

# Monopoly, Monopsony, and the Phillips Curve

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## Abstract

This paper relates the observed flattening of the Phillips Curve to the increased bargaining power of employers in the labour market. Traditionally it is assumed that it is employees who can set the wage of the labour they supply, this is monopoly power. But when employers set the wage of the labour they demand, this is *monopsony* power.

If wages are set by firms who face nominal rigidities, and there is inflation, firms cannot adjust their wages fully. The real wage falls, and labour supply hence output decreases. This provides a Phillips Curve where the output gap is negatively correlated with wage inflation.

This paper provides a model of monopsony in the labour market that remains tractable within the New Keynesian framework. A New Keynesian Phillips Curve with monopsonistic competition in the labour market is then derived. This paper also provides a model where both monopoly and monopsony are present in the labour market, so that the equilibrium depends on the relative bargaining power of employers and employees: the balance of power affects both the wage level and the slope of the Phillips Curve. This framework can shed light on some past and current monetary phenomena.

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# 1 Introduction

After the 2008 financial crisis, unemployment increased and then fell sharply, while inflation remained low and positive. The correlation between inflation and unemployment – the Phillips Curve – is not as strong empirically as it was before. The Phillips Curve has become flatter, as evidenced by Blanchard et al. (2015) or Ball and Mazumder (2014).

Policymakers such as Haldane (2016), Kuroda (2017) or the IMF (WEO, Oct 2017) are hinting towards the labor market as a possible cause for this. The bargaining power of workers and unions has declined over time in most countries. As a result, their ability to obtain wage increases might be reduced. The gig economy, temporary employment, work agencies, and more generally the increased bargaining power of employers, might be causes of the weaker link between employment and wage inflation. It is however unclear whether the impact of these trends is permanent or temporary. To the extent that this can affect the real wage, are we simply observing a temporary lower nominal wage growth while the real wage slowly falls? Is this simply a temporary deflationary pressure? Or does this gig economy have a more fundamental impact on inflation and the way we think monetary policy?

The interplay between structural reforms – in the goods and labour market – and monetary policy has also been debated in the Eurozone. At Sintra in 2015, ECB President Mario Draghi famously pushed for market reforms and flexibility as a complement to monetary policy: *"Any reforms undertaken now will in fact have an improved interaction with macroeconomic stabilisation policies."* Is there a role for structural policies to stabilize economic activity and inflation, alongside fiscal and monetary policy? Did the New Deal's "codes of fair competition" simply create inflationary pressure by raising prices and wages, or did the reduced competition interact with the monetary and fiscal expansions? Did market deregulation and the weakening of unions and collective bargaining in the US and the UK in the 1980s play a role in their disinflation? By shifting power from workers to firms, did the German Hartz reforms change the German Phillips curve for good?

This paper argues that the rise in monopsony power – the bargaining power of employers in the labour market – not only influences the limited wage growth that has been observed recently, but also has a more profound impact on the Phillips Curve and on monetary policy.

## Monopsony in the labour market

Literally, monopsony is *a market situation in which there is only one buyer*, as opposed to monopoly with only one seller. More generally, it encompasses the case of an individual buyer facing an elastic supply curve. This could be the result of a pure monopsony with only one buyer, or a limited number of buyers (oligopsony). But modern theories of monopsony emphasize the role of other frictions in the market. In the same way that a one percent increase in a firm's price is unlikely to crowd out all consumption, a one percent reduction in the wage it pays will not crowd all employment.

The candidates for monopsonistic frictions are the same as those for monopolistic frictions. If workers cannot observe the wage offered by every firm, or if a supplier cannot observe the price paid by all downstream buyers, there will be a search friction where it takes time, effort or money to find a new employer or customer – in the same way that finding a new worker or supplier can be costly in monopolistic models. In terms of mobility costs, the canonical Salop or Hotelling model can be used for either monopoly or monopsony. But one can also assume that employers or buyers are differentiated along meaningful characteristics, so that they are imperfect substitutes.

Any market, goods or services, could be monopsonistic in theory. In the goods market, the most common examples are agriculture, mining and forestry. Cattle, corn, fruits, wood logs are very homogeneous commodities, used as intermediate inputs for food processing or manufacturing. While the commodity is very homogeneous, with little room for product differentiation, and with a large number of small producers, food processing and manufacturing firms are much bigger and more differentiated, giving them more market power both for their output and input goods.

Traditionally, only a few labour markets were considered monopsonic. Nurses, policemen, teachers may have only one potential employer: the local or national government. Even with local governments, monopsony will be strong if pay is decided at the national or regional level. Company towns of the Industrial Revolution were another example of monopsonic employers, providing employment, housing and amenities for the whole town.

But some labour economist have recently argued that monopsony is pervasive in other employment markets. With the fall in unionization and collective bargaining, monopoly is losing relevance as a description of the labour market. The increase in self-employment, flexible and part-time work – the so called *gig economy* – has made work more divisible and insecure (Haldane 2017). This divisibility and insecurity is a likely further shift in market power from workers to employers, making monopsony even more relevant to understand the labour market.

## Monopsony and the Phillips Curve

This paper formalizes the policymakers' insight of a link between the gig economy and the Phillips Curve, by looking at the role that monopsonic employers can have in the determination of wages and inflation. The New Keynesian model usually assumes that wages are set by workers or unions having monopoly power. Individual workers face a labor demand curve that is not perfectly elastic. Here, I relax the assumption that wages are set by employees, and I look at the effect of employers setting wages for their employees. Individual employers face a labor supply curve that is not perfectly elastic: they have monopsony power.

In the normal wage Phillips Curve with monopoly power, wages are set by employees (or unions) who face nominal rigidities. When there is inflation, the nominal wage cannot be fully adjusted. The real wage falls, and labour demand – hence output – increases. This provides the positive correlation between inflation and output under the classical monopoly case.

But if wages are set by firms who face nominal rigidities, and there is inflation, firms cannot adjust their wages fully. The real wage falls, and labour supply hence output decreases. This provides a Phillips Curve where the output gap is negatively correlated with wage inflation.

The same would be true in the goods market. If sticky prices are set by producers, and there is inflation, the markup falls, and demand increases. But if sticky prices are set by monopsonic consumers (or, possibly, by large retailers and supermarkets), then the supply of goods by producers will fall when inflation lowers the price compared to nominal costs.

This paper also studies the interplay of monopoly and monopsony power in the same market: workers and firms both have limited market power to set a wage. Instead of one agent choosing the level of employment in response to the wage set by the other agent, there is a two-stage process for determining the wage and employment, and there is Nash bargaining in the two stages.

The result is different from monopoly pricing, monopsony pricing or perfect competition. As such it can be thought of the general case encompassing these particular cases. This setup can be used to study a gradual shift in bargaining power from workers to firms. As the bargaining power of firms increases, the Phillips Curve flattens, up to a point when the slope is inverted.

## Related literature

While different authors have studied and provided explanations for the recently observed flatter Phillips Curve, this paper is the first attempt to link it with monopsony power. Ball and Mazumder (2011) suggest that with menu costs, price changes will be less frequent when inflation is low, and the resulting Phillips Curve will be flatter. Blanchard (2016) relies on anchored inflation expectations. The idea of a global Phillips Curve – inflation reacting to global not domestic conditions – has also been floated (eg. Carney, 2017). While the labour market has been highlighted as a possible driver of the flatter Phillips Curve (see Haldane, 2017 or chapter 2 of the October 2017 World Economic Outlook), no proper model has been suggested yet. This paper attempts to provide a sound theoretical link between employment conditions and the Phillips Curve.

In the labour market, monopsony (or oligopsony) has been highlighted as a possible explanation for different observed features. Monopsony can offer a simple explanation for the size-wage correlation (Brown and Medoff, 1989; Green, Machin and Manning 1996): large firms have to pay higher wages to attract a larger labour supply, since the labour supply is not perfectly elastic. Also, under monopsony, minimum wage laws are not necessarily detrimental to employment, because a higher wage will increase labour supply.<sup>1</sup> For example, Manning (1996) found that equal pay laws in the UK significantly increased women’s earnings, but without any fall in their employment level.

Monopsony has also been studied outside of the labour market. Food processing industries, and saw mills are typical example of oligopsonic buyers (see, among others, Schroeter 1988, Just and Chern 1980, Murray 1995 or Bergman and Brännlund, 1995). Recently, Morlacco (2018) documented that French firms exercise significant buyer power in their foreign input market: they curb the demand of foreign inputs in order to keep prices low. However, no paper has studied the impact of monopsony on the Phillips Curve.

