Avoiding Liquidity Traps With Minimum Wages: Can Stability Justify Distortions?

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Abstract

A sufficiently high real minimum wage eliminates liquidity-trap equilibria in the sticky-price New Keynesian model by putting a floor on deflation expectations. This stability comes with a cost, since the minimum wage distorts the relative input of low and high productivity labor in the intended equilibrium. Theoretically, the minimum wage's effects are non-monotonic: a sufficiently high minimum wage eliminates the liquidity trap, whereas a low one actually makes it worse. Empirically, cross-region and state increases in minimum wages are associated with higher inflation expectations. Quantitatively, setting the real minimum wage just high enough to eliminate the liquidity trap may reduce or increase welfare, depending on the calibrated share of minimum wage earners and the frequency of liquidity traps.

Very Preliminary

We must sustain and strengthen Japan's positive economic cycle next year to achieve our long-standing goal of beating deflation. For that, I'd like to ask companies to raise wages by 3 *percent or higher next spring.*

– Japanese Prime Minister Shinzo Abe, Dec. 2017

1 Introduction

Many countries have undergone extended periods of near-zero nominal interest rates in recent years, which has challenged macroeconomists to explain how and when the zero lower bound (ZLB) will bind in the future, as well as what policies can stimulate the economy when it does. The first question is complicated because there are two common theoretical models of the zero lower bound in the New Keynesian literature. Models like Eggertsson and Woodford [3] posit a preference shock to aggregate demand is so large that the monetary authority lowers nominal rates to zero when attempting to offset it, while Benhabib, Schmitt-Grohé, and Uribe [1] show that New Keynesian models may have multiple equilibria, all but one of which converge to a liquidity trap in which the ZLB binds. Borağan, Cuba-Borda, and Schorfheide [2] provide evidence that both types of ZLB episodes have occurred in different countries, which is important because, as emphasized by Mertens and Ravn [5], the underlying cause of a ZLB episode dictates the efficacy of non-monetary policies aimed at alleviating the severe recession that it causes.

In this paper, I first extend the New Keynesian model to include heterogeneous labor inputs and minimum wage regulations. I show that may have multiple equilibria, one of which has high output and constant inflation but is unstable, while a continuum of equilibria that converge to an expectations-driven liquidity trap, as in the standard model with homogeneous labor. Comparative statics demonstrate that a sufficiently high real minimum wage eliminates all but the best equilibrium, though it suffers in terms of allocative efficiency in most cases. I then test the ability of real minimum wages to affect inflation expectations in historical data, use a calibrated example to assess when it may be sound policy to eliminate liquidity traps with a distortionary minimum wage, and finally conclude.

2 Labor Market

Time is discrete and the economy comprises a continuum of producer-consumer households, indexed by $j \in [0, 1]$.[1] Each household comprises one worker of two types, high-productivity and low-productivity, and produces a differentiated consumption good using the labor of other households' workers, which it sells to all other households under monopolistic competition and Rotemberg [8] price adjustment costs. Household j therefore chooses time paths of each consumption good, $(c_\ell)_{\ell \in [0,1]}$, bonds, b, labor demands, N_H and N_L, labor supplies, n_H and n_L, as well as prices, p_j, to maximize expected discounted utility:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\log \left[\int_0^1 c_{\ell,t}^{\frac{\epsilon-1}{\epsilon}} d\ell \right]^{\frac{\epsilon}{\epsilon-1}} - \sum_{i \in \{L,H\}} \theta \frac{\nu}{1+\nu} n_i^{\frac{1+\nu}{\nu}} - \frac{\gamma}{2} \left(\frac{p_{j,t}}{p_{j,t-1}} - 1 \right)^2 \right], \quad (1)$$

subject to the constraints

$$\begin{aligned}
\int_0^1 p_{\ell,t} c_{\ell,t} d\ell + b_{t+1} &= (1+i_t) b_t + W_{L,t} n_{L,t} + W_{H,t} n_{H,t} + Profit_{j,t}, && (2) \\
Profit_{j,t} &= p_{j,t} y_{j,t}^d(p_{j,t}) - W_{L,t} N_{L,t} - W_{H,t} N_{H,t}, && (3) \\
N_{H,t}^{\alpha} \left(N_{L,t} \right)^{1-\alpha} &\geq y_{j,t}^d \left(p_{j,t} \right), && (4) \\
n_{H,t} &\leq \overline{n}_{H,t}, && (5) \\
n_{L,t} &\leq \overline{n}_{L,t}, && (6)
\end{aligned}$$

where the labor supply constraints, $n_{i,t} \leq \overline{n}_{i,t}$, are taken as an arbitrary constraint by households, but will be equal to per-capita labor demand in equilibrium. The idea of higher productivity for $H-$type workers will appear as $\alpha > 0.5$ in this formulation, which will guarantee that these workers receive higher wages than do $L-$type. Finally, I focus on a symmetric equilibrium with $p_{j,t} = P_t$ and $y_{j,t}^d(p_{j,t}) = Y_t$.

