Monopsony, Wage Bargaining
and the Phillips Curve

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Abstract

With nominal wage rigidities, it is crucial to distinguish whether wages are set by workers or firms – whether we have monopoly or monopsony power. This paper provides a model of wage bargaining in the labour market where workers have monopoly power over firms, but firms also have monopsony power over workers, and the model also features nominal wage rigidities. When employees have all the bargaining power (monopoly), the wage is above the competitive equilibrium, and the Phillips Curve is upward sloping. When employers have all the bargaining power (monopsony), the wage is below the competitive equilibrium, and the PC is downward sloping. In equilibrium, the wage level and the slope of the Phillips Curve depends on the bargaining power of employers and employees.

JEL codes: E24, E31, E52, J42, J52

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1 Introduction

Policymakers have recently argued that monopsony is increasingly pervasive in the labour market.\(^1\) With the fall in unionization and collective bargaining (documented for example in CEA (2016) or IMF (2017)), monopolistic unions are no longer a good description of the labour market. The *gig economy* – self-employment, part-time work – has made work more insecure. However, the consequence of these trends for monetary policy is unclear. Is monopsony simply leading to a lower nominal wage growth and lower long run real wage? Or is there a more fundamental change to monetary policy? New Keynesian models assume that rates are set by the supplier: the producer sets his own price, and/or the worker/union sets its own wage. If wage setting is decided by the firm and worker, what is the effect of a shift in bargaining power?

Structural reforms and the Phillips Curve

Some historic events tend to document a link between structural policies and the slope of the Phillips Curve. The New Deal in the US famously featured anti-competitive policies, alongside monetary and fiscal expansions. Codes of "fair competition" reduced "destructive competition" in the goods market, while the bargaining power of unions increased in the private sector. While some have argued 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 and the weakening of labour unions, especially in the UK and the US. More recently, the German Hartz reforms in the 2000s – minijobs, shorter and tougher access to unemployment benefits\(^2\) – have shifted the bargaining power towards employers. This has led to very low wage inflation, despite very low unemployment.

\(^1\)Robinson (1933) originally defined monopsony as a market situation in which there is only one buyer, as opposed to monopoly with only one seller. More generally, it also encompasses any situation of imperfect competition where buyers face an elastic supply curve and choose the price (or wage) that they offer, below the competitive level.

\(^2\)Hartz II created low-paid minijobs, often part time or secondary jobs. Hartz IV lowered long term unemployment benefits, and imposed stricter job search condition.
While this suggests a link between structural reforms and 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. Unless these reforms affect structural parameters (like the elasticities of substitution between varieties), a boom (or a downturn) will always have the same inflationary (or deflationary) effects. This article provides a link between structural reforms and inflation, by building a model with market power for employers and workers, and bargaining. From a situation where sellers (workers and producers) have relatively more power, pro-competitive reforms make the Phillips Curve flatter.

Related literature

Monopsony (or oligopsony) has been studied both theoretically and empirically in the labour literature.\(^3\) Theoretical models of monopsony have usually relied on the Salop (1979) or Hotelling (1929) models of geographical differentiation, or on search frictions as in Burdett and Mortensen (1998) where search generates wage dispersion even when employees and firms are ex-ante identical. As in Berger et al. (2019) or Dennery (2020), I rely instead on a model with a constant elasticity of substitution. Based on Horvath (2000), it is the mirror analog of CES monopolistic competition: workers have a taste for diversity and work in several firms/sectors – as opposed to monopolistic competition as in Erceg et al. (2000) where firms have a taste for diversity and work with different worker types. Having a CES model is particularly tractable and suitable to study the interaction of monopoly and monopsony power in a bargaining setup with nominal rigidities, and the effect on wage inflation. This is the key novel contribution of this paper. This paper is the first to combine monopolistic and monopsonistic competition in a wage bargaining setup with nominal rigidities.

This paper is also related to to the recent literature looking at the growing

role of very large and powerful firms. Eeckhout and de Loecker (2018), or Gutierrez and Philippon (2017) have documented an increase in monopoly power, where firms charge higher prices, and output is sub-optimally low. Policymakers such as CEA (2016) or IMF (2017) have highlighted the shift of bargaining power from employees to employers, new features of the labour markets, and the resulting effect on weak wage growth but without looking at monopsony power specifically. Recent papers have looked at the link between monopsony power and weak wage growth. Azar et al. (2017) find a strong negative relationship between monopsony power and wages in the US. Looking at US manufacturing, Benmelech et al. (2018) document the same effect, though on a much smaller scale. Abel et al. (2018) find similar results to Benmelech et al. in the UK, for a larger firm sample.