This paper is organised as follows. Section 2 builds a model of monopsony: workers do not substitute perfectly from one firm to another and this gives market power to firms. A Phillips Curve with monopsony is then derived. Section 3 combines monopoly power and monopsony power in a model of bargaining, so as to build a generalised Phillips Curve. Section 4 discusses the results: their robustness to alternative assumptions, as well as the historical and current relevance for monetary policy.

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<sup>1</sup>With monopsony there is no notion of unemployment where workers would like to work more given the prevailing wage. Instead there is rationing: firms could hire more given the low real wage but choose not to. Nevertheless it leads to underemployment.

## 2 The Phillips curve with monopsony

Before introducing a full model of bargaining, I develop a smaller toy model of *monopsonistic competition*, as the analogue of monopolistic competition.

### 2.1 Flexible steady state

#### Households

I assume a continuum of firms on the interval  $[0, 1]$ , indexed by  $i$ . A worker (or a household) can allocate its time (or the time of its members) across different employers. By allocating  $L_i$  to each employer  $i$ , the total wage received is  $\int_{i=0}^1 W_i L_i$  with  $W_i$  the wage in firm  $i$ .<sup>2</sup>

The consumptions good  $C_t$  is assumed to be homogeneous at a price  $P_t$ . The representative households maximizes a separable utility function

$$\max E_0 \sum_{t=0}^{+\infty} \beta^t [u(C_t) - v(L_t)]$$

Disutility of work depends on an aggregate *effective* labour supply  $L_t$ .  $L_t$  is a convex function of each  $L_t(i)$ , the labour supplied to each firm  $i$  :

$$L_t = \left[ \int_0^1 L_t(i)^{1+1/\eta} di \right]^{\frac{1}{1+1/\eta}}$$

$\eta = \frac{\partial \ln L_i}{\partial \ln W_i} |_{L,C}$  is the wage elasticity of labour supply.<sup>3</sup>

The household faces a budget constraint

$$P_t C_t + Q_t B_t = B_{t-1} + \int_0^1 W_t(i) L_t(i) di + \int_0^1 D_t(i) di$$

From every firm  $i$ , the household receives a dividend  $D_t(i)$ , and a wage compensation  $W_t(i) L_t(i)$  for supplying  $L_t(i)$  to firm  $i$ . New bonds  $B_t$  can be bought or sold at price  $Q_t$ , the stochastic discount factor of the household.

The Euler equation pins down the stochastic discount factor

$$Q_t = E_t \beta \frac{P_t}{P_{t+1}} \frac{u'(C_{t+1})}{u'(C_t)} \quad (1)$$

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<sup>2</sup>Assuming that agents share their time across different employers is a simplification. But it can be rationalised if agents have a probability to work for one employer or another. In Section 5, I formalize this probabilistic micro-foundation

<sup>3</sup>See Section 5 for a robustness check on non constant elasticities

The first order condition for each  $L_t(i)$  brings

$$\frac{u'(C)}{P} W_i = \left( \frac{L_i}{L} \right)^{1/\eta} v'(L) \quad (2)$$

If we introduce the wage aggregate  $W = \left[ \int_0^1 W_i^{1+\eta} . di \right]^{\frac{1}{1+\eta}}$ , this pins down the aggregate labour supply and firm  $i$ 's own labour supply curve

$$\frac{W}{P} = \frac{v'(L)}{u'(C)} = MRS \quad \left( \frac{L_i}{L} \right) = \left( \frac{W_i}{W} \right)^\eta$$

## Firms

The representative firm  $i$  takes prices as given, and has a production function  $Y_i = F(L_i)$ . It maximizes its profits  $P.Y_i - W_i.L_i$  subject to the labour supply curve  $\left( \frac{L_i}{L} \right) = \left( \frac{W_i}{W} \right)^\eta$ . The FOC with respect to  $L_i$  is  $P.F'(L_i) - (1 + 1/\eta)W_i = 0$ . The optimal wage is a markup below the marginal product of labour:

$$W_i = \frac{P.F'(L_i)}{1 + 1/\eta} \quad \frac{W}{P} = \frac{MPL}{1 + 1/\eta}$$

Let us look at flexible prices and wages. Under monopolistic competition, the wage is equal to the MPL and is a markup over the MRS. Here, the wage is equal to the MRS and is a markup below the MPL. Hence this is not a state of unemployment where workers would like to work more given the current wage. Instead, jobs are rationed and firms could hire more given the wage. While there is technically no unemployment, there is still underemployment.

To some extent, it is more similar to monopolistic competition in the goods market, where the real wage would be the MRS and below the MPL (since prices are a markup over marginal costs in that case).

## 2.2 Calvo wage rigidity

Let me assume that the firm faces a Calvo fairy when setting its wage: only a fraction  $(1 - \theta)$  of firms can reset their wage in each period. The wage is set to maximize the discounted profits subject to the labour supply curve:

$$\max_{W_t^*(i)} E_t \sum_{k=0}^{+\infty} (\theta\beta)^k \frac{u'(C_{t+k})}{P_{t+k}} [P_{t+k} F(L_{t+k}(i)) - W_t^*(i) L_{t+k}(i)] \quad (3)$$

$$st. \left( \frac{L_{t+k}(i)}{L_{t+k}} \right) = \left( \frac{W_t^*(i)}{W_{t+k}} \right)^\eta \quad (4)$$

Around a zero-inflation steady state, the log linear approximation of the optimal Calvo wage (dropping the markup) is

$$w_t^* = (1 - \beta\theta) \sum_{k=0}^{+\infty} (\beta\theta)^k [p_t + mpl_{t+k|t}]$$

From the worker's problem,  $mrs = w - p$  and since  $F(L_i) = L_i^{1-\alpha}$ ,

$$mpl_{t+k|t} = -\alpha l_{t+k|t} = mpl_{t+k} + \alpha\eta(w_{t+k} - w_t^*)$$

Using this expression of the real wage, and standard algebra (see appendix), an expression for the wage inflation  $\pi_t$  can be derived:

**Theorem 1 *Monopsonic Phillips Curve:*** *With monopsony, there is a negative correlation between inflation and real economic activity*

$$\pi_t = \frac{(1 - \beta\theta)(1 - \theta)}{\theta} \left( \frac{-1}{1 + \alpha\eta} \right) (mrs_t - mpl_t) + \beta E[\pi_{t+1}] \quad (5)$$

$\frac{(1-\beta\theta)(1-\theta)}{\theta}$  comes from the Calvo modeling, while  $(mrs_t - mpl_t)$  is a measure of real economic activity that is also standard in New Keynesian models. Monopsony only plays a role through  $\eta$  and the *negative sign*.<sup>4</sup>

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But if wages are set by firms who face nominal rigidities, and there is inflation, firms cannot adjust their wages fully. The real wage falls, and labour supply hence output decreases. This provides a Phillips Curve where the output gap is negatively correlated with wage inflation.

In a sense, monopoly and monopsony can be thought of two limiting cases of a bargaining between a union with some monopoly power and a firm with some monopsony power. Monopoly could be the limiting case where all the

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<sup>4</sup>The monopolistic New Keynesian Phillips Curve with sticky wages is typically written

$$\pi_t = \frac{(1 - \beta\theta)(1 - \theta)}{\theta} \left( \frac{1}{1 + \phi\epsilon} \right) (mrs_t - mpl_t) + \beta E[\pi_{t+1}]$$

with  $\phi$  the disutility curvature and  $\epsilon$  the elasticity of substitution between labour types.



power and surplus accrues to the union/workers, while monopsony would be the situation where all the power and surplus accrues to the firm. Looking at the intermediate case can then provide insights about what happens when there is a gradual shift of power from one side to the other.

In the next section, I attempt to build such a *generalised* bargaining model that encompasses monopoly and monopsony as the two limiting cases.