2.1 Labor Demand

The novel feature of this model is the combination of heterogeneous labor and constraints arising from the minimum wage. I therefore characterize the labor demand decisions in production, which determine the real unit cost of production, which enters the Phillips Curve in the final equilibrium system. The

[1] This formulation follows Michaillat and Saez [6], but in discrete time.

first-order conditions give the following expression for relative labor demands

$$\frac{N_{L,t}}{N_{H,t}} = \frac{1-\alpha}{\alpha}\frac{W_{H,t}}{W_{L,t}}. \tag{7}$$

Which yields high-productivity labor demand as a function of output and relative wages:

$$N_{H,t} = \left(\frac{1-\alpha}{\alpha}\frac{W_{H,t}}{W_{L,t}}\right)^{\alpha-1} Y_t. \tag{8}$$

These conditions hold in general, while the labor supply side of the economy depends on whether the minimum wage binds for either or both worker types. They imply that the real unit cost of production,

$$\frac{\mathcal{W}_t}{P_t} \equiv \frac{W_{H,t}N_{H,t} + W_{L,t}N_{L,t}}{Y_t}, \tag{9}$$

simplifies to[2]

$$\frac{\mathcal{W}_t}{P_t} = \alpha^{-1}\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} W_{H,t}^{\alpha} W_{L,t}^{1-\alpha}. \tag{10}$$

2.2 Labor Supply

Under the assumption that $\alpha > 0.5$, there are three regions of labor supply outcomes that depend on aggregate output relative to the real minimum wage, ω. In the first case, output is sufficiently large that both $\frac{W_{L,t}}{P_t}$ and $\frac{W_{H,t}}{P_t}$ are above ω. In the second case, for intermediate output levels, $\frac{W_{L,t}}{P_t} = \omega < \frac{W_{H,t}}{P_t}$. Finally, for low levels of output, both real wages are below the minimum.

In general, the intratemporal Euler Equation for high-productivity workers holds for all but the lowest levels of output, in which case they receive the minimum wage. This gives a general expression for the high-productivity real wage as

$$\frac{W_{H,t}}{P_t} = \theta^{\frac{\nu}{1-\alpha+\nu}}\left(\frac{\alpha}{1-\alpha}\right)^{\frac{1-\alpha}{1-\alpha+\nu}} Y_t^{\frac{1+\nu}{1-\alpha+\nu}} \left(\frac{W_{L,t}}{P_t}\right)^{\frac{1-\alpha}{1-\alpha+\nu}}. \tag{11}$$

For sufficiently high Y_t, the real wage of low-productivity workers is above the minimum, so their intratemporal Euler Equation is satisfied. Their real wage is then proportional to the high-productivity real wage:

$$\frac{W_{L,t}}{P_t} = \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1}{1+\nu}} \frac{W_{H,t}}{P_t}. \tag{12}$$

[2] All derivations are in the appendix.

Equation (12) guarantees that low-productivity wages are lower than high-productivity wages whenever $\alpha > 0.5$. Using equation (8) to replace high-productivity labor and equation (12) to replace relative wages, the intratemporal Euler Equation for labor supply yields the following relationship between $\frac{W_{H,t}}{P_t}$ and output

$$\frac{W_{H,t}}{P_t} = \theta\left(\frac{\alpha}{1-\alpha}\right)^{\frac{1-\alpha}{1+\nu}} Y_t^{\frac{1+\nu}{\nu}}. \tag{13}$$

Importantly, the unit cost and both real wages are zero for $Y_t = 0$, which means that both will hit the real minimum wage for sufficiently low output. Furthermore, the low-productivity worker's wage will fall below the real minimum first. Therefore, for sufficiently high Y_t, equations (12) and (13) mean that the real unit cost of production from equation (10) is given by

$$\frac{\mathcal{W}_t}{P_t} = \alpha^{-1}\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} \theta Y_t^{\frac{1+\nu}{\nu}}, \tag{14}$$

which is an increasing and convex function of output.

For sufficiently low Y_t, the low-productivity worker's wage in equation (12) falls below the real minimum wage ω, in which case the expression for the real wage of high-productivity workers also changes. Denote the level of output for which low-productivity workers earn the minimum wage by

$$\underline{Y}_L(\omega) = \left[\frac{\omega}{\theta}\left(\frac{\alpha}{1-\alpha}\right)^{\frac{\alpha}{1+\nu}}\right]^{\frac{\nu}{1+\nu}}. \tag{15}$$

For $Y_t \leq \underline{Y}_L(\omega)$, the unit cost of production is found by replacing low-productivity real wages with ω in equation (11) and then evaluating equation (10). The unit cost in this region is still a convexly increasing function of output, but is flatter than the expression in equation (14). Finally, once output falls below

$$\underline{Y}_H(\omega) = \left[\frac{\omega}{\theta}\left(\frac{1-\alpha}{\alpha}\right)^{\frac{1-\alpha}{\nu}}\right]^{\frac{\nu}{1+\nu}}, \tag{16}$$

all workers earn the real minimum wage, so the unit cost of production is just ω. The unit cost is therefore a piece wise continuous function in output and the real minimum wage,

$$\frac{\mathcal{W}_t}{P_t} = \begin{cases} \alpha^{-1}\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} \theta Y_t^{\frac{1+\nu}{\nu}} & \text{if } Y_t \geq \underline{Y}_L(\omega) \\ \alpha^{-1}\theta^{\frac{\alpha\nu}{1-\alpha+\nu}}\left[\left(\omega\frac{\alpha}{1-\alpha}\right)^{1-\alpha} Y_t^{\alpha}\right]^{\frac{1+\nu}{1+\nu-\alpha}} & \text{if } \underline{Y}_H(\omega) \leq Y_t < \underline{Y}_L(\omega) \\ \alpha^{-1}\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha}\omega & \text{if } Y_t < \underline{Y}_H(\omega). \end{cases} \tag{17}$$

This is a piece-wise continuous function that is convex in output, with a horizontal region for very low levels of Y_t.