The rest of the paper is organised as follows. Section 2 builds a model of wage bargaining with staggered wage adjustment, and derives a bargaining Phillips Curve that encompasses the two limiting cases. Section 3 provides a discussion of the historical relevance and assumptions. Section 4 concludes.

2 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 worker-firm pair is a match. I assume a two-stage model of wage bargaining: in the second stage, the bargaining between the firm and worker generates a labour bargain curve between the match-specific wage and the match-specific employment; in the first stage the firm and worker bargain over the wage, subject to the second-stage bargaining curve. In the second stage, if there is a project of size $L$, the firm and worker bargain over the wage $W$ (or equivalently the wage compensation $WL$). This provides a function $W(L)$, a wage for each amount of work, and implicitly the reciprocal function $L(W)$: this labour bargain curve shares the surplus of the match. In the first stage, the bargaining maximizes the joint surplus, subject to the labour bargain curve.
This two-stage wage bargaining differs from the classical two-stage wage setting. When workers or unions set their own wages, firms observe them and freely choose their labour demand, equating the wage with the marginal product of labour. But the firm is free to choose employment because it is a wage-taker; wage taking is not compatible with wage bargaining. But the $W = MPL$ or $W = MRS$ conditions that arise with wage taking can be reinterpreted in a way more compatible with wage bargaining. Instead of being equal to the wage as a result of a choice of labour demand by the wage-taking firm, the $MPL$ is also the maximum wage that the firm is willing to pay, for a given employment $L$. And similarly, for a wage-taking worker, the $MRS$ is the minimum wage at which it is willing to work. Hence a wage-taking firm can also be thought as having no bargaining power, so that all surplus is extracted: the $W \leq MPL$ constraint binds. Conversely a wage-taking employee has all her surplus extracted: $W \geq MRS$ is binding.

Because the firm and the worker bargain over the wage in the second stage, this model is also different from Manning’s (1987) 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, hence being some kind of average of the labour demand and supply for the given wage $w$. But the second-stage 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. With a certain balance of bargaining power, the labour bargain curve could be perfectly inelastic, which would be 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.

4Similarly, under monopsony, workers observe wages set by firms and choose the labour supply, equating the wage and MRS. They choose labour because they are wage-takers.
The surplus of the match

If the firm and worker disagree, their default option is to not work at all with each other: a worker can always quit eventually, or the firm can fire him. Hence they will bargain over the total employer and employee surpluses, not merely \((MPL - W)\) and \((W - MRS)\).\(^5\)

Figure 1: Marginal vs. average bargaining

Figure 1 illustrates this. The figure plots the marginal product of labour and marginal rate of substitution of the employer and employee (in a match). For a given \(L\), the wage \(W\) is not set to split the surplus \(B - C\). Instead, the wage bill \(WL\) is set to 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.

\(^5\)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.
2.1 Model

I assume a continuum of firms indexed by $i \in [0, 1]$, and a continuum of workers indexed by $j \in [0, 1]$. Each firm employs all workers, and each worker works with all firms. Each pair of worker and firm is a match.

Households

A worker (or a household) $j$ can allocate its time (or the time of its members) across different employers. By allocating $L_t(i, j)$ to each employer $i$, the total wage received is $\int_{i=0}^{1} W_t(i, j) L_t(i, j) di$ with $W_t(i, j)$ the wage in firm $i$.

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

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

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

$$v(L(j)) = L(j)^{1+\phi} \quad \text{with} \quad L(j)^{1+\eta} = \int_{i=0}^{1} L(i, j)^{1+1/\eta} di$$

The household faces a budget constraint

$$P_t C_t(j) + Q_t B_t(j) = B_{t-1}(j) + \int_{i=0}^{1} W_t(i, j) L_t(i, j) di + \int_{i=0}^{1} D_t(i) di$$

From every firm $i$, the household receives a dividend $D_t(i, j)$, and a wage compensation $W_t(i, j) L_t(i, j)$ for supplying $L_t(i, j)$.

New bonds $B_t$ can be bought or sold at price $Q_t$, the stochastic discount factor of the household. I as-

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6Hence there is no search and matching friction to generate monopsony power and wage dispersion as in Burdett and Mortensen (1998): wage dispersion will only be caused by staggered wage adjustment.