### 3 Phillips curve with Nash bargaining

I construct a model with both monopoly power for workers and monopsony power for firms. I assume that a firm employs a continuum of workers, and a worker works with a continuum of firms. Each pair of worker and firm is a match. I assume a two-stage process: in the second stage, there is bargaining over the match-specific surplus, while the first-stage bargaining shares the total surplus of the worker and the firm. The imperfect substitutability of firms and workers takes place in the second stage but not the first stage. The result of the second stage is to create a labour bargain curve  $L(w)$  that shares the surplus of the match. In the first stage, the bargaining maximizes the joint aggregate surplus, subject to the labour bargain curve.<sup>5</sup>

I assume a modified version of Manning's (1987) model:<sup>6</sup> In the first stage, the firm and worker bargain over the wage, and in the second stage they bargain over employment. Hence the second stage provides a function  $L(w)$ : for each wage there is a bargained level of employment. But Nash bargaining is most often done over a payment or a rate, not a quantity. It makes more sense to assume that the agents in the second stage behave *as if* they were bargaining over the wage, *for a given employment*.

If there is a project of size  $L$ , the firm and worker bargain over the wage compensation  $WL$  over a wage or a payoff makes more sense than bargaining over quantities. This provides a function  $w(L)$ , a wage for each amount of work, which implicitly defines the reciprocal function  $L(w)$ .

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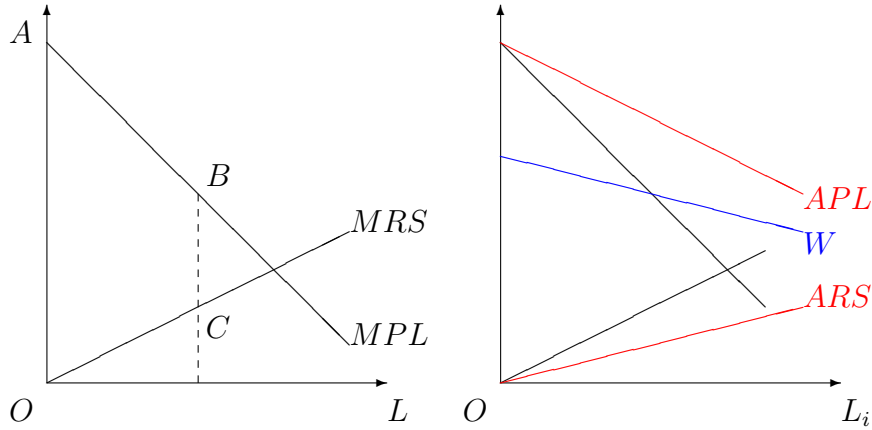
<sup>5</sup>There is no commitment between the two stages because the agents bargain over a different surplus in each stage, and it is as if the agents were different in the two stages. From the first stage point of view, the second stage is done by a representative firm and worker not the the first stage agents. One way to think about it could be that the second stage features an individual worker and an individual employer, while the first stage would be conducted by a sectoral union and a sectoral business group.

<sup>6</sup>See section 5 for a critical discussion of this model, and a comparison with the literature on collective bargaining in general, and in particular the differences with Manning's model.

## The surplus of the match

I need to define the default option for the firm and the union. If they disagree, I assume that they do not work at all with each other. When a union decides on a strike, the ultimate default option is the indefinite strike, and the ultimate default option of the employer is to shut down the company completely. Hence they will bargain over the total employer and employee surpluses, not merely  $(MPL - W)$  and  $(W - MRS)$ .<sup>7 8</sup>

The figure below illustrates this. The figure plots the marginal product of labour and marginal rate of substitution of the employer and employee. For a given  $L$ , the wage  $W$  is not set to split the surplus  $B - C$ . Instead, the wage bill  $WL$  is set to split the total surplus represented by the area  $OABC$  (left figure). In other words, the wage does not split the difference between the marginal product of labour and marginal rate of substitution, but the difference between the average product of labour and the average rate of substitution (right figure). The wage curve (in blue) lies between the average product of labour and average rate of substitution curves.



<sup>7</sup>This alternative possibility would be more likely in an anonymous market where agents do not observe the total effort, hence the default option of their opponent. See Section 5, for a discussion of the alternative modeling.

<sup>8</sup>This issue of total vs marginal surplus is often muted in the matching literature when the production and disutility functions are assumed to be linear.

### 3.1 Model and flexible equilibrium

I introduce the representative production and disutility functions

**Assumption 1** (1) *Production is a function of a concave labour aggregate*

$$F(L) = L^{1-\alpha} \quad \text{with} \quad L^{1-1/\epsilon} = \int_{i=0}^1 L_i^{1-1/\epsilon} di \quad (6)$$

(2) *Labour disutility is a function of a convex labour aggregate*

$$v(L) = L^{1+\phi} \quad \text{with} \quad L^{1+1/\eta} = \int_{j=0}^1 L_j^{1+1/\eta} dj \quad (7)$$

(3) *Concavity of the production function requires  $1 > \alpha > 1/\epsilon > 0$ ;  
Convexity of the disutility requires  $\phi > 1/\eta > 0$* <sup>9</sup>

#### payoff functions in the two stage

I can now introduce the payoff functions of the agents in the two stages.

**Lemma 1** *First Stage*

*In the first stage, the payoffs of the firm and worker depend on the aggregate labour  $L_i$  and wage  $W_i$  that they agree together. Respectively,*

$$p_f(L_i, W_i) = F(L_i) - \frac{W_i L_i}{P} \quad \text{and} \quad p_w(L_i, W_i) = \frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \quad (8)$$

A worker working an aggregate  $L$  has a marginal disutility of working  $L_i$  with firm  $i$ :  $\frac{\partial v}{\partial L_i} = \left(\frac{L_i}{L}\right)^{1/\eta} v'(L)$  while a firm employing an aggregate  $L$  and  $L_i$  from worker  $i$  has a marginal product with him writing  $\frac{\partial F}{\partial L_i} = \left(\frac{L_i}{L}\right)^{-1/\epsilon} F'(L)$

Hence, conditional on aggregate  $L$ , the total surplus of the match is

$$S(L_i|L) = \int_{l=0}^{L_i} \left[ \left(\frac{l}{L}\right)^{-1/\epsilon} MPL - \left(\frac{l}{L}\right)^{1/\eta} MRS \right] .dl$$

$$S(L_i|L) = \frac{\epsilon}{\epsilon - 1} \frac{L_i^{1-1/\epsilon}}{L^{-1/\epsilon}} MPL - \frac{\eta}{\eta + 1} \frac{L_i^{1+1/\eta}}{L^{1/\eta}} MRS$$

Let me now write the second stage payoffs, which depend on match specific employment  $L_i$  and wage  $W_i$ , as well as aggregate labour  $L$

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<sup>9</sup>This provides the concavity/convexity of the production/disutility with respect to each  $L_i$  or  $L_j$ , but also with respect to the number of varieties

**Lemma 2** *Second Stage*

In the second stage, the payoff of the firm (in real terms) is

$$\tilde{P}_f(L_i, W_i|L) = \frac{\epsilon}{\epsilon - 1} \frac{L_i^{1-1/\epsilon}}{L^{-1/\epsilon}} MPL - \frac{W_i L_i}{P} \quad (9)$$

The worker's payoff in the second stage is, in terms of the goods

$$\tilde{P}_w(L_i, W_i|L) = \frac{W_i L_i}{P} - \frac{\eta}{\eta + 1} \frac{L_i^{1+1/\eta}}{L^{1/\eta}} MRS \quad (10)$$

**Second stage bargaining**

In each match, the wage bargaining is as follows: for each level of employment  $L_i$  in the match, the wage bill  $W_i L_i$  maximizes the Nash product

$$\max_{W_i} \tilde{P}_w(L_i, W_i|L)^\gamma \tilde{P}_f(L_i, W_i|L)^{1-\gamma}$$

$\gamma$  and  $(1 - \gamma)$  are the bargaining power of the employee and the firm respectively. As a result, the wage bill is a weighted average of the total production and disutility in the match.

**Theorem 2** *Labour bargain curve*

The second stage defines the relationship between  $W_i$  and  $L_i$  in the match, for a given level of employment  $L$  (and hence given  $MRS$  and  $MPL$ ).

$$\frac{W_i}{P} = (1 - \gamma) \frac{\eta}{\eta + 1} \left( \frac{L_i}{L} \right)^{1/\eta} MRS + \gamma \frac{\epsilon}{\epsilon - 1} \left( \frac{L_i}{L} \right)^{-1/\epsilon} MPL \quad (11)$$

and the labour bargain elasticity is  $e = \frac{\partial \ln L_i}{\partial \ln W_i} |_{W, L}$

This model does not boil down exactly to the usual model of monopoly, or the monopsony one I have introduced previously, when  $\gamma = 1$  or  $\gamma = 0$ .