3 Equilibrium System

I will assume that monetary policy sets nominal interest rates subject to the zero-lower bound. That is,

$$1 + i_t = \max\{\beta^{-1}\Pi_t^{\phi}, 1\}, \tag{18}$$

where Π_t is the growth factor of prices and $\phi > 1$ is the response to inflation of a monetary authority that follows the Taylor Principle. In the *intended* steady state, $P_t = P_{t-1}$ and the nominal rate is just the inverse of the discount factor. In the liquidity trap, however, the nominal rate is zero.

The goods market is standard, so the intertemporal Euler Equation (or IS curve) is given by

$$Y_t^{-1} = \beta \mathbb{E}_t \left[Y_{t+1}^{-1} \frac{1 + i_{t+1}}{\Pi_{t+1}} \right]. \tag{19}$$

Pricing decisions, together with the real unit cost described in section 2, give the Phillips Curve

$$\Pi_t(\Pi_t - 1) = \beta \mathbb{E}_t \left[\Pi_{t+1}(\Pi_{t+1} - 1) \right] + \frac{\epsilon}{\gamma} \frac{\mathcal{W}_t}{P_t} - \frac{\epsilon - 1}{\gamma}. \tag{20}$$

Defining $\pi_t = \Pi_t(\Pi_t - 1)$, I will now plot the Euler Equations and Phillips Curve in (Y, π) space, treating ω as a shifter, according to the characterization of $\frac{\mathcal{W}_t}{P_t}$ in equation (17).[3]

3.1 Steady State Equilibria

As in well known, the sticky-price New Keynesian model in which interest rates are set according to the Taylor Principle may have two steady-state equilibria. One of these equilibria features inflation on target (which I set to zero) and high output, which is referred to as the "intended" equilibrium. In the other, firms expect low demand and deflation, which leads them to cut prices, thereby causing the deflation. This leads an active monetary authority to cut nominal rates to zero, which means that real interest rates are high and, as expected,

[3]Note that, to a first-order approximation around stable prices, π_t is equal to the net inflation rate as typically defined, i.e. $\pi_t \approx \Pi_t - 1$.

demand is low. This equilibrium is referred to as the "Expectations Driven Liquidity Trap".

Geometrically, these two equilibria correspond to two possible aggregate demand curves in (Y, π) space, as shown in Figure 2, where the parameter $\delta \equiv \beta - 1$. The Phillips Curve without minimum wages is plotted as the upward sloping dashed line, while the horizontal dotted lines represent aggregate demand under the liquidity trap (lower line) and high output (upper line).[4] Note that the Phillips Curve has been drawn with an intercept below $-\delta$ so that it crosses both aggregate demand lines, which generates two steady state equilibria. The condition for this multiplicity to arise is simply

$$-\frac{\epsilon - 1}{\gamma} < -\delta, \tag{21}$$

which I will assume from here on.

Now consider the model with minimum wages. The aggregate demand lines are unchanged, but now the Phillips Curve is represented by the solid curve in Figure (2). There are now three sections of the Phillips Curve, corresponding to high output, intermediate levels of output, and low output. In the first region, the minimum wage is slack for all workers and the curve has the same slope as in the standard model. In the second region, the minimum wage binds for just the low-productivity workers, and the curve is flatter than the standard model. Finally, for sufficiently low output, the minimum wage binds for all workers and the Phillips Curve is horizontal.

3.2 Comparative Statics

As can be seen in Figure (2), the effect of the real minimum wage depends on the levels of output where the slope changes. The figure illustrates the case when the real minimum wage is sufficiently low that the flat section of the Phillips Curve is below the liquidity-trap aggregate demand line, but where the Phillips Curve crosses the zero-inflation aggregate demand line at a level of output where low-productivity workers are paid a binding minimum wage. Figure (3) begins with this Phillips Curve and considers the effect of increasing the minimum wage to two higher values.

The first thing to note in Figure (3) is that any increase in the minimum wage reduces output in the zero-inflation steady state, as seen in the leftward movement of the points A_M and A_H. In each case, a higher minimum wage

[4] I have drawn the Phillips Curve linearly for graphical simplicity. It is in fact convex for a finite value of ν, but the qualitative analysis is the same.

distorts the labor inputs away from low-productivity workers. The wage of high-productivity workers responds in equilibrium, but not fully, which reduces allocative efficiency and output.

While the level of output associated with zero inflation falls monotonically with the real minimum wage, the effect on output in the liquidity-trap steady state is more complex. Starting from a low minimum wage, a small increase in the minimum wage from ω_L to ω_M moves the Phillips Curve from PC_L to PC_M. This reduces steady-state output in the liquidity trap from Z_L to Z_M, mirroring the reduction in zero-inflation output. As in the zero-inflation steady state, this reduction in output is due to a reduction in allocative efficiency.

When the real minimum wage is further increased to ω_H, the Phillips Curve moves further upward to PC_H. In this case, the flat region is above the liquidity-trap aggregate demand line and there is no longer a steady state with low output and deflation. The liquidity trap requires that households' expectation of a high real interest rate due to deflation is realized because deflation actually occurs in the face of low aggregate demand. Rapid deflation is only optimal if real wages fall with output, which is not possible in the face of a high real minimum wage.