7See Dennery (2019) or Berger et al. (2019) for a discrete choice probabilistic microfoundation of this CES monopsony assumption, along the lines of Anderson et al (1987): workers have idiosyncratic preferences over different types of jobs and work for only one employer. As relative wages change, some workers fully substitute to a new occupation, which creates imperfect substitutability in the aggregate.
sume full consumption risk sharing, so that consumption is equalized across individuals. The Euler equation pins down the stochastic discount factor

$$Q_t = E_t \beta \frac{P_t}{P_{t+1}} \frac{u'(C_{t+1})}{u'(C_t)} \quad (2)$$

**Firms**

Each firm $i$ employs a continuum of workers $j$. The firm’s wage bill is

$$\int_{j=0}^{1} W_t(i, j) L_t(i, j) dj$$

with $W_t(i, j)$ the wage with worker $j$. Each firm has a production function is $Y_t(i) = F(L_t(i))$ where effective employment $L_t(i)$ is a concave aggregate of employment $L_t(i, j)$ of each worker $j$

$$F(L(i)) = L(i)^{1-\alpha} \quad \text{with} \quad L(i)^{1-1/\epsilon} = \int_{j=0}^{1} L(i, j)^{1-1/\epsilon} dj \quad (3)$$

**Payoff functions**

I can now introduce the payoff function of the agents. A worker working an aggregate $L_j$ has a marginal disutility of working $L_{i,j}$ with firm $i$:

$$\frac{\partial w}{\partial L_{i,j}} = \left(\frac{L_{i,j}}{L_j}\right)^{1/\eta} v'(L_j)$$

while a firm employing an aggregate $L_i$ and $L_{i,j}$ from worker $j$ has a marginal product with him writing

$$\frac{\partial F}{\partial L_{i,j}} = \left(\frac{L_{i,j}}{L_i}\right)^{-1/\epsilon} F'(L_i).$$

Conditional on aggregates $L_i$ and $L_j$, the total surplus of the match is

$$S(L_{i,j}|L_i, L_j) = \int_{l=0}^{L_{i,j}} \left[ \left( \frac{l}{L_i} \right)^{-1/\epsilon} MPL(L_i) - \left( \frac{l}{L_j} \right)^{1/\eta} MRS(L_j) \right] dl$$

$$S_{i,j} = S(L_{i,j}|L_i, L_j) = \frac{\epsilon}{\epsilon - 1} \frac{L_{i,j}^{1-1/\epsilon}}{L_i^{-1/\epsilon}} MPL(L_i) - \frac{\eta}{\eta + 1} \frac{L_{i,j}^{1+1/\eta}}{L_j^{1/\eta}} MRS(L_j)$$

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 $L$

**Lemma 1** The payoff of the firm (in real terms) is

$$\tilde{P}_{i,j}^f = \tilde{P}_{i,j}^f (L_{i,j}, W_{i,j}|L_i) = \frac{\epsilon}{\epsilon - 1} \frac{L_{i,j}^{1-1/\epsilon}}{L_i^{-1/\epsilon}} MPL(L_i) - \frac{W_{i,j} L_{i,j}}{P} \quad (4)$$
The worker’s payoff in the second stage is, in terms of the goods

\[ \tilde{P}_{i,j}\mid_j = \tilde{P}_{i,j}(L_{i,j}, W_{i,j}\mid L_j) = \frac{W_{i,j}L_{i,j}}{P} - \frac{\eta}{\eta + 1} \frac{L_{i,j}^{1+1/\eta}}{L_j^{1/\eta}} \text{MRS}(L_j) \]  (5)

Let me also look at the worker’s and firm’s aggregate payoffs

**Lemma 2** Denoting \( W_i L_i = \int_{j=0}^{1} W_{i,j} L_{i,j} dj \), the firm’s aggregate payoff is

\[ \tilde{P}_i^f = \tilde{P}_i^f(L_i, W_i) = \int_{j=0}^{1} \tilde{P}_{i,j}^f \ dj = \frac{\epsilon}{\epsilon - 1} L_i MPL(L_i) - \frac{W_i L_i}{P} \]  (6)

Denoting \( W_j L_j = \int_{i=0}^{1} W_{i,j} L_{i,j} di \), the worker’s aggregate payoff is

\[ \tilde{P}_j^w = \tilde{P}_j^w(L_j, W_j) = \int_{i=0}^{1} \tilde{P}_{i,j}^w \ di = \frac{W_j L_j}{P} - \frac{\eta}{\eta + 1} L_j \text{MRS}(L_j) \]  (7)

### 2.2 Flexible equilibrium

I solve the flexible equilibrium using backward induction. I solve first the second-stage bargaining problem to derive the labour bargain curve. This curve is then used as a constraint in the first-stage bargaining.

#### Second stage bargaining

In each match, the wage bargaining is as follows: for each level of employment \( L_{i,j} \) in the match, the wage bill \( W_{i,j} L_{i,j} \) maximizes the Nash product

\[ \max_{W_{i,j}} (\tilde{P}_{i,j}^w) \gamma (\tilde{P}_{i,j}^f)^{1-\gamma} \]

\( \gamma (1-\gamma) \) is the bargaining power of the employee (firm). The wage bill is a weighted average of the production and disutility functions.

