Supplementary Material for "Labor Market Dynamics under Long-Term Wage Contracting"

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Appendix C Robustness

This section examines the sensitivity of results to alternative specifications of the productivity process, the matching function elasticity, as well as an alternative measure of volatility.

Alternative Productivity Process

In the model productivity follows an AR1-process, with the parameters estimated from data. This section begins by examining how large is the impact of the standard errors of these estimates for the results. Figure C.1 shows the difference a one standard error (0.03) increase in the AR1 coefficient of productivity ($\lambda \approx 0.89$) makes for outcomes. As the figure shows, both the vacancy-unemployment ratio and the aggregate wage respond more to a shock which is expected to last longer. Under limited commitment wage volatility increases also because increased persistence makes participation constraints bind more.

Figure C.2 shows how outcomes change when the standard deviation of productivity (0.02) is increased by 25% and 50%. The estimated probability that the standard deviation of the empirical productivity process is greater than this is 12% and 3%, respectively.[1] This leaves the regression coefficient $P(\theta|z)$ roughly unchanged, indicating that the increased volatility of the shock translates linearly to an increase in the volatility of the vacancy-unemployment ratio. The same holds also for the aggregate wage, under full commitment. With larger productivity shocks participation constraints bind more frequently, however, leading to increased cyclicality in limited-commitment wages.[2] The increased wage volatility from these changes in the productivity process allows the

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[1] This is based on an AR1-specification for the productivity process, with Box-Tiao priors for the coefficients. The standard deviation was computed by drawing from the posterior density where the (proportionately few) draws with $|\lambda| > 1$ were discarded.

[2] This may appear contradictory to other limited commitment literature where more volatility generally improves

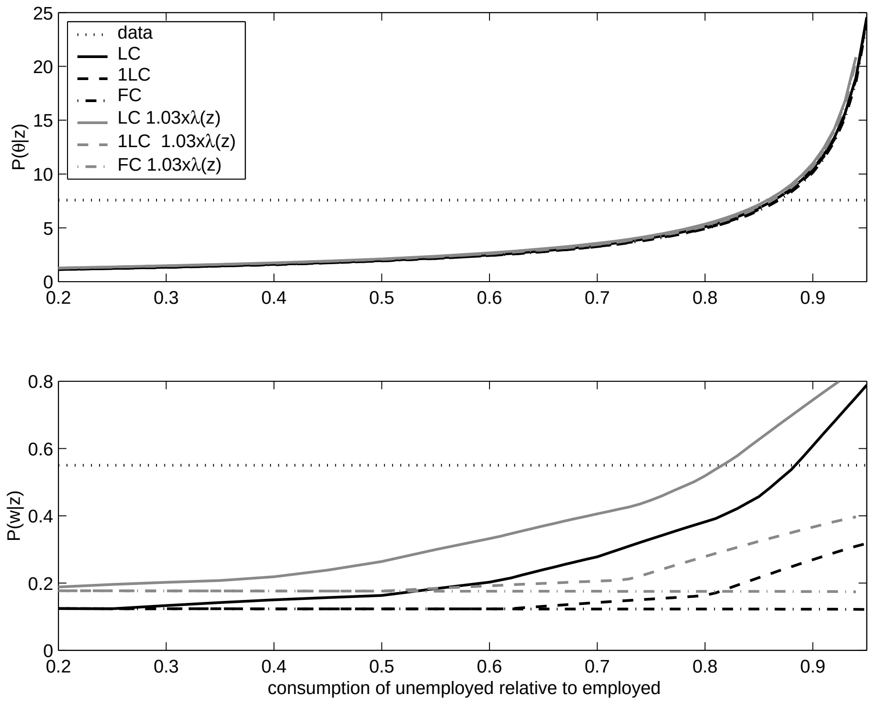

Figure C.1: The effects of a one standard error increase in the AR1 coefficient of labor productivity

model to match the empirical level of wage volatility better, but still only the two-sided limited-commitment economy is able to approximate the data.

Solving for equilibrium under two-sided limited commitment becomes tedious when the number of productivity states increases, and hence the baseline calibration is done with only three states. The number of states may have an effect on the variability of limited-commitment wages however. Intuition suggests that if the discretization of productivity states is coarse, the contract wage may be more likely to hit the wage bounds than if the discretization is fine and productivity adjusts in small increments. This suggests that increasing the number of productivity states may decrease wage cyclicality.