A sufficiently high real minimum wage therefore eliminates the liquidity-trap steady-state equilibrium altogether. Furthermore, the liquidity-trap steady state is the limit of a continuum of dynamic equilibrium paths, all of which are also eliminated when the real minimum wage is set to ω_H. The only equilibrium is therefore the zero-inflation steady state, which presents the tradeoff from having a high real minimum wage since it features a lower level of output than when the minimum wage is low, but is now stable.

The tradeoff between allocative efficiency and stability relies on the minimum wage binding for low-productivity workers for all levels of output up to the zero-inflation steady state. If the low-productivity real wage is above the minimum at the zero-inflation steady state, then it is possible to eliminate the liquidity-trap steady state (and all equilibria that converge to it) without distorting labor inputs in the zero-inflation steady state. This situation is shown in figure (4). Even in this case, raising the minimum wage may reduce output in the liquidity-trap steady state, which can be seen by the movement from point Z_L to Z_M.

4 Empirical Test

The minimum wage eliminates the expectations-driven liquidity trap by altering inflation expectations. A natural question is whether the minimum wage empirically affect inflation expectations, which I test using cross-sectional data from the Michigan Survey of Consumers.

4.1 Data Description and Summary Statistics

I make use of four data sources. The first is a panel of state-level nominal minimum wages at a monthly frequency, constructed and made public by Neumark [7]. This is aggregated to census region and made real using regional consumer price indices. Figure (5) plots each region's real-minimum wage from January 1978 to December 2017, which is the longest period for which inflation expectations are available.

These regional real minimum wage series are then merged with the Michigan Survey of Consumers (MSC) and the Federal Reserve Bank of New York's Survey of Consumer Expectations (SCE). The MSC provides monthly repeated cross sections of individual expectations of inflation over the next twelve months, as well as basic demographic and socioeconomic status information of respondents. Importantly, it also reports the census region (one of "Northeast, South, North Central, or West") in which the respondent resides and is available since 1978. The SCE also asks about inflation expectations over the next twelve months, but identifies the state of residence for each respondent, which allows inflation expectations to be matched with state-level nominal minimum wages. However, the SCE is only available from June, 2013 to December, 2016.

Inflation expectations are elicited at the interviewee level in the MSC on a monthly basis, starting in January 1978. An interviewee is first asked "During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?" If they say that prices will go up or down, then they are asked "By about what percent do you expect prices to go (up/down) on the average, during the next 12 months?", with further probing for extreme answers (more than $+/-5\%$) and verification that signs are correct (i.e. a person who says they expect prices to go up but then answers -5% is recoded as responding with 5%). Further probes are made for people who say that they believe prices will stay the same (to verify that they didn't intend that *inflation* will remain the same). Figure (6) plots the resulting mean and median inflations rates for each region.

Table 1: Inflation Expectations and Real Min. Wage

	$\mathbb{E}_{i,r,t}\pi_{t+1} = \beta w_{r,t} + \mu_t + \gamma_r + G_r(X_{i,r,t}) + \varepsilon_{i,r,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Real Min Wage	0.034***	0.033**	0.034**	0.024**	0.023**	0.023**
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Education	N	Y	Y	Y	Y	Y
Age	N	N	Y	Y	Y	Y
Gas Expectation	N	N	N	Y	Y	Y
Real Income	N	N	N	N	Y	Y
Lag π	N	N	N	N	N	Y
Obs.	246,600	244,005	243,015	112,423	107,072	107,072
R^2	0.107	0.111	0.113	0.421	0.427	0.427

Notes: Estimated regression in header of table. Dependent variable is individual-level inflation expectations from the Michigan Survey of Consumers. Independent variable of interest is the logarithm of regional real minimum wage, multiplied by 100. Standard errors clustered by region and month in parenthesis, significance levels reported at 10%(*), 5%(**) and 1%(***). Controls are all interacted with region. "Education" and "Age" have fixed effect for each year of education and age reported. "Gas Expectation", "Real Income", and "Lag π" enter regression linearly with region-specific slope coefficients.

4.2 Regression Results

Table 1 reports the estimated response of inflation expectations to the regional real minimum wage from the following regression

$$\mathbb{E}_{i,r,t}\pi_{t+1} = \beta w_{r,t} + \mu_t + \gamma_r + G_r(X_{i,r,t}) + \varepsilon_{i,r,t}, \tag{22}$$

where $\mathbb{E}_{i,r,t}\pi_{t+1}$ is the expected inflation over the next year for person i in region r at date t. The coefficient of interest is β, which measures the response of inflation expectations to a 1% increase in the real minimum wage of region r at date t.

All specifications include aggregate time fixed effects for two reasons. First, inflation expectations have trended downward nationally and the real minimum wage has a U-shape, so a positive relationship in the time series may be spurious. Second, the theory requires a higher minimum wage to increase inflation expectations at a liquidity trap, when there is no response in the nominal interest rate through monetary policy. This setting is approximated in the panel regression by assuming that any nominal interest rate response to common changes in the minimum wage is contained in the time fixed effect. In addition, each specification includes region fixed effects since the regional price indices are constructed with different average price levels in the base year. The remaining controls are included iteratively and are interacted with region dummies. Controls include real household income as well as fixed effects for years of education, age, and decile of expected gas price growth over the next year.

The regression results using the MSC data are summarized in Table 1, where columns (1) - (5) vary only by which controls are included. The point estimate for the real minimum wage's effect on inflation expectations is always positive at the 5% level, suggesting that higher minimum wages can increase inflation expectations. The coefficients are similar across specifications, ranging from 0.023 to 0.034, which implies that a 10% increase in the real minimum wage is associated with at least a 0.23% increase in inflation expectations. Since the average inflation expectation in the Michigan Survey of Consumers is 4.3% overall (3.1% since 1985), this represents a substantial increase.