**Theorem 1** (Labour bargain curve)

The second stage defines the relationship between \( W_{i,j} \) and \( L_{i,j} \) in the match, for given \( L_i \) and \( L_j \) – and hence given \( \text{MRS}(L_j) \) and \( MPL(L_i) \):
\[ \frac{W_{i,j}}{P} = (1 - \gamma) \frac{\eta}{\eta + 1} \left( \frac{L_{i,j}}{L_j} \right)^{1/\eta} MRS(L_j) + \gamma \frac{\epsilon}{\epsilon - 1} \left( \frac{L_{i,j}}{L_i} \right)^{-1/\epsilon} MPL(L_i) \] (8)

The labour bargain elasticity is \( e = \frac{\partial \ln L_{i,j}}{\partial \ln W_{i,j}} \).

When \( \gamma = 1 \), \( \frac{W_{i,j}}{P} = \frac{\epsilon}{\epsilon - 1} \left( \frac{L_{i,j}}{L_i} \right)^{-1/\epsilon} MPL(L_i) > \left( \frac{L_{i,j}}{L_i} \right)^{1/\eta} MRS(L_j) \). The wage is lower than usual, because the firm captures the total surplus generated by the match.

Property 1 (Ergodicity) Since the distribution of wages and hours is ergodic, the effective labour and wages are identical across workers and firms:

\[ \forall (i,j) \in [0, 1]^2, L_i = L_f, W_i = W_f, L_j = L_w, W_j = W_w \]

Wage and employment heterogeneity\(^8\) imply: \( W_w \leq W_f \) and \( L_f \leq L_w \)

The aggregate payoffs are symmetric across firms and across individuals

\[ \tilde{P}_f(L_i, W_i) = \tilde{P}_w(L_f, W_f) \quad \text{and} \quad \tilde{P}_j(L_j, W_j) = \tilde{P}_w(L_w, W_w) \]

The labour bargain curve can be aggregated as follows:

\[ \frac{W_f L_f}{P} = \frac{W_w L_w}{P} = (1 - \gamma) \frac{\eta}{\eta + 1} L_w MRS(L_w) + \gamma \frac{\epsilon}{\epsilon - 1} L_f MPL(L^f) \] (9)

\(^8\)This is due to Jensen’s inequality, but only matters at the second order
First stage bargaining

I can now turn to the first stage of the bargaining. The Nash bargaining maximizes the joint product, subject to the labour bargain curve (8):

$$\max_{W_{i,j},L_{i,j}} (\tilde{P}^w_{i,j})^{\gamma'} (\tilde{P}^f_{i,j||i})^{1-\gamma'} \quad \text{st. (eq 8)}$$ (10)

Using the labour bargain curve, the joint product can be rewritten

$$(\tilde{P}^w_{i,j})^{\gamma'} (\tilde{P}^f_{i,j||i})^{1-\gamma'} = \left[\gamma^{\gamma'}(1-\gamma)^{1-\gamma'}\right] S(L_{i,j}|L_i,L_j)$$

Hence the firm and worker can simply choose a wage $W_{i,j}$ such that the corresponding $L_{i,j}$ maximizes the surplus $S(L_{i,j}|L_i,L_j)$. This yields an efficient, symmetric equilibrium when wages are flexible.

**Theorem 2 (Flexible equilibrium)**

The flexible symmetric equilibrium ($L_{i,j} = L^f = L^w = L$) is always efficient:

$$MPL = MRS = \left(1 + \frac{1}{e}\right) \frac{W}{P}$$ (11)

$e = \frac{\partial \ln L_{i,j}}{\partial \ln W_{i,j}} |_{W,L}$, the labour bargain elasticity around the steady state, satisfies

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

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

**Property 2** (1) When $\gamma = 1$, $e = -\epsilon$ and we have perfect monopoly:

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

I allow the bargaining power to differ in the first and second stage. Only the second stage bargaining power matters for the flexible equilibrium and the Phillips Curve
When $\gamma = 0$, $e = \eta$ and we have perfect monopsony:

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

When $\frac{\gamma}{\epsilon - 1} = (1 - \gamma) \eta + 1$, the bargain is isomorphic to perfect competition:

$$\frac{W}{P} = MPL = MRS \quad \text{and labour in a match is perfectly elastic:} \quad \frac{1}{\epsilon} = 0$$

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 wage-setting as the two limiting cases.

As the bargaining shifts smoothly in the interior of the interval, the slope of the wage bargaining curve smoothly changes sign. Also, with this model, perfect competition 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.