Table C.1 examines what happens to the results when the number of productivity states is changed. The table shows a similar exercise as Table 2, now comparing different productivity processes. It compares outcomes under two-, three- and four-state productivity processes, calibrated to produce the same standard deviation and AR1 coefficient in aggregated and filtered data. The transition matrixes[3] are such that when the number of states increases, productivity changes become more gradual. The table shows that the dimension of z has little effect on the volatility of the vacancy-unemployment ratio. In the case of full commitment the aggregate wage also remains unaffected. However, as anticipated, in the limited-commitment economies wage volatility decreases as the

insurance possibilities, as in Krueger and Perri (2006). In their framework the outside options reflect exclusion of the agents forever into autarky, where they face risky income. Here the outside options reflect the opportunity to find a new trading partner who will be subject to the same, persistent, productivity realization.

[3]The transition matrixes are

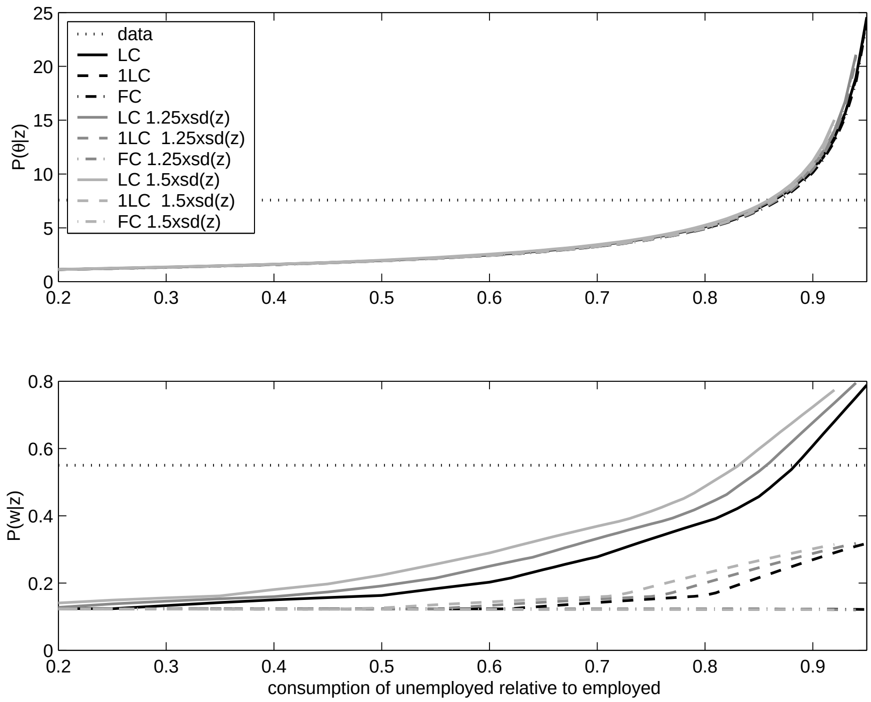

Figure C.2: The effects of a 25% and 50% increase in the standard deviation of labor productivity

Notes: The estimated probability that the standard deviation of the productivity process is greater than this is 12% and 3% respectively.

number of states increases, and more so in the two-sided case. The change from three to four states is small however, suggesting that increasing the dimension further may not reduce the value significantly.

Alternative Matching Function Elasticity

The matching function elasticity is potentially important for the dynamics of the model. Petrongolo and Pissarides (2001) survey empirical literature on the matching function and conclude that most aggregate studies deliver α in the range $0.5 - 0.7$. The value used here, $\alpha = 0.72$, is on the high end of these estimates. On the other hand, recently available JOLTS[4] data led Hall (2005) to use a clearly lower value of 0.235. To assess the sensitivity of the results to the value of α, Table C.2 presents the calibration results for the case of $\alpha = 0.25$.

A lower α means that the job finding rate will fall more quickly if the vacancy-unemployment ratio

$$\Pi = \lambda \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} + (1-\lambda) \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \text{ and } \Pi = \lambda \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} + (1-\lambda) \begin{pmatrix} 0 & 1 & 0 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 0 & 1 & 0 \end{pmatrix}.$$

[4]Job Openings and Labor Turnover Survey of the Bureau of Labor Statistics

Table C.1: Calibration varying the dimension of the productivity shock

dimension of z	wage setting	b	k	$P(w_t\|z_t)$
	data			0.55
2	FC	0.87	0.05	0.12
	1LC	0.87	0.05	0.27
	LC	0.86	0.05	0.62
3	FC	0.87	0.05	0.12
	1LC	0.87	0.05	0.23
	LC	0.86	0.05	0.49
4	FC	0.87	0.05	0.13
	1LC	0.87	0.05	0.23
	LC	0.86	0.05	0.49

Notes: Each row is a separate calibration, where k is s.t. $E\mu = 0.15$ and b is s.t. $P(\theta_t|z_t) = 7.583$.