The regression results using the SCE data are summarized in Table 2. The real minimum wage is measured as the state's nominal minimum wage, deflated by regional CPI. All regressions include state and time fixed effects, and columns (1)-(5) vary by which controls are included. The point estimates are higher than in the MSC data, but typically less precisely estimated. However, the coefficients are significant at the 10% level or more except for the last specification, which includes region by time fixed effects. In summary, both the MSC and SCE indicate that increasing the real minimum wage has the predicted effect of raising inflation expectations at the household level.

5 Quantitative Evaluation

I now use the model to calculate expected discounted utility from different values of a real minimum wage in a stochastic model in which a sunspot moves the economy between the intended and liquidity trap equilibria, when the latter exists. That is, there is an underlying state $s_t \in \{0, 1\}$, with 0 representing the liquidity trap and 1 representing the intended equilibrium. This state follows a Markov process with transition probabilities p_{00} and p_{11}.

Table 2: Inflation Expectations and Real Min. Wage

	$\mathbb{E}_{i,s,t}\pi_{t+1} = \beta w_{s,t} + \mu_t + \gamma_s + G_r(X_{i,s,t}) + \varepsilon_{i,s,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Real Min Wage	0.088*	0.088**	0.092**	0.052***	0.047**	0.028
	(0.048)	(0.043)	(0.044)	(0.017)	(0.021)	(0.024)
Education	N	Y	Y	Y	Y	Y
Age	N	N	Y	Y	Y	Y
Gas Expectation	N	N	N	Y	Y	Y
Lag π	N	N	N	N	Y	Y
Region x Date FE	N	N	N	N	N	Y
Obs.	56,132	55,986	55,938	48,412	48,412	48,412
R^2	0.002	0.047	0.043	0.243	0.245	0.249

Notes: Estimated regression in header of table. Dependent variable is individual-level inflation expectations from the Survey of Consumer Expectations. Independent variable of interest is the logarithm of state real minimum wage (state nominal minimum wage deflated by regional CPI), multiplied by 100. Standard errors clustered by state and month in parenthesis, significance levels reported at 10%(*), 5%(**) and 1%(***). Controls are all interacted with state. "Education" and "Age" have fixed effect for each year of education and age reported. "Gas Expectation" and "Lag π" enter regression linearly with state-specific slope coefficients.

5.1 Parameter Values

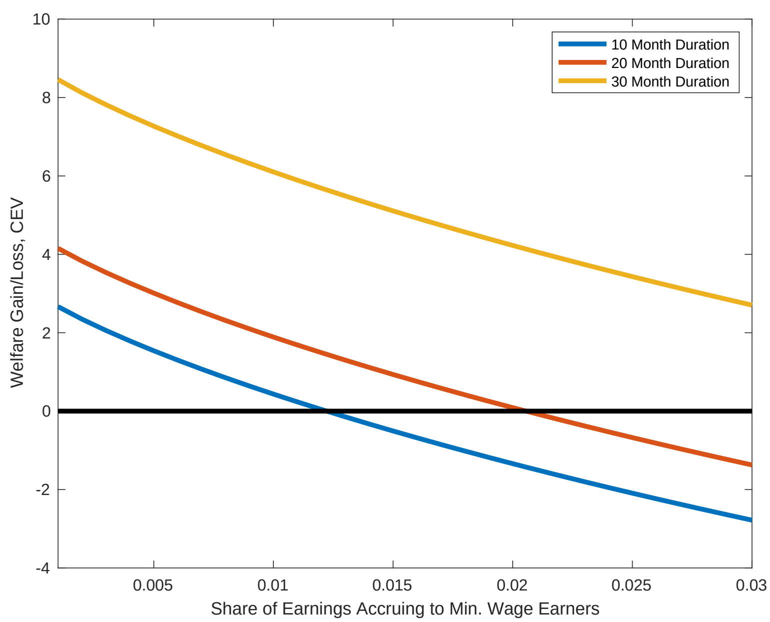
I calibrate the model to an economy without minimum wages and set parameter values to be as close to Mertens and Ravn [5]'s quarterly calibration for the United States as possible. The model frequency is quarterly and $\beta = 0.99$. I set the Frisch elasticity of labor supply to $\nu = 0.75$ and the elasticity of substitution parameter to $\epsilon = 10$. I vary p_{00} between 0.7, which is the value used by Mertens and Ravn, and 0.9. Throughout I keep $p_{11} = 1.0$, so that the economy starts in a liquidity trap, but once it transitions to the intended equilibrium, it remains there. I set the response of monetary policy to inflation to $\psi = 1.5$

This leaves three parameters to set - the output elasticity of $H-$type labor, α, the disutility of labor supply, θ, and the adjustment cost parameter, γ. For a given value of α, I set α to match the intended equilibrium output of $Y^I = 0.33$ used by Mertens and Ravn, and then set γ to match their output in the liquidity trap. This leave just the output share of high-productivity workers, which I vary between $\alpha = 0.97$ and $\alpha = 1.0$.

5.2 Quantitative Analysis

Figure (1) displays the resulting welfare consequences of setting the minimum wage as a function of the share of low-productivity workers' earnings in aggregate, which corresponds to $1 - \alpha$ in the model. Three curves are plotted and rise monotonically as the persistence of the liquidity trap rises. For any given persistence, the minimum wage becomes more distortionary in the intended equilibrium as minimum wage earners' share of production rises. On the other hand, it becomes more attractive, in a welfare sense, to eliminate liquidity traps the more persisten they become.