### 2.3 The wage bargain Phillips curve

Under flexible wages, the timing of the game didn’t matter. The second stage featured a bargaining over the wage $W_{i,j}$ (or wage bill $W_{i,j}L_{i,j}$) in the atomistic match $(i,j)$, for a given match labour $L_{i,j}$. Since wages were flexible, they could be agreed on in the second stage as a normal wage bargaining. With rigid wages, I assume that the wage bargaining curve derived previously holds in the second stage, or at least, that the slope of the second-stage bargaining curve is an average of the slopes of the MPL and MRS curves.
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

\[ P^w_t(i,j) = \sum_{k=0}^{+\infty} (\beta \theta)^k u'(C_{t+k}) P^w_{t+k}(i,j) \]

\[ P^f_t(i,j) = \sum_{k=0}^{+\infty} (\beta \theta)^k u'(C_{t+k}) P^f_{t+k}(i,j) \]

Bargaining maximizes the joint product:\(^{10}\)

\[
\max_{W_t(i,j)} P^w_t(i,j) \gamma' P^f_t(i,j)^{1-\gamma'} \quad \text{st} \quad \frac{\partial \ln L_t(i,j)}{\partial \ln W_t(i,j)} |_{W,L} = e
\]

Since the joint product is proportional to the discounted sum of surpluses,\(^{11}\) the optimal reset wage equals the match \(MPL\) and MRS on average:

\[
E_t \sum_{k=0}^{+\infty} (\beta \theta)^k u'(C_{t+k}) L_{t+k}(i,j) \left[ \left( \frac{L_{t+k}(i,j)}{L_{t+k}(j)} \right)^{-1/\epsilon} MPL(L_{t+k}(i)) - \left( \frac{L_{t+k}(i,j)}{L_{t+k}(j)} \right)^{1/\eta} MRS(L_{t+k}(j)) \right] = 0
\]

First order approximation

Using the fact that \(MRS = MPL = (1 + \frac{1}{\eta}) \frac{W}{\eta}\) on average, the log deviation of the optimal reset wage can be written as a discounted sum: \(^{12}\)

\[
w^*_t = (1 - \beta \theta) \sum_{k=0}^{+\infty} (\beta \theta)^k E_t \left[ w_{t+k} + mrs(l_{t+k}(i)) + p_{t+k} - w_{t+k} \right] / (1 - e/\eta)
\]

Up to the first order, \(l(i) = l(j) = l\), and \(w(i) = w(j) = w\). Denoting

\[
\gamma = \frac{2 - \epsilon}{(1-\gamma)\frac{\gamma}{\epsilon + 1}}, \quad \gamma_m = \frac{2 - \epsilon}{\frac{\epsilon}{\epsilon + 1}},
\]

the log of the aggregate labour bargain curve is

\[
w_{t+k} - p_{t+k} = (1 - \gamma)mrs(l_{t+k}) + \gamma_m pl(l_{t+k}) \quad (12)
\]

\(^{10}\)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

\(^{11}\)\[P^w_t(i,j) \gamma' P^f_t(i,j)^{1-\gamma'} = \gamma' (1 - \gamma)^{1-\gamma'} E_t \sum_{k=0}^{+\infty} (\beta \theta)^k u'(C_{t+k}) S_{t+k}(i,j)\]

\(^{12}\)\[\sum_{k=0}^{+\infty} (\beta \theta)^k E_t (w_t - p_{t+k} - mrs(l_{t+k}(i)) + \frac{1}{\eta}(l_{t+k}(i) - l_{t+k}(i))) = 0\]
This brings the recursive expression for the reset wage:

\[
    w^*_t = (1 - \beta \theta) w_t + \gamma \frac{1 - \beta \theta}{1 - \epsilon/\eta} [mrs(l_{t+k}) - mpl(l_{t+k})] + \beta \theta E_t w^*_t + 1
\]

Using some algebra, \( \frac{\gamma}{1 - \epsilon/\eta} = -\frac{1/\epsilon}{1/\epsilon + 1/\eta} \). Putting the optimal rest wage \( w^*_t \) into the dynamics of inflation, I get the Nash Bargaining Wage Phillips Curve:

**Theorem 3 (Nash Bargaining Wage Phillips Curve)**

\[
    \pi^w_t = \frac{(1 - \beta \theta)(1 - \theta)}{\theta} \frac{-1/\epsilon}{1/\epsilon + 1/\eta} (mrs_t - mpl_t) + \beta E_t \pi^w_{t+1} \quad (13)
\]

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

**Property 3** The slope of the Phillips Curve solely depends on

\[
    -\frac{1}{\epsilon} = \frac{\gamma}{\epsilon - 1} - \frac{(1 - \gamma)}{\eta + 1} + \frac{\gamma \epsilon}{\epsilon - 1}
\]

(1) If \( \frac{\gamma}{\epsilon - 1} > \frac{(1 - \gamma)}{\eta + 1} \) (monopolistic competition), \( -\frac{1}{\epsilon} > 0 \), the slope is positive

(2) If \( \frac{(1 - \gamma)}{\eta + 1} > \frac{\gamma}{\epsilon - 1} \) (monopsonistic case), \( -\frac{1}{\epsilon} > 0 \), 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.\(^{13}\) It is easy to verify that \( \gamma = 1 \) and \( \gamma = 0 \) give the normal monopoly and monopsony Phillips curves respectively – except that the steady-state is efficient.

