the LD). These adjustments are illustrated in Figure 1.

**Figure 1: Comparative statics with $\varphi = 0$**

Note: Calibration as described in the text, in particular $A = 1; \alpha = .66; \psi = .9; n = .95; \nu = .75; \rho = .5$

For the $\varphi = 1$ case, the reaction of the system of equations is fundamentally different and crucially depends on the nature of the shock. Consider the negative technology shock first. Again taking the equilibrium effort level as initially given, the firm still needs to decrease $n$ to counteract the drop in $y/n$. Since the WS now stipulates a positive relationship between $w$ and $y/n$, however, the firm no longer finds it optimal to
also decrease $w$ for in this case, either the WS or the LD would be violated. In other words, the LD and WS curves form a system in $w$ and $y/n$ that is independent of $A$. Technology shock therefore leave $w$, $y/n$ as well as $e$ unchanged.

By contrast, demand shocks under fixed prices may also affect the firm’s real marginal costs $\psi$. This additional margin on the LD (but not the WS) condition means that all $w$, $y/n$ and $e$ may adjust. Assuming as before that $e$ initially remains at its equilibrium level, the drop in demand requires the firm to decrease $n$, thus resulting in an increase in $y/n$. This increase in $y/n$ leads the firm to raise $w$ (by the WS), such that workers increase $e$ (by the EC). These adjustments are illustrated in Figure 2.

**Figure 2: Comparative statics with $\varphi = 1$**

Note: Calibration as described in the text, in particular $A = 1; \alpha = .66; \psi = .9; n = .95; \nu = .75; \rho = .5$

In sum, the definition of the wage reference leads to very different optimal wage setting behavior by the firm, which in turn implies general equilibrium effects of technology and demand shocks that are very much different. If the wage reference is purely external ($\varphi = 0$), employment, wages and effort are all procyclical, independently of the type
of shock. For standard calibrations, the model then fails to generate any wage rigidity. Conversely, if the wage reference is purely internal ($\varphi = 1$), employment remains procyclical but wages, labor productivity and effort react very differently with respect to the two shocks; they are acyclical conditional on technology shocks and countercyclical conditional on a demand shock. The purely internal reference case thus implies extreme wage rigidity.\footnote{In a companion paper (Danthine and Kurmann [2005]), we show that the same distinction between internal and external reference and their implications for wage rigidity applies in the reduced-form gift exchange model of Akerlof’s [1982], that is, for an effort function of the form $e = -a_0 + a_1 \frac{w}{\varphi}$.} For the general case $(0 < \varphi < 1)$, the comparative statics are a weighted average of the two extreme cases. The larger the worker’s rent-sharing motive, the more wage rigidity, internal amplification and asymmetry to shocks the model implies.

4.3 Robustness

We assess the robustness of benchmark model along two dimensions. First, we report how the comparative statics change for different calibrations of $\nu$ and $\theta$, the two parameters for which we have little a priori evidence. Second, we consider an alternative definition of the worker’s gift $d(e, w)$.

4.3.1 Robustness to alternative calibrations of $\nu$ and $\theta$

Tables 5a and 5b display the changes in $y$, $n$, $w$ and $e$ following a -1% technology shock and a -1% demand shock when $\nu = 0.5$ and $\nu = 0.9$, respectively. All other parameters are left at their benchmark calibration values. The following observations are worth making. First, a higher value of $\nu$ does not alter the reaction to a technology shock when $\varphi = 1$, that is, in the internal reference case. In the case of a demand shock, the reaction of all three endogenous variables, employment, wage and effort is amplified when $\nu = .9$. By contrast, the performance of the model with an entirely external reference deteriorates with both shocks being met by a larger wage adjustment and a smaller employment reaction. The intuition here is that the higher value of $\nu$ make the outside wage reference even more responsive to general equilibrium effects. The consequence is the performance of the model where both perspectives are present (and $\varphi = .5$) deteriorates somewhat quantitatively. Our previous message, however, remains unchanged: The more firms accounts for rent-sharing in their wage policy, the more wage rigidity, internal amplification, and asymmetric responses to technology and demand shocks the model implies.

Table 5a: Robustness to different $\nu$ for -1% technology shock
Tables 5b and 6b display the same information for alternative values of the parameter \( \theta \): \( \theta = 2.5 \) and \( \theta = 0.5 \) (recall that \( \theta > 2 \) for the model to have a positive equilibrium). A larger \( \theta \) increases the workers aversion to provide effort. The effort function thus becomes more concave in its arguments, i.e. changes in \( w, y/n \) or \( w^n b^{1-n} \) have a relatively smaller effect on the supply of effort. Here as well there is no impact of this parameter change in the case of a technology shock when \( \varphi = 1 \). In the case of a demand shock, all three endogenous variables, \( n, w, e \) react less when \( \theta \) increases. The changes are in the same direction under a technology shock when \( \varphi = 0 \): an increase in \( \theta \) decreases the reaction of \( n, w \) and \( e \). By contrast, a demand shock causes a larger decrease in both \( n \) and \( w \) (but not \( e \)). These contrasted results imply that the comparative statics is little affected by variations in \( \theta \) when both perspectives are present (\( \varphi = 0.5 \)).