Figure 1: Setting Minimum Wage to Eliminate Liquidity Trap



6 Conclusion

I have extended the sticky-price New Keynesian model to include heterogeneous labor and minimum wage policy. This slightly richer model opens the door to a new macroeconomic role of minimum wage regulation. By decoupling wages and output in a deep recession, deflation is bounded and a continuum of equilibrium featuring self-fulfilling bouts of pessimism are eliminated. On the other hand, the remaining equilibrium exhibits a distortion between high and low productivity labor in most cases, creating a trade off between aggregate stability and allocative efficiency.

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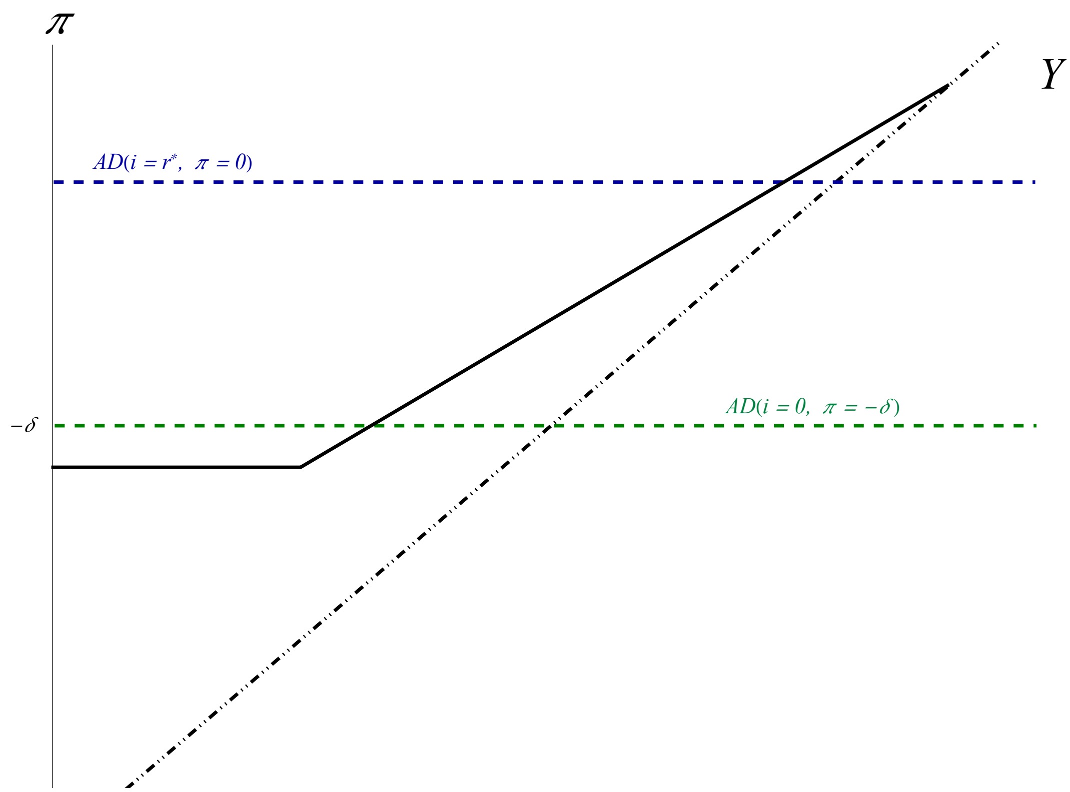
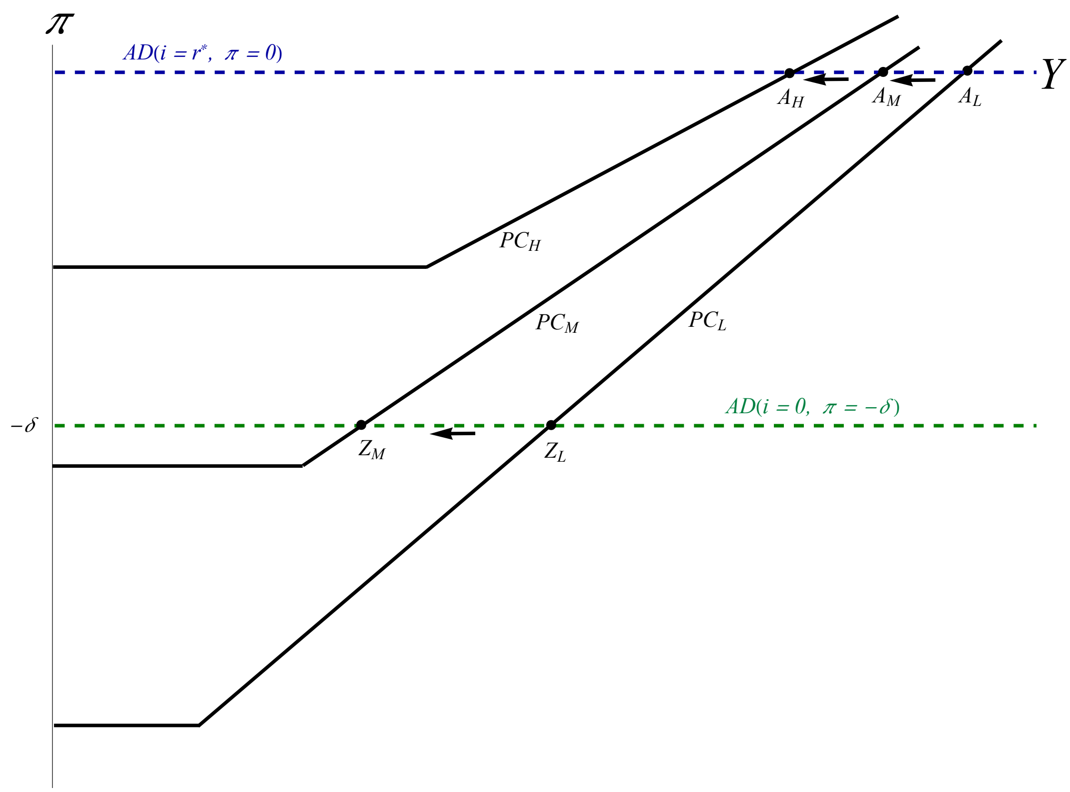
Figure 2: Equilibrium Determination