\(^{13}\) 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.
3 Discussion

In this section I interpret the model in light of historical cases of strong interconnection between structural and monetary outcomes. I also look at the robustness of the model to alternative assumptions.

3.1 Interpretation

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. Industry, labour and the government would write "codes of fair competition" to reduce "destructive competition" in each sector. This included minimum
wages, prices and standards, as well as maximum hours. 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 some have argued 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 postwar neo-corporatist policies, where unions, producers and governments tended to weaken competition. Large sectors were privatized or deregulated in western countries. In the labour market, the UK and the US were the most prominent in reducing the power and influence of unions: Margaret Thatcher and Ronald Reagan effectively broke strikes, and heavily regulated unions, weakening their power.

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.
3.2 Centralised first stage bargaining

Suppose that the first-stage bargaining maximizes not the match-specific surplus, but the aggregate surplus, if done by unions of firms and workers. For simplicity, I assume a constant curvature for production and disutility:

Assumption 1 (Constant curvature)

(1) The production function is \( F(L) = L^{1-\alpha} \) with \( L^{1-1/\epsilon} = \int_{i=0}^{1} L_i^{1-1/\epsilon} \, di \)

Concavity of the production function requires \( 1 > \alpha > 1/\epsilon > 0 \);

(2) The disutility function is \( v(L) = L^{1+\phi} \) with \( L^{1+1/\eta} = \int_{j=0}^{1} L_j^{1+1/\eta} \, dj \)

Convexity of the disutility requires \( \phi > 1/\eta > 0 \)

The payoffs of the second-stage are the same as before, but in the first-stage,

Lemma 3 (First Stage Payoffs)

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,

\[
p_f(L_i, W_i) = F(L_i) - \frac{W_i L_i}{P} \quad \text{and} \quad p_w(L_i, W_i) = \frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \quad (14)
\]

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:

\[
\max_{W_i, L_i} \left[ \gamma \ln \left( \frac{W_i L_i}{P} - \frac{v(L_i)}{u'(C)} \right) + (1 - \gamma) \ln \left( F(L_i) - \frac{W_i L_i}{P} \right) \right] \quad (15)
\]

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

This yields the same efficient flexible equilibrium as in theorem (2) before.
Calvo rigidities

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

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

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

Hence the maximization problem is

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

First order approximation

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

The log linear approximation around the steady state becomes

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

(16)

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.\(^{14}\) 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 \( t \)).\(^{15}\) Approximation (12) is still valid with the same expression for \( \tilde{\gamma} \). All this combined, I get the following PC:

\(^{14}\)With \( F(L) = L^{1-\alpha} \) and \( v(L) = L^{1+\phi} \), \( \frac{PF(L)}{WL} - 1 = \frac{\frac{1}{1-\alpha} + \alpha}{1-\alpha} \) and \( 1 - \frac{Pv(L)}{u'(C)WL} = \frac{\phi - 1}{1+\phi} \)

\(^{15}\)mrs\(_{t+k|t} = mrs\(_{t+k} + c \phi (w^*_t - w_{t+k}) \) and \( mpl\(_{t+k|t} = mpl\(_{t+k} - c \alpha (w^*_t - w_{t+k}) \)
Theorem 4 (Phillips Curve – Centralized bargaining)

$$\pi_t = \frac{(1 - \beta\theta)(1 - \theta)}{\theta} \lambda \left(\frac{-1}{e}\right) (mrs_t - mpl_t) + \beta E_t \pi_{t+1}$$ (17)

with $\lambda > 0$ so the sign of the slope solely depends on $-1/e$ as before.\(^{16}\)

3.3 Flattening the price Phillips Curve instead

It is possible to build an alternative model where wage bargaining institutions have an impact on the price Phillips Curve, instead of the wage curve. One key element is the procyclicality of hourly compensation for workers. As argued by Swanson (2007), variable pay margins such as bonuses, commissions, overtime and late shift premia play a substantial role in the cyclicality of compensation for workers, more so than their straight time hourly wage.