When  $\gamma = 1$ ,  $\frac{W_i}{P} = \frac{\epsilon}{\epsilon - 1} \left( \frac{L_i}{L} \right)^{-1/\epsilon} MPL = \frac{\epsilon}{\epsilon - 1} MMPL(L_i)$ . In a classical model of monopolistic unions, the firm would take the wage and equalize the marginal match product of labour with the wage. However, here, the worker is able to extract more than his  $MMPL$ , because he is able to capture the surplus that he generates for the firm. From a contract theory point of view, this is price discrimination instead of linear pricing.

Similarly, when  $\gamma = 0$ ,  $\frac{W_i}{P} = \frac{\eta}{\eta + 1} \left( \frac{L_i}{L} \right)^{1/\eta} MRS = \frac{\eta}{\eta + 1} MMRS(L_i)$ . The wage is below the worker's  $MMRS$ , because the firm captures the total surplus generated by the match.

### First stage bargaining

Having derived a match specific labour bargain curve, I can now turn to the first stage of the bargaining. In the match bargaining, each worker is facing one type of firm, and each firm is facing one type of worker. However, in the first stage, when the wage and employment is decided, workers are now facing the continuum of firms, and firms face the continuum of workers.

The payoff of the worker now is  $\frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)}$  and the payoff of the firm is  $F(L_i) - \frac{W_i L_i}{P}$ . The Nash bargaining maximizes the joint product, subject to the labour bargain curve:

$$\begin{aligned} & \max_{W_i, L_i} \left[ \gamma \ln \left( \frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \right) + (1 - \gamma) \ln \left( F(L_i) - \frac{W_i L_i}{P} \right) \right] \quad (12) \\ \text{st} \quad & \frac{W_i}{P} = (1 - \gamma) \frac{\eta}{\eta + 1} \left( \frac{L_i}{L} \right)^{1/\eta} MRS + \gamma \frac{\epsilon}{\epsilon - 1} \left( \frac{L_i}{L} \right)^{-1/\epsilon} MPL \end{aligned}$$

This yields an efficient, symmetric equilibrium when prices are flexible

**Theorem 3** *Irrespective of  $\gamma$ , the flexible symmetric equilibrium always has*

$$MPL = MRS = \left( 1 + \frac{1}{e} \right) \frac{W}{P} \quad (13)$$

$e = \frac{\partial \ln L_i}{\partial \ln W_i} \big|_{W, L}$ , the labour bargain elasticity around the steady state, satisfies

$$\frac{1}{e} = \frac{\frac{(1-\gamma)}{\eta+1} - \frac{\gamma}{\epsilon-1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma\frac{\epsilon}{\epsilon-1}} \quad \text{or} \quad \frac{1}{e+1} = \frac{(1-\gamma)}{\eta+1} - \frac{\gamma}{\epsilon-1}$$

We can look at three particular values for  $\gamma$

**Property 1** (1) *When  $\gamma = 1$ ,  $e = -\epsilon$  and we have perfect monopoly:*

$$MPL = MRS = \left( 1 - \frac{1}{\epsilon} \right) \frac{W}{P} \quad \text{and} \quad \frac{W_i}{W} = \left( \frac{L_i}{L} \right)^{-1/\epsilon}$$

(2) *When  $\gamma = 0$ ,  $e = \eta$  and we have perfect monopsony:*

$$MPL = MRS = \left( 1 + \frac{1}{\eta} \right) \frac{W}{P} \quad \text{and} \quad \frac{W_i}{W} = \left( \frac{L_i}{L} \right)^{1/\eta}$$

(3) *When  $\frac{\gamma}{\epsilon-1} = \frac{(1-\gamma)}{\eta+1}$ , the bargain is isomorphic to perfect competition:  $\frac{W}{P} = MPL = MRS$  and labour in a match is perfectly elastic:  $\frac{1}{e} = 0$*

It is first worthy to note that the  $MPL$  and  $MRS$  are equal, but can differ from the wage. This is due to the assumption of bargaining over the total surplus. As a result, since the wage lies between the average product of labour and average disutility of work, it can be above or below. Of course, this might no longer be efficient with capital or entry in the labour market: the incentives to invest or search for a job would be altered. But here, as we abstract from this, the outcome is always efficient.

Second, this model, which allows the bargaining power to vary between the union and the firm, is able to encompass monopoly and monopsony as the two limiting cases. As the bargaining shifts smoothly in the interior of the interval, the slope of the Phillips curve smoothly changes sign. Also, with this model, perfect competition and flexible prices can be thought as the case where the relative bargaining power of employers and employees exactly offsets their relative market power coming from the imperfect substitutability.

### 3.2 The wage bargain Phillips curve

Under flexible wages, the timing of the game didn't really matter. The second stage featured a bargaining over the wage  $W_i$  (or compensation  $W_i L_i$ ) in the atomistic match  $i$ , *for a given match labour*  $L_i$ . Since wages were flexible, they could be agreed on in the second stage as a normal wage bargaining.

However, this isn't as straightforward in the case of rigid wages. I have to assume that agents in the second stage behave *as if* they could bargain over the wage, despite the sticky wage having been decided in the first stage. So the second stage bargaining described previously will still apply when wages are rigid, and the bargained wage is a weighted average of the  $MPL$  and  $MRS$ . Since it provides a relationship between the wage and the labour in the match, this relationship can then be used to provide a level of employment  $L_i$  for each wage  $W_i$ .<sup>10</sup>

#### Payoff functions and Nash problem

With Calvo wage rigidity, the firm and worker maximize a joint product of payoffs. The discounted payoff of the worker and the firm are, respectively

$$P_w = \sum_{k=0}^{+\infty} (\beta\theta)^k \left( \frac{u'(C_{t+k})}{P_{t+k}} W_t L_{t+k|t} - v(L_{t+k|t}) \right)$$

$$P_f = \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} (P_{t+k} F(L_{t+k|t}) - W_t L_{t+k|t})$$

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<sup>10</sup>See section 5 for a further discussion of this assumption

Hence the maximization problem is<sup>11</sup>

$$\max_{W_t} P_w^\gamma P_f^{1-\gamma} \quad \text{st} \quad \frac{\partial \ln W_i}{\partial \ln L_i} \Big|_{W,L} = \frac{1}{e}$$

### First order approximation

I take the first order condition with respect to  $W_t$ , and around a zero inflation equilibrium, I can use  $MRS = MPL = (1 + \frac{1}{e}) \frac{W}{P}$ . (see appendix)

The log linear approximation around the steady state becomes

$$\begin{aligned} & \gamma \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{(w_t^* - p_{t+k} - mrs_{t+k|t})}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(1 - \frac{Pv(L)}{u'(C)WL}\right)} \\ &= (1 - \gamma) \sum_{k=0}^{+\infty} (\beta\theta)^k \frac{(w_t^* - p_{t+k} - mpl_{t+k|t})}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left(\frac{PF(L)}{WL} - 1\right)} \end{aligned} \quad (14)$$

Around the steady state, the denominators in the previous equations are constant, and can be greatly simplified under the assumption of constant curvature for the production and disutility function. This constant curvature is also helpful for an expression of the labour supplied at time  $t+k$  to a firm whose wage was set at time  $t$  (and the labour demanded at  $t+k$  from a worker whose wage was set at time  $t$ ).