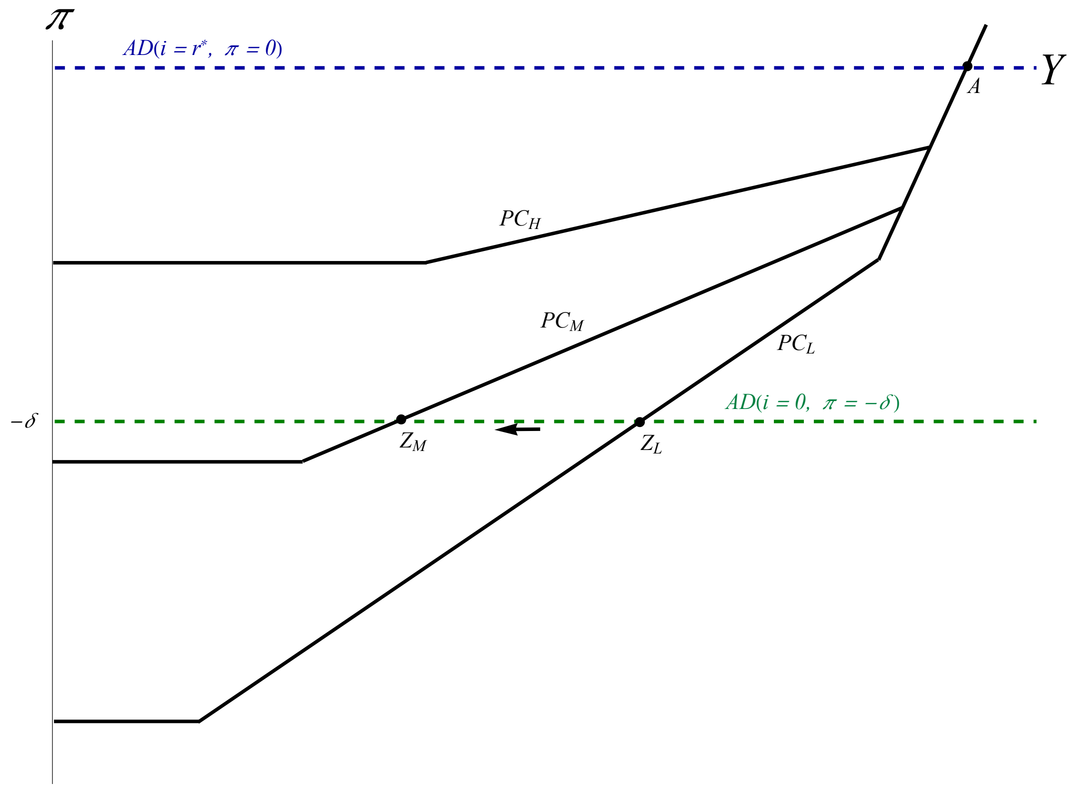
Notes: Dashed line shows Phillips Curve locus for $\dot{\pi}_t = 0$ in model without minimum wages. Solid line shows Phillips Curve locus for $\dot{\pi}_t = 0$ in model with a positive real minimum wage. Dotted lines correspond to $\dot{Y}_t = 0$ loci under two steady-state inflation rates: $\pi = -\delta$ and $\pi = 0$.