I will assume that in a firm, if employees (or unions) have strong bargaining power, the hourly compensation is more procyclical than if employers enjoy most of the bargaining leverage. One clear example is the treatment of overtime. Across countries, there is a strong heterogeneity about the extent of overtime, and how it is compensated for. In some countries the number of overtime hours is limited by law, and they must be paid a premium over straight-time hours. In others there is more flexibility, and they only have to be paid if they make the hourly compensation of the employee fall below the minimum wage. Whether overtime hours are paid more (or less) than normal hours is clearly dependent on labour market institutions, and it makes the marginal (and average) work compensation procyclical (or countercyclical).

Assumption 2 (Cyclicality of compensation) Denoting $\gamma$ the worker’s bargaining power, the log deviation of the marginal real hourly compensation in firm $i$ is a weighted average of the worker’s $MRS$ and the firm’s $MPL$:

$$\hat{w}(i) - p = \gamma mrs(i) + (1 - \gamma) mpl(i)$$ (18)

\(^{16}\lambda = \frac{\gamma^2 (1 + \phi)(1 + 1/\epsilon)}{\gamma^2 - \gamma^2 (1 - \alpha)(1 + 1/\epsilon) - \gamma^2 (1 + \phi)(1 + 1/\epsilon)} > 0\) since $-\alpha < -1/\epsilon < 1/e < 1/\eta < \phi$ from assumption (1). $\frac{(1 - \beta\theta)(1 - \theta)}{\theta}$ and $(mrs_t - mpl_t)$ are unchanged from theorem 3.
As such, if $\gamma = 1$ and the firm imposes overtime on workers, they are fully compensated: their marginal rate of substitution is equal to their marginal compensation. On the other hand, when $\gamma = 0$, the firm does manage to pay workers at their marginal productivity, which decreases as output increases.\textsuperscript{17}

**Nominal price rigidities**

Instead of assuming imperfect substitutability across workers or jobs, I assume imperfect substitution across goods. The consumption good $C_t$ is a CES aggregate of the varieties $C_t(i)$ produced by each firm $i$:

$$C_t^{1-1/\epsilon} = \int_0^1 C_t(i)^{1-1/\epsilon} di$$

If the firm faces Calvo price rigidities, with a probability $\theta$ that her prices remain fixed in every period, standard algebra provides the optimal reset price $p^*_t$ for firm $i$ in period $t$. Dropping the markup, and in log deviations,\textsuperscript{18}

$$p^*_t = (1 - \beta \theta) \sum_{k=0}^{+\infty} (\beta \theta)^k [\tilde{w}_{t+k}(i) - mpl_{t+k}(i)]$$

With $\alpha = -\frac{LF''(L)}{F'(L)}$ and $\phi = \frac{LV''(L)}{V'(L)}$, the reset price is recursively written:

$$p^*_t = (1 - \beta \theta)p_t + \frac{1 - \beta \theta}{1 + \gamma(\phi + \alpha)}(mrst_t - mpt_t) + \beta \theta E_t \pi_{t+1}^p$$

This yields the following price Philips Curve:

$$\pi_t^p = \frac{(1 - \theta)(1 - \beta \theta)}{\theta} \frac{\gamma (1 - \alpha)}{(1 - \alpha) + \gamma \epsilon (\phi + \alpha)} (mrst_t - mpt_t) + \beta \theta E_t \pi_{t+1}^p$$  \hspace{1cm} (19)

\textsuperscript{17}Here I am not modelling monopsony through imperfect substitution. Instead I assume that switching frictions prevent employees from moving to another employer with a slightly higher wage. Conversely, when the union impresses a higher wage on the employer due to the overtime, the firm cannot hire new workers immediately to undercut this higher wage. Hence monopsony and monopoly power are necessary for heterogeneity in wages.

\textsuperscript{18}From my previous assumption, $\tilde{w}_{t+k}(i) = p_{t+k} + \gamma mrs_{t+k}(i) + (1 - \gamma)mpl_{t+k}(i)$ hence $p^*_t = (1 - \beta \theta) \sum_{k=0}^{+\infty} (\beta \theta)^k [p_{t+k} + \gamma (mrs_{t+k}(i) - mpl_{t+k}(i))]$. This is combined with $mrst_{t+k}(i) = mrst_{t+k} + \phi(l_{t+k}(i) - l_{t+k}) = mrst_{t+k} - \frac{\phi}{1-\alpha}(p^*_t - p_{t+k})$ and $mpl_{t+k}(i) = mpl_{t+k} - \alpha(l_{t+k}(i) - l_{t+k}) = mpl_{t+k} + \frac{\alpha}{1-\alpha}(p^*_t - p_{t+k})$. 