**Lemma 3** *Under the assumption that  $F(L) = L^{1-\alpha}$  and  $v(L) = L^{1+\phi}$ ,*

(1) *The steady state labour satisfies*

$$\frac{PF(L)}{WL} - 1 = \frac{\frac{1}{e} + \alpha}{1 - \alpha} \quad \text{and} \quad 1 - \frac{Pv(L)}{u'(C)WL} = \frac{\phi - \frac{1}{e}}{1 + \phi}$$

(2) *At time  $(t+k)$ , the log linear approximation of the MRS and MPL is*

$$\begin{aligned} mrs_{t+k|t} &= mrs_{t+k} + e\phi(w_t^* - w_{t+k}) \\ mpl_{t+k|t} &= mpl_{t+k} - e\alpha(w_t^* - w_{t+k}) \end{aligned}$$

Taking logs of equation (13) in theorem 2, the log of the real wage is

$$w_{t+k} - p_{t+k} = (1 - \tilde{\gamma})mrs_{t+k} + \tilde{\gamma}mpl_{t+k}$$

$$\text{with } \tilde{\gamma} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma \frac{\epsilon}{\epsilon-1}} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{\frac{\epsilon}{\epsilon+1}}$$

All this combined, the log linear approximation provides a Phillips Curve

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<sup>11</sup>Gertler and Trigari (2009) also have a model of bargaining with staggered wage adjustments, and their bargaining also maximizes a joint product of two discounted payoffs

**Theorem 4** *Nash Bargaining Phillips Curve*

$$\pi_t = \frac{(1 - \beta\theta)(1 - \theta)}{\theta} \lambda (mrs_t - mpl_t) + \beta\pi_{t+1} \quad (15)$$

with a slope coefficient

$$\lambda = \frac{\frac{\gamma^2(1+\phi)(1+1/e)}{\phi-1/e} \frac{\epsilon}{\epsilon-1} + \frac{(1-\gamma)^2(1-\alpha)(1+1/e)}{\alpha+1/e} \frac{\eta}{\eta+1}}{\gamma(1+\phi) + (1-\gamma)(1-\alpha)} \left( \frac{-1}{e} \right)$$

The coefficient  $\frac{(1-\beta\theta)(1-\theta)}{\theta}$  simply comes from Calvo rigidities, and is common in any Calvo New Keynesian model.  $(mrs_t - mpl_t) = (\phi l_t + \sigma c_t) + \alpha l_t$  the measure of real economic activity, is also standard in monetary models. Here the relative power of monopoly and monopsony is in the coefficient  $\lambda$ .

**Property 2** *From property (1), we have  $\phi > 1/\eta$  and  $\alpha > 1/\epsilon$ , so  $-\alpha < 1/e < \phi$ . Hence the slope of the Phillips Curve solely depends on*

$$\frac{-1}{e} = \frac{\frac{\gamma}{\epsilon-1} - \frac{(1-\gamma)}{\eta+1}}{(1-\gamma)\frac{\eta}{\eta+1} + \gamma\frac{\epsilon}{\epsilon-1}}$$

- (1) If  $\frac{\gamma}{\epsilon-1} > \frac{(1-\gamma)}{\eta+1}$  (monopolistic competition),  $\frac{-1}{e} > 0$ , the slope is positive
- (2) If  $\frac{(1-\gamma)}{\eta+1} > \frac{\gamma}{\epsilon-1}$  (monopsonistic case),  $\frac{-1}{e} > 0$ , the slope is negative
- (3) When  $\frac{\gamma}{\epsilon-1} = \frac{(1-\gamma)}{\eta+1}$ , the Phillips curve is flat

This model provides a tractable reduced-form Phillips Curve that encompasses both monopoly and monopsony power, and depends on the relative bargaining power of workers and firms. With both monopoly and monopsony power, the sign of the slope depends on the relative bargaining power of the two sides, as well as the built-in market power that arises from the imperfect substitutability of employees for firms and jobs for workers.<sup>12</sup>

It is easy to verify that the cases  $\gamma = 1$  and  $\gamma = 0$  give the normal monopoly and monopsony Phillips curves respectively. As with other Calvo models of the Phillips Curve, this is only an approximation valid around a zero inflation steady state where output is equal to its natural level.<sup>13</sup>

<sup>12</sup>If one side does not have market power at all ( $\epsilon$  or  $\eta$  is infinite), then a shift of bargaining power would not change the sign of the slope, but only its magnitude

<sup>13</sup>But here the natural rate of output around which the log linear approximation is done is also the first-best efficient outcome



## 4 Applications

### 4.1 Interpretation

This paper has focused on monopsony in the labour market rather than the goods market, because it is likely to be more prevalent, and has been more documented in the micro literature. But there is little doubt that large supermarket chains have monopsony power over some producers. After all, some are franchise networks with a large central purchasing body – which gives them a larger bargaining power with producers. Monopsony power has also been documented between producers and suppliers in some industries.

Mathematically, it would give very similar predictions as monopsony in the labour market: if the buyers sets a rigid price, inflation will lower the real price, and sellers will reduce their supply. It would also be possible to have monopsony and bargaining both in the goods and labour market. As in a New Keynesian model with nominal rigidities in monopolistic goods and labour market, a monopsonistic version would have price and wage inflation depending on the output gap and the real wage.

### Structural reforms and inflation

While there is a strong sense among policymakers that structural reforms can have lasting impacts on inflation, this is not a direct feature of the standard New Keynesian model. In the standard NK model, pro-competitive reforms in the goods and labour market tend to reduce the price and wage markup. While this reduces inflation in the short run as real prices and real wages fall with the markups, there is no long term effect when the markups have fallen. On the contrary, anti-competitive reforms will be inflationary, but only in the short run as the price or wage markups increase. Unless these reforms affect structural elasticities of substitution, a boom (or a downturn) will always have the same inflationary (or deflationary) effects.

This article provides a link between structural reforms and inflation. From a situation where sellers (workers and producers) have relatively more power, pro-competitive reforms will make the Phillips Curve flatter. Hence, booms and bust will be less inflationary (or deflationary). Starting from a monopsonic situation where buyers have more powers, shifting even more power to buyers makes the economy more monopsonic and less competitive. At the same time, this would steepen a negatively sloped Phillips Curve where booms are deflationary. It is unlikely that a predominantly monopsonic situation would ever occur, hence a shift of power from sellers to buyers would always be pro-competitive and flatten the Phillips Curve.

Some historic events tend to document this link between structural policies and long term inflation

The New Deal in the US famously featured anti-competitive policies, alongside monetary and fiscal expansions. The National Recovery Administration aimed at eliminating cut-throat competition. In each sector, industry, labour and the government would write "codes of fair competition" to reduce "destructive competition". This included minimum wages, maximum hours, and minimum prices and standards for sold prices. The National Labor Relations Act also increased the bargaining power of unions in the private sector, guaranteeing a right to collective action and requiring employers to engage with unions. While it has been argued by some that these policies slowed down the economic recovery, there is little doubt over their inflationary effect.

Disinflation in the 1980s was largely due to monetary and/or fiscal contraction, but it did coincide with large, pro-competitive deregulation reforms. These reforms effectively removed many of the neo-corporatist policies implemented in European countries after World War II, where unions, producers and governments tended to weaken competition. Large sectors were privatized or deregulated in countries like the US, the UK or France. In the labour market, the UK was the most prominent in reducing the power and influence of unions: Margaret Thatcher broke the Coal Miners' strike, and unions became more heavily regulated. Union power was also weakened under Ronald Reagan in the US.

More recently, Germany in the 2000s has seen the impact of structural reforms on inflation. The Hartz IV reform lowered long term unemployment benefits, and imposed stricter job search condition on the claimants, while the Hartz II package created minijobs that were paid substantially less than normal jobs. These minijobs, often part time jobs or secondary jobs, facilitate gig employment, and has shifted the bargaining power towards employers in some sectors. At the same time, Germany has seen very low wage inflation compared to its neighbours, despite high output and very low unemployment. The idea of adopting the Hartz reforms in southern Europe is regularly floated, to improve its competitiveness and lower wage inflation.

This tends to suggest that structural reforms, by reducing the power of producers and sellers, makes the Phillips Curve flatter, making booms (bust) less inflationary (deflationary). Hence this is likely to be beneficial in normal times, especially combined with monetary or fiscal expansions, because it lowers their cost in terms of inflation. However, if an economy is at or close to the Zero Lower Bound, structural reforms will not only put deflationary pressure in the short run. It also makes fiscal and monetary policy less inflationary, so that it is harder to steer the economy away from the ZLB.

## 4.2 Monetary policy in a world of monopsony

How is monopsony power relevant for monetary policy? What would happen if the Phillips Curve became flat, or if its slope coefficient became negative?

It is possible to look at this question using reduced form equations. For simplicity, I assume monopsony in the goods market instead in this subsection, because standard Euler equations and Taylor rules rely on price – not wage – inflation<sup>14</sup>. Since monopsony in the goods market is the symmetric analogue of the labour market, the negatively sloped Phillips Curve remains.