### Table 5b: Robustness to different \( \nu \) for -1% demand shock

<table>
<thead>
<tr>
<th>Value of ( \varphi )</th>
<th>( \nu = 0.5 )</th>
<th>( \nu = 0.9 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>( n )</td>
</tr>
<tr>
<td>0</td>
<td>-2.38</td>
<td>-1.48</td>
</tr>
<tr>
<td>.5</td>
<td>-2.58</td>
<td>-1.95</td>
</tr>
<tr>
<td>1</td>
<td>-2.97</td>
<td>-2.97</td>
</tr>
</tbody>
</table>

### Table 6a: Robustness to different \( \theta \) for -1% technology shock

<table>
<thead>
<tr>
<th>Value of ( \varphi )</th>
<th>( \theta = 2.5 )</th>
<th>( \theta = 5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>( n )</td>
</tr>
<tr>
<td>0</td>
<td>-2.38</td>
<td>-0.90</td>
</tr>
<tr>
<td>.5</td>
<td>-2.51</td>
<td>-1.23</td>
</tr>
<tr>
<td>1</td>
<td>-2.97</td>
<td>-2.97</td>
</tr>
</tbody>
</table>

### Table 6b: Robustness to different \( \theta \) for -1% demand shock

<table>
<thead>
<tr>
<th>Value of ( \varphi )</th>
<th>( \theta = 2.5 )</th>
<th>( \theta = 5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>( n )</td>
</tr>
<tr>
<td>0</td>
<td>-1.00</td>
<td>-0.87</td>
</tr>
<tr>
<td>.5</td>
<td>-1.00</td>
<td>-1.43</td>
</tr>
<tr>
<td>1</td>
<td>-1.00</td>
<td>-2.65</td>
</tr>
</tbody>
</table>
4.3.2 Robustness to alternative definition of the worker’s gift

The second robustness check we perform concerns an alternative definition of the worker’s gift to the firm, \( d(e, w) \). In section 2.1, we defined this gift as \( d(e, w) = An^{\alpha-1}[e^\alpha - \mu w^{\alpha/\theta}] \). The presence of the \( An^{\alpha-1} \) term implies that the worker realizes that supplying effort is less valuable to the firm in low productivity situations and vice versa in high productivity state. As we noted, this quasi-labor hoarding effect on behalf of the workers is one explanation for the procyclicality of effort in our model.

Yet, it seems also possible that the worker does not internalize the productivity situation of the firm when measuring his gift of effort. If this is the case, it may be more appropriate to define the worker’s gift to the firm directly in terms of effort as in

\[
d(e, w) = G(e - \mu w^{1/\theta}).
\]

For simplicity and for lack of indication otherwise, we assume here that \( G(e) \) is a constant normalized to 1. Leaving the gift of the firm towards the worker unchanged, the effort function thus becomes

\[
Qe^\theta = e \left[ w - \{ \varphi \left( \frac{y}{n} \right)^\nu + (1 - \varphi) \left[ \bar{w} \bar{b} (1-\bar{n})^{\nu} \right] \} \right],
\]

with \( Q = \theta/\lambda \). As can be seen immediately, the \( y/n \) term in front of the gift of the firm towards the worker on the left-hand-side of this equation is replaced by \( e \). Hence, the firm’s productive situation (i.e. \( An^{\alpha-1} \)) no longer affects the worker’s evaluation of the gift to the firm. At the same time, the fact that effort now enters linearly on the left-hand side makes the supply of effort less concave. Everything else constant, movements in the gift of the firm therefore have a larger effect on effort than before.

The change in the effort function hardly affects the rest of the model. The wage setting curve in (10) remains exactly the same, while the labor demand takes on a slightly different form and becomes

\[
w = \alpha \psi \frac{y}{n} + (1 - \alpha) v \varphi \left( \frac{y}{n} \right)^\nu.
\]

Tables 7a and 7b report the comparative statics with respect to a technology shock for this alternative definition of the effort function (all parameters are kept at their benchmark calibration values).

Table 7a: Changes in endogenous variables following a 1% technology shock
(Alternative definition of the gift of the worker - Various \( \varphi \)
In the case of a technology shock, the missing quasi-labor hoarding effect outweighs the amplifying effect the smaller curvature in the EC has on the supply of effort. Effort therefore becomes less procyclical (unless, of course, $\varphi = 1$ in which case, effort remains constant). This in turn reduces the internal amplification mechanism and implies a smaller fall in output and labor productivity. As a result, both wages and employment decrease by a smaller amount.

For the negative demand shock case, the relative forces are inverted: the amplifying effect of the smaller curvature in the EC outweighs the missing quasi-labor hoarding effect and thus, effort becomes more procyclical. Employment therefore needs to fall by less to meet the lower demand, and wages also become less procyclical.

Overall, these differences are quantitatively small and they do not alter the qualitative message of our model: rent-sharing considerations promote wage rigidity, internal amplification and asymmetric responses to technology and demand shocks.

### 5 Conclusion

To be added

### References