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Here, the slope of the price PC depends \( \frac{\gamma(1-\alpha)}{(1-\alpha)+\gamma(\rho+\alpha)} \), which is increasing in \( \gamma \). The curve is steepest when workers have all the bargaining power (\( \gamma = 1 \)). When firms have all the bargaining power (\( \gamma = 0 \)), the PC is flat. Hence a shift of power towards employers flattens the price Phillips Curve now.

4 Conclusion

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 competitive equilibrium, 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. While structural reforms make the inflation-output less costly in normal times, they are detrimental during liquidity traps, as fiscal policy and other demand stimuli are less effective at inflating the economy away from the Zero Lower Bound.

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.

References


Appendix – for online publication

First order approximation – Centralised Bargaining

The first order condition with respect to $W^*_t$ is

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

or $LHS = RHS$ with

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

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

Around a zero inflation equilibrium, we have $MRS = MPL = (1 + \frac{1}{e}) \frac{W}{P}$. Let’s assume $F(L) = L^{1-\alpha} = \frac{L}{1-\alpha} MPL = L^{1+\frac{1}{\alpha}} \frac{W}{1-\alpha}$. Similarly, $\frac{v(L)}{u'(C)} = \frac{L^{1+\phi}}{u'(C)} = \frac{L}{1+\phi} MRS = L^{1+\frac{1}{\phi}} \frac{W}{1+\phi}$. Then $F(L) - \frac{WL}{P} = \frac{1}{1-\alpha} WL$ and $\frac{W}{P} - \frac{v(L)}{u'(C)} = \frac{\phi}{1+\phi} \frac{WL}{P}$.

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

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

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

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

$$lhs = \gamma \frac{(1 - \beta \theta) (1 + \phi)}{\frac{1}{e}} \sum_{k=0}^{+\infty} (\beta \theta)^k \left[ \frac{1}{e} + e \phi (w^*_t - w_{t+k}) + (w_{t+k} - p_{t+k}) - mrs_{t+k} \right]$$
\[ mpl_{t+k|t} = mrs_{t+k} - \alpha(l_{t+k|t} - l_{t+k}) = mpl_{t+k} - e\alpha(w_t^* - w_{t+k}), \text{ so} \]

\[ rhs = (1 - \gamma) \left( 1 - \beta \theta \right) \left( 1 - \alpha \right) \left( \frac{\gamma \left( 1 + \phi \right)}{\phi - 1} \right) + \alpha \sum_{k=0}^{\infty} (\beta \theta)^k \left[ \left( 1 + e\alpha \right) \left( w_t^* - w_{t+k} \right) \right. \]

The aggregate wage satisfies

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

with \( \tilde{\gamma} = \frac{\gamma \left( 1 + \phi \right)}{(1 - \gamma) \left( \frac{\phi}{\phi - 1} \right)} = \frac{\gamma \left( 1 + \phi \right)}{\phi - 1} \), so

\[ rhs = (1 - \gamma) \left( 1 - \beta \theta \right) \left( 1 - \alpha \right) \left( \frac{\gamma \left( 1 + \phi \right)}{\phi - 1} \right) + \alpha \sum_{k=0}^{\infty} (\beta \theta)^k \left[ \left( 1 + e\alpha \right) \left( w_t^* - w_{t+k} \right) \right. \]

\[ lhs = \gamma \left( 1 - \beta \theta \right) \phi - 1 \sum_{k=0}^{\infty} (\beta \theta)^k \left[ \left( 1 - e\phi \right) \left( w_t^* - w_{t+k} \right) \right. \]

Setting \( lhs = rhs \) implies

\[ (\gamma \left( 1 + \phi \right) + (1 - \gamma) \left( 1 - \alpha \right)) w_t^* \]

\[ = (1 - \beta \theta) \sum_{k=0}^{\infty} (\beta \theta)^k \left[ \left( 1 - e\phi \right) \left( w_t^* - w_{t+k} \right) \right. \]

This can be written recursively as

\[ (w_t^* - w_t) = (1 - \beta \theta) \left( \frac{\gamma (1 + \phi)}{\phi - 1} \right) + \left( \frac{1 - \gamma (1 - \alpha)}{1 + \alpha e} \right) (1 - \tilde{\gamma}) \left( mpl_t - mrs_{t+k} \right) \]

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

\[ \lambda = \left( \frac{\gamma (1 + \phi)}{\phi - 1} \right) + \left( \frac{1 - \gamma (1 - \alpha)}{1 + \alpha e} \right) \left( \frac{-1}{\epsilon} \right) \]

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

\[ = \frac{\gamma^2 (1 + \phi) (1 + 1/\epsilon)}{\epsilon (1 + \phi) + (1 - \gamma) (1 - \alpha)} \left( \frac{-1}{\epsilon} \right) \]