The Euler equation (1) can be approximated in log linear terms:

$$y_t = -\frac{1}{\sigma}(i_t - E_t\pi_{t+1} - \rho) + E_ty_{t+1} \quad (16)$$

while the monopsony Phillips curve, in reduced form, is

$$\pi_t = -\kappa y_t + E_t\pi_{t+1} + u_t \quad (17)$$

We can also assume a Taylor rule in inflation and output:

$$i_t = \rho + \phi_\pi\pi_t + \phi_y y_t + v_t \quad (18)$$

Combining them in matrix form

$$\begin{bmatrix} y_t \\ \pi_t \end{bmatrix} = A_T \begin{bmatrix} E_ty_{t+1} \\ E_t\pi_{t+1} \end{bmatrix} + B_T \begin{bmatrix} u_t \\ v_t \end{bmatrix}$$

with  $A_T = \Omega \begin{bmatrix} \sigma & 1 - \beta\phi_\pi \\ -\sigma\kappa & -\kappa + \beta(\sigma + \phi_y) \end{bmatrix}$ ,  $B_T = \Omega \begin{bmatrix} -\phi_\pi & -1 \\ \sigma + \phi_y & -\kappa \end{bmatrix}$  and  $\Omega = \frac{1}{\sigma + \phi_y - \kappa\phi_\pi}$

Determinacy requires that the two eigenvalues of  $A_T$  are lower than 1,<sup>15</sup> or alternatively that the eigenvalues of  $(A_T - Id)$  are negative. As in Bullard and Mitra (2002), the trace and determinant conditions for a 2x2 matrix are

$$-\Omega [(\phi_y + \sigma(1 - \beta) - \kappa\phi_\pi) + (\phi_y(1 - \beta) - \kappa(\phi_\pi - 1))] < 0 \quad (19)$$

$$\Omega (\phi_y(1 - \beta) - \kappa(\phi_\pi - 1)) > 0 \quad (20)$$

Because of the minus sign in front of  $\kappa$ , the conditions for determinacy of the equilibrium are more complicated compared to the normal monopoly case studied in Bullard and Mitra, and can be reversed. There are two cases.<sup>16</sup>

<sup>14</sup>If the utility function is such that the MRS is constant, then the two inflation rates are equalized. But in general it is not the case and expressions would be more complicated.

<sup>15</sup>Blanchard and Kahn (1980)

<sup>16</sup>With a positive sign,  $\Omega = (\sigma + \phi_y + \kappa\phi_\pi)^{-1} > 0$ . If  $[\phi_y(1 - \beta) + \kappa(\phi_\pi - 1)] > 0$  is satisfied, then  $[(\phi_y + \sigma(1 - \beta) - \kappa\phi_\pi) + \phi_y(1 - \beta) - \kappa(\phi_\pi - 1)] > 0$  is also always satisfied, hence  $[\phi_y(1 - \beta) + \kappa(\phi_\pi - 1)] > 0$  is a sufficient condition for determinacy

(1) If  $\kappa$  is not too high,  $\Omega$  is positive and the determinacy conditions are

$$\phi_\pi < 1 + \frac{1-\beta}{\kappa}\phi_y \quad \phi_\pi < \frac{1}{2} + \frac{\phi_y + (1-\beta)(\phi_y + \sigma)}{2\kappa} \quad (21)$$

The interpretation of the  $(\phi_\pi < 1 + \frac{1-\beta}{\kappa}\phi_y)$  condition is the exact reverse of the normal monopoly case. Under monopoly, the condition implies that if the inflation permanently increased by one point, the nominal interest rate through the  $\phi_\pi$  and  $\phi_y$  coefficient increases by more than 1, hence the real interest rate increases, and this creates a self correcting deflationary pressure.

With monopsony, a permanent increase inflation by one percent has to lead to a smaller increase in the nominal interest rate, so that the real interest falls. The fall in the real interest rate is expansionary in terms of output in the Euler equation, but because of the negatively-sloped Phillips Curve, the increased output is deflationary and stabilizes inflation.

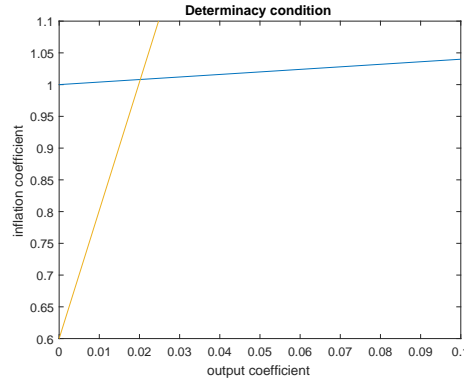


Figure 1: Determinacy zone: the inflation coefficient is the lower right zone

The other condition has a less straightforward interpretation. If the central bank does not react to the output gap ( $\phi_y = 0$ ), then the inflation coefficient in the Taylor rule has to be very low:  $\phi_\pi < \frac{1}{2} + \frac{(1-\beta)\sigma}{2\kappa}$ . The coefficient is much lower than 1. On the other hand, if the central bank responds to output ( $\phi_y > 0$ ), higher values of  $\phi_\pi$ , potentially above 1, can be sustained.

While monopsony probably isn't a good description for the economy as a whole, monetary policy after the Great Recession has been much more output-sensitive than inflation-sensitive, in line with the model's predictions.

(2) For a very high  $\kappa$ , then  $\Omega < 0$  and the inequalities in eq (21) are flipped:  $\phi_\pi > 1 + \frac{1-\beta}{\kappa}\phi_y$  and  $\phi_\pi > \frac{1}{2} + \frac{\phi_y + (1-\beta)(\phi_y + \sigma)}{2\kappa}$

For  $\kappa \rightarrow \infty$ , this becomes  $\phi_\pi > 1$  and  $\phi_\pi > 1/2$ . Hence the flexible limit of the model has the same determinacy conditions as a normal flexible model.

## 5 Robustness of the model

### 5.1 Labour aggregates

#### Microfoundations for constant elasticities

How can we model monopsony in the labour market? There needs to be imperfect substitutability between different firms or occupations. Of course most employees only work with one company – the gig economy where an employee faces many employers is still a tiny fraction of the workforce.

But even if individuals perfectly substitute, there can still be imperfect aggregate substitutability. Take the Hotelling or Salop model: firms are located on a line or a circle, and a mass of consumers is evenly distributed on the line or circle. Workers can choose where they want to work, but face a transportation cost linked to their distance from the firm. Each worker only works for a single firm, but since workers are distributed over a continuous interval, some will work for one company and others for another company. A firm will attract more labour by paying a higher wage, but this will not attract the whole mass of workers: there is imperfect substitutability.

Instead of using the Salop or Hotelling model, I will try to remain as close as possible to the usual monopolistic CES setup, because a CES can be modeled as the aggregate of probabilistic individuals. Assume  $N$  firms. An individual  $j$  can allocate his time among the  $N$  firms. But for each firm  $i$ , he has a particular distaste  $a_{i,j}$  for the job. The disutility of working is

$$v \left( \sum_{i=1}^N a_{i,j} L_{i,j} \right)$$

where  $L_{i,j}$  is labour supplied by  $j$  to firm  $i$ . There is perfect substitutability across jobs. The worker maximizes a separable utility

$$u \left( \frac{\sum_{i=1}^N w_i L_{i,j}}{P} \right) - v \left( \sum_{i=1}^N a_{i,j} L_{i,j} \right)$$

Worker  $j$  chooses to work (only) for the company with the highest  $(w_i/a_{i,j})$ . If the  $(a_{i,j})$  are independent random variables, then the number of workers in firm  $i$  is the probability that it has the highest ratio for one individual:

$$L_i = P[w_i/a_{i,j} > \max_{k \neq i} (w_k/a_{k,j})]$$

Now, if the  $(a_{i,j})$  follow an appropriate Frechet distribution as in Eaton and Kortum (2002), this can provide a CES structure:  $\frac{L_i}{L_k} = \left( \frac{w_i}{w_k} \right)^\eta$  with a one to one mapping between  $\eta$  and the parameters of the Frechet distribution.