Figure 3: Equilibrium Comparative Statics



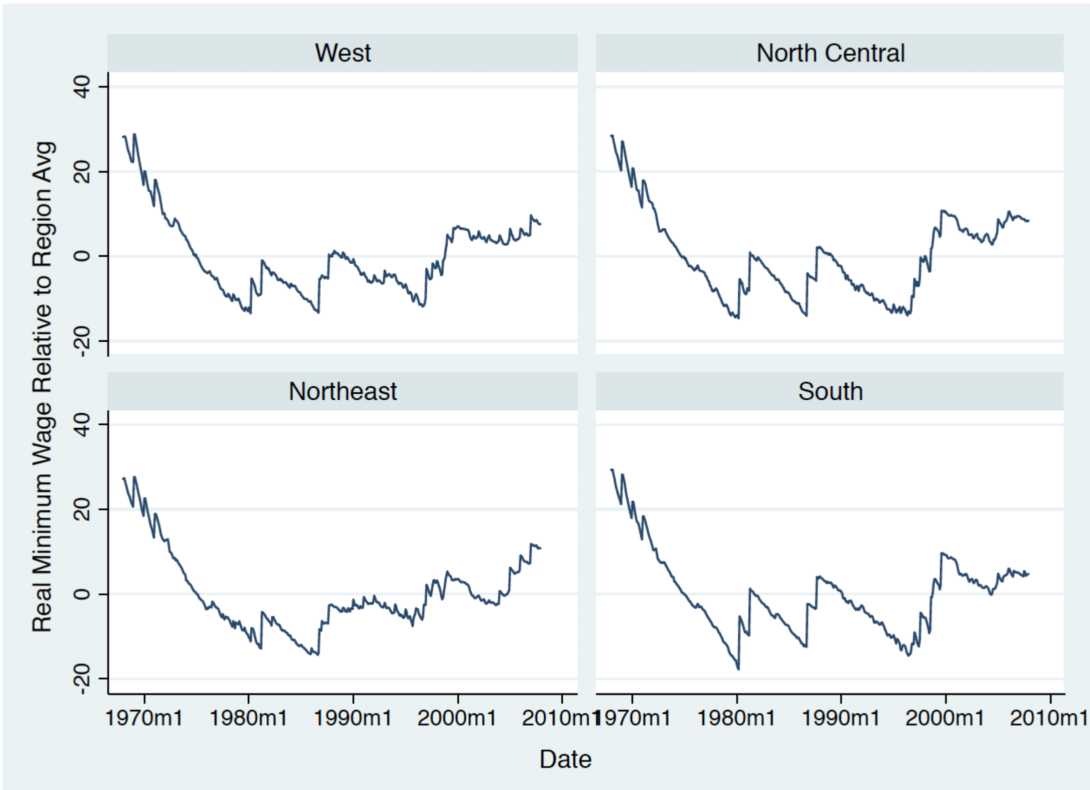
Notes: Solid lines show Phillips Curve loci for $\dot{\pi}_t = 0$ in model with different real wages, $\omega_L < \omega_M < \omega_H$. Dotted lines correspond to $\dot{Y}_t = 0$ loci under two steady-state inflation rates: $\pi = -\delta$ and $\pi = 0$.

Figure 4: Equilibrium Comparative Statics



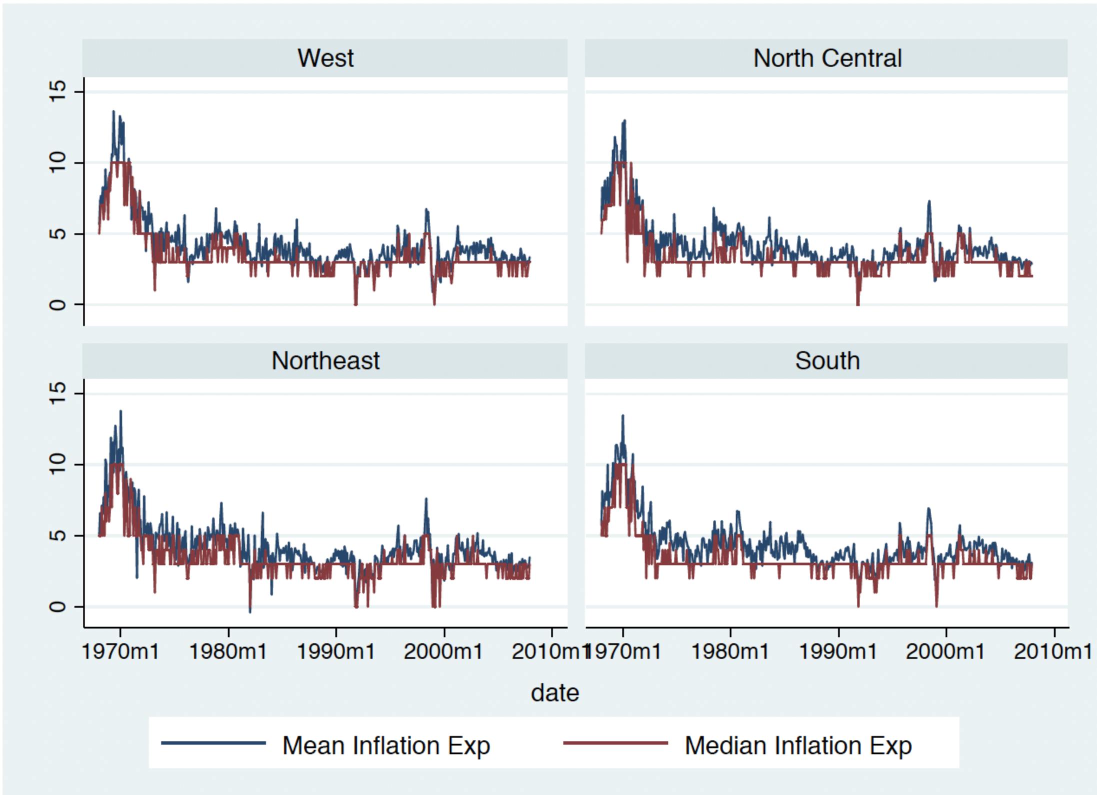
Notes: Solid lines show Phillips Curve loci for $\dot{\pi}_t = 0$ in model with different real wages, $\omega_L < \omega_M < \omega_H$. Dotted lines correspond to $\dot{Y}_t = 0$ loci under two steady-state inflation rates: $\pi = -\delta$ and $\pi = 0$.

Figure 5: Real Minimum Wages by Region



Notes: Plots show average of nominal minimum wage for states in each census region, deflated by regional CPI, logarithmically transformed. All series are relative to the region's time series mean.

Figure 6: Inflation Expectations by Region



Notes: Plots show average and median of household inflation expectations in each census region.