Table C.2: Calibration with $\alpha = 0.25$

utility function	wage setting	b	k	$P(w_t\|z_t)$
linear	FC	0.84	0.35	0.12
	1LC	0.84	0.35	0.23
	LC	0.84	0.35	0.25
	re-barg	0.84	0.35	0.92
$\gamma = 1$	FC	0.84	0.37	0.11
	1LC	0.84	0.38	0.22
	LC	0.84	0.38	0.23

Notes: Each row is a separate calibration, where k is s.t. $E\mu = 0.15$ and b is s.t. $P(\theta_t|z_t) = 7.583$.

falls. This works to increase the steady-state vacancy-unemployment ratio and lower unemployment. To maintain the level of unemployment fixed, the vacancy cost k must rise. The table shows the volatility of θ increase slightly with a low value of α (seen in the value of b decreasing).

With a lower α, firms must make higher profits on new hires to cover the higher vacancy cost, so the limited-commitment value- and wage-intervals must be larger. Larger wage-intervals suggest that participation constraints bind less, making the limited-commitment contract wage less variable. Moreover, workers are likely to start contracts at a wage close to the lower bound of the interval, so the lower bound is more likely to bind than the upper bound. Both predictions are reflected in Table C.2: Not only is the volatility of the aggregate wage clearly reduced, but the wage results for the one-sided and two-sided limited-commitment economies now appear more similar than in the baseline calibration. Given that the baseline calibration adopts a value of α on the high end of reported values, the results confirm that the model tends to produce wages that are rigid relative to data.

Alternative Measure of Volatility

Figure C.3 reproduces Figure 4 using an alternative measure of volatility – a simple standard deviation. Moving to this measure raises the empirical volatility targets relative to model produced volatilities, because it does not adjust for the fact that the correlation of θ and w with productivity in the data is only 0.4 and 0.6, respectively. In the model this correlation is approximately one in the case of θ, and somewhat lower for wages (see Figure 2). Examining this alternative measure underlines the rigidity of model-produced wages relative to data, while the cyclicality of vacancy-creation and unemployment at the same time remain well below their empirical levels.

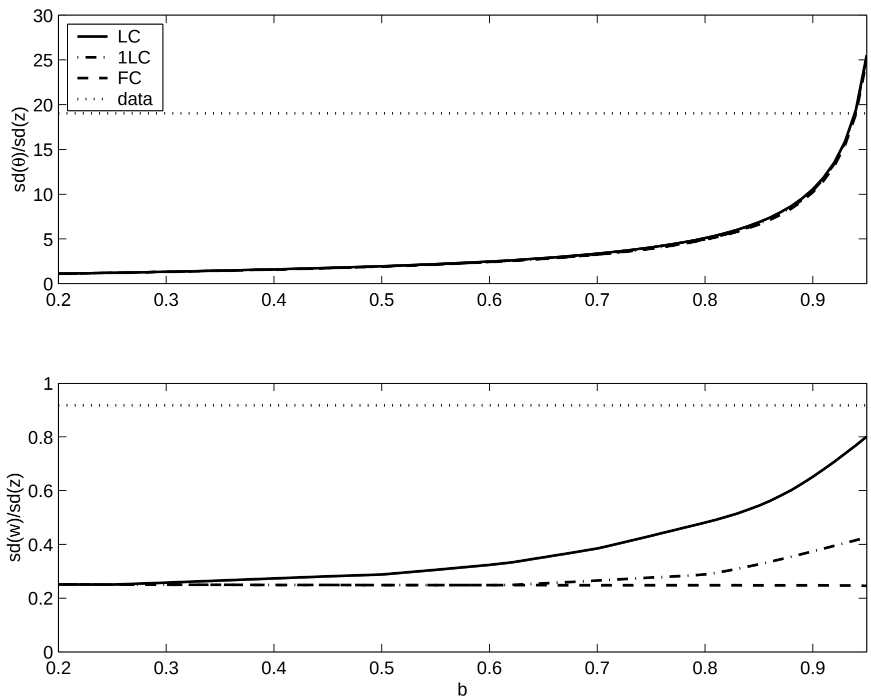

Figure C.3: The consumption of the unemployed b and the volatility of the vacancy-unemployment ratio θ and wages w

In all, the robustness checks confirm that the model tends to produce wages that are rigid relative to data, and only when contracting is subject two-sided limited-commitment is it able to approximate empirical wage volatility.

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