### Labour aggregates with non constant elasticities

Assuming a constant elasticity of substitution for the labour aggregates, the production function and the disutility function makes the model more tractable, but it is not essential. I can assume the more general form for the production function and its corresponding labour aggregate:<sup>17</sup>  $Y = F(L)$  with

$$L = g^{-1} \left[ \int_{i=0}^1 g(L_i) di \right]$$

I can assume a general labour disutility function with its corresponding labour aggregate:<sup>18</sup>  $v(L)$  with

$$L = h^{-1} \left[ \int_{j=0}^1 h(L_j) dj \right]$$

The match product of labour and match rate of substitution are now

$$TMPL(L_i) = \frac{g(L_i)}{g'(L)} MPL \quad \text{and} \quad TMRS(L_j) = \frac{h(L_j)}{h'(L)} MRS$$

**Property 3** Define  $(\eta, \epsilon, \bar{\alpha}, \bar{\phi}, \tilde{\alpha}, \tilde{\phi})$  locally by  $\frac{1}{\eta} = \frac{Lh'(L)}{h(L)} - 1$ ,  $\frac{1}{\epsilon} = 1 - \frac{Lg'(L)}{g(L)}$ ,  $\bar{\alpha} = 1 - \frac{LF'(L)}{F(L)}$ ,  $\bar{\phi} = \frac{Lv'(L)}{v(L)} - 1$ ,  $\tilde{\alpha} = -\frac{LF''(L)}{F'(L)}$  and  $\tilde{\phi} = \frac{Lv''(L)}{v'(L)}$

(1) Theorem (3) is unaffected: the steady state expression of the wage and the labour bargain elasticity with  $\eta$  and  $\epsilon$  remain unchanged

(2) The Phillips curve in eq (15) simply has a modified slope coefficient

$$\bar{\lambda} = \frac{\frac{\gamma^2(1+\bar{\phi})}{\bar{\phi}-1/e} \frac{1+1/e}{1-1/\epsilon} + \frac{(1-\gamma)^2(1-\bar{\alpha})}{\bar{\alpha}+1/e} \frac{1+1/e}{1+1/\eta}}{\gamma(1+\bar{\phi}) \frac{\tilde{\phi}-1/e}{\bar{\phi}-1/e} + (1-\gamma)(1-\bar{\alpha}) \frac{\tilde{\alpha}+1/e}{\bar{\alpha}+1/e}} \left( \frac{-1}{e} \right)$$

Since  $(\bar{\phi} - 1/e)$ ,  $(\tilde{\phi} - 1/e)$ ,  $(\bar{\alpha} + 1/e)$  and  $(\tilde{\alpha} + 1/e)$  are all strictly positive<sup>19</sup>, the sign of the slope still only depends on  $(\frac{-1}{e})$ .

<sup>17</sup>Both  $F(\cdot)$  and  $g(\cdot)$  are increasing, concave function satisfying  $F(0) = g(0) = 0$ . Concavity of production requires that  $F(g^{-1}(\cdot))$  is also concave, which is a stronger condition

<sup>18</sup>Both  $v(\cdot)$  and  $h(\cdot)$  are increasing, convex function satisfying  $v(0) = h(0) = 0$ . Convexity of disutility requires that  $v(h^{-1}(\cdot))$  is also convex, which is a stronger condition

<sup>19</sup>Concavity and convexity assumptions on production and disutility require  $\bar{\phi} > 1/\eta$ ,  $\tilde{\phi} > 1/\eta$ ,  $\bar{\alpha} > 1/\epsilon$  and  $\tilde{\alpha} > 1/\epsilon$

## 5.2 The bargaining assumptions

### relation with the literature and the Manning model

While there is no existing model that combines monopolistic and monopsonistic power together, the labour literature on collective bargaining has some related elements, in micro models with just one firm and one union. Sometimes called a *bilateral monopoly* it is de-facto a monopoly and a monopsony.

In the *right-to-manage* model of Nickell and Andrews (1983), the union and the firm bargain over a wage in the first stage, but in the second stage the firm is free to choose employment as it sees fit. But this implies that the second-stage labour demand curve gives no role to bargaining. McDonald and Solow (1981) consider a model where the union and the firm bargain simultaneously over wages and employment, but the simultaneity doesn't allow for a second stage *labour curve*. Manning (1987) builds a two stage model where the firm and the union first bargain over the wage, and over employment in the second stage. Given a wage  $w$ , the firm would like to demand  $L^d(w)$  while the union would like to supply  $L^s(w)$ . The bargained employment  $L^*(w)$  will maximize a Nash product of the payoffs.

While Manning's two-stage timing is very appealing, this model does feature some dubious axiomatic properties that come from the way the second-stage modeled. First, the Nash bargaining is done over employment, for a given wage, while Nash bargaining is most often done over a price or payment. More importantly, since the bargained labour  $L^*(w)$  is some form of average of the labour demand and the labour supply, the labour bargain curve will end up *steeper* than the demand or supply curve. Applied to the context of monopoly and monopsony power with imperfect substitutability, the resulting labour bargain curve when bargaining power is more or less balanced will be steeper, as if substitutability was lower than under either pure monopoly or monopsony. The labour bargain curve could be perfectly inelastic, which would be very problematic in the first stage of the bargaining. Last, if either the labour demand or supply is perfectly elastic (with a linear production function or a linear disutility from labour), the labour bargain curve would also be perfectly elastic, irrespective of the bargaining power.

Instead of bargaining over employment, *for a given wage*, I assumed that the firm and union behave *as if* they were bargaining over the wage, *for a given employment*. This has a few advantages. First, this labour bargain curve will always be more elastic than the pure monopoly or monopsony curve, and cannot be inelastic. In a sense, when the bargaining power is balanced between the firm and union, this is *as if* there was perfect competition. Hence perfect competition can be thought as a well-balanced market.

### Alternative bargaining

I have assumed that there are two stages of Nash bargaining, and the worker and firm have the same relative bargaining power in the two stages. This is however not crucial. If the bargaining power were different in the two stages, this would imply minimal changes for the coefficient  $\lambda$ . Crucially, what matters for the elasticity  $e$ , and hence the sign of the slope of the Phillips curve, is the bargaining power in the second stage match bargaining.

I have assumed that a firm and a worker share the total surplus of their match, because the default option is to not work with each other at all. If instead, I assume that the default option is to work one hour less with each other, the labour bargain curve would be

$$\frac{W_i}{P} = (1 - \gamma) \left( \frac{L_i}{L} \right)^{1/\eta} MRS + \gamma \left( \frac{L_i}{L} \right)^{-1/\epsilon} MPL$$

One consequence is that the flexible steady state is no longer efficient: in general:  $MRS \neq MPL$ . For low and high values of  $\gamma$ , we have  $MPL > MRS$ , which ensures that the surplus of a match is positive. But for intermediate values this is not the case, so that the match "surplus" would be negative. In the range where bargaining occurs, it is possible to define an appropriate steady state and labour bargain elasticity. The log linear approximation around the (new) steady state is the same as equation (14):

$$\gamma \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k [w_t^* - p_{t+k} - mrs_{t+k|t}]}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left( 1 - \frac{Pv(L)}{u'(C)WL} \right)} = (1 - \gamma) \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k [w_t^* - p_{t+k} - mpl_{t+k|t}]}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left( \frac{PF(L)}{WL} - 1 \right)}$$

Lemma (1) still holds and provides a log linear MRS and MPL

Now however, since  $MPL \neq MRS$  in steady state, the log linear approximation of the real wage in equation (13) is slightly modified:

$$w_{t+k} - p_{t+k} = \frac{(1 - \gamma)(MRS)mrs_{t+k} + \gamma(MPL)mpl_{t+k}}{(1 - \gamma)MRS + \gamma MPL}$$

A Phillips Curve can still be built, by adjusting the coefficient  $\lambda$



## 6 Conclusion

This paper first introduced a tractable model of monopsony power that closely resembles the monopolistic competition model of Dixit and Stiglitz (1979). This model has the advantage of being tractable and symmetric, and it allows for a close comparison with monopoly power, which almost always uses the Dixit-Stiglitz framework. While the monopolistic competition model features imperfect substitution of employers between workers or worker types – a love of variety – monopsonistic competition features imperfect substitutability of workers across different employers or job types. Workers prefer to work for different employers because the disutility from working is lower when working with multiple employers – the love of variety comes from a reduced distaste for work. Having introduced this CES model of monopsony, it is easy to build a New Keynesian model with wages set by monopsonic employers. The crucial difference with the classical monopoly Phillips Curve is that the output-inflation correlation becomes negative.

Then this paper provides a model of bargaining over sticky wages, with both monopoly and monopsony power for workers and employers respectively. Because of the imperfect substitutability of workers and firms, a surplus can be shared through Nash bargaining by the two agents. This process brings an efficient outcome: depending on the worker's and firm's relative bargaining power, the wage will be above or below the worker's MRS and the firm's MPL, but the MRS and MPL are always aligned. When introducing wage stickiness, the slope of the Phillips Curve also depends on the relative bargaining power of the two agents. Thus, a shift of power from workers to firms can explain a flattening of the Phillips Curve. Finally, the paper explores the robustness of the result to different assumptions about the production and disutility function, as well as the bargaining process. The predictions of the model are compared with some past events where structural reforms seemed to have strongly complemented monetary policy: the New Deal, the 1980s disinflation and liberalisation, and the German Hartz reforms in the early 2000s. I also compare some of the prediction to how monetary policy has been conducted recently, the nominal interest rate being more responsive to output than inflation.

Looking at heterogeneity is an obvious avenue for future research. The balance of power between workers and employers can be quite different across countries and sectors – and possibly even across firms and regions. On the empirical side, it would allow to test the prediction using this heterogeneity. On the theoretical side, it would be useful to understand the impact of monetary shocks (and possibly other shocks) in an economy where some sectors are more monopolistic while other are more monopsonistic.

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## Appendix

### First order approximation

The first order condition with respect to  $W_t^*$  is

$$0 = \gamma \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \left( \frac{u'(C_{t+k})}{P_{t+k}} (1+e) L_{t+k|t} - e \frac{L_{t+k|t}}{W_t^*} v'(L_{t+k|t}) \right)}{\sum_{k=0}^{+\infty} (\beta\theta)^k \left( \frac{u'(C_{t+k})}{P_{t+k}} W_t^* L_{t+k|t} - v(L_{t+k|t}) \right)} \\ + (1-\gamma) \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} \left( e \frac{L_{t+k|t}}{W_t^*} P_{t+k} F'(L_{t+k|t}) - (1+e) L_{t+k|t} \right)}{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} (P_{t+k} F(L_{t+k|t}) - W_t^* L_{t+k|t})}$$

or  $LHS = RHS$  with

$$LHS = \gamma \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} L_{t+k|t} [(1+e)W_t^* - eP_{t+k}MRS_{t+k|t}]}{\sum_{k=0}^{+\infty} (\beta\theta)^k u'(C_{t+k}) \left( \frac{W_t^* L_{t+k|t}}{P_{t+k}} - \frac{v(L_{t+k|t})}{u'(C_{t+k})} \right)} \\ RHS = (1-\gamma) \frac{\sum_{k=0}^{+\infty} (\beta\theta)^k \frac{u'(C_{t+k})}{P_{t+k}} L_{t+k|t} [(1+e)W_t^* - eP_{t+k}MPL_{t+k|t}]}{\sum_{k=0}^{+\infty} (\beta\theta)^k u'(C_{t+k}) \left( F(L_{t+k|t}) - \frac{W_t^* L_{t+k|t}}{P_{t+k}} \right)}$$

Around a zero inflation equilibrium, we have  $MRS = MPL = (1 + \frac{1}{e}) \frac{W}{P}$ .

Let's assume  $F(L) = L^{1-\alpha} = \frac{L}{1-\alpha} MPL = L^{\frac{1+\frac{1}{e}}{1-\alpha}} \frac{W}{P}$ .

Similarly,  $\frac{v(L)}{u'(C)} = \frac{L^{1+\phi}}{u'(C)} = \frac{L}{1+\phi} MRS = L^{\frac{(1+\frac{1}{e})}{1+\phi}} \frac{W}{P}$

Then  $F(L) - \frac{WL}{P} = \frac{\frac{1}{e} + \alpha}{1-\alpha} \frac{WL}{P}$  and  $\frac{WL}{P} - \frac{v(L)}{u'(C)} = \frac{\phi - \frac{1}{e}}{1+\phi} \frac{WL}{P}$

The first order log approximation of  $LHS$  and  $RHS$  become

$$lhs = \gamma \frac{(1-\beta\theta)(1+\phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k [w_t^* - (p_{t+k} + mrs_{t+k|t})]$$

$$rhs = (1-\gamma) \frac{(1-\beta\theta)(1-\alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k [w_t^* - (p_{t+k} + mpl_{t+k|t})]$$

$mrs_{t+k|t} = mrs_{t+k} + \phi(l_{t+k|t} - l_{t+k}) = mrs_{t+k} + e\phi(w_t^* - w_{t+k})$ , so

$$lhs = \gamma \frac{(1-\beta\theta)(1+\phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k [(1-e\phi)(w_t^* - w_{t+k}) + (w_{t+k} - p_{t+k}) - mrs_{t+k}]$$

$mpl_{t+k|t} = mrs_{t+k} - \alpha(l_{t+k|t} - l_{t+k}) = mpl_{t+k} - e\alpha(w_t^* - w_{t+k})$ , so

$$rhs = (1-\gamma) \frac{(1-\beta\theta)(1-\alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k [(1+e\alpha)(w_t^* - w_{t+k}) + (w_{t+k} - p_{t+k}) - mpl_{t+k}]$$

The aggregate wage satisfies  $\frac{W}{P} = (1 - \gamma) \frac{\eta}{\eta+1} MRS + \gamma \frac{\epsilon}{\epsilon-1} MPL$ , so  
 $w_{t+k} - p_{t+k} = (1 - \tilde{\gamma}) mrs_{t+k} + \tilde{\gamma} mpl_{t+k}$   
 with  $\tilde{\gamma} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{(1-\gamma) \frac{\eta}{\eta+1} + \gamma \frac{\epsilon}{\epsilon-1}} = \frac{\gamma \frac{\epsilon}{\epsilon-1}}{\frac{e}{e+1}}$

$$lhs = \gamma \frac{(1 - \beta\theta)(1 + \phi)}{\phi - \frac{1}{e}} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[ \begin{array}{c} (1 - e\phi)(w_t^* - w_{t+k}) \\ + \tilde{\gamma}(mpl_{t+k} - mrs_{t+k}) \end{array} \right]$$

$$rhs = (1 - \gamma) \frac{(1 - \beta\theta)(1 - \alpha)}{\frac{1}{e} + \alpha} \sum_{k=0}^{+\infty} (\beta\theta)^k \left[ \begin{array}{c} (1 + e\alpha)(w_t^* - w_{t+k}) \\ + (1 - \tilde{\gamma})(mrs_{t+k} - mpl_{t+k}) \end{array} \right]$$

Setting  $lhs = rhs$  implies

$$(\gamma(1 + \phi) + (1 - \gamma)(1 - \alpha)) w_t^*$$

$$= (1 - \beta\theta) \sum_{k=0}^{+\infty} (\beta\theta)^k \left[ \begin{array}{c} (\gamma(1 + \phi) + (1 - \gamma)(1 - \alpha)) w_{t+k} \\ + \left( \frac{\gamma(1+\phi)}{e\phi-1} \tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{1+\alpha e} (1 - \tilde{\gamma}) \right) (mpl_{t+k} - mrs_{t+k}) \end{array} \right]$$

This can be written recursively as

$$(w_t^* - w_t) = (1 - \beta\theta) \frac{\frac{\gamma(1+\phi)}{e\phi-1} \tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{1+\alpha e} (1 - \tilde{\gamma})}{\gamma(1 + \phi) + (1 - \gamma)(1 - \alpha)} (mrs_t - mpl_t) + \beta\theta (w_{t+1}^* - w_t)$$

As a result, I get a Phillips curve

$$\pi_t = \frac{(1 - \beta\theta)(1 - \theta)}{\theta} \lambda (mrs_t - mpl_t) + \beta\pi_{t+1}$$

with a slope coefficient

$$\lambda = \frac{\frac{\gamma(1+\phi)}{\phi-1/e} \tilde{\gamma} + \frac{(1-\gamma)(1-\alpha)}{\alpha+1/e} (1 - \tilde{\gamma})}{\gamma(1 + \phi) + (1 - \gamma)(1 - \alpha)} \left( \frac{-1}{e} \right)$$

$$\lambda = \frac{\frac{\gamma^2(1+\phi)(1+1/e)}{\phi-1/e} \frac{\epsilon}{\epsilon-1} + \frac{(1-\gamma)^2(1-\alpha)(1+1/e)}{\alpha+1/e} \frac{\eta}{\eta+1}}{\gamma(1 + \phi) + (1 - \gamma)(1 - \alpha)} \left( \frac{-1}{e} \right)$$