OTJ Search, Minimum Wages, and Labor Market Outcomes

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  - The minimum wage acts as a side constraint on the NB problem
- Using CPS data, Flinn (2006) estimated primitive parameters of partial and general equilibrium versions of the model.
- He found that "optimal" minimum wage was $8.50 in 1996 (partial equilibrium) or $3.35 (general equilibrium).

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  - Job-to-job transitions are an important component of wage growth, empirically and theoretically
  - This is particularly true for younger workers, who are disproportionately impacted by the minimum wage
  - Minimum wages can have complex and diverse effects on labor market outcomes, depending on the bargaining environment, with OTJ search

Previous Analyses

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  - We will have a similar type of effect, though coming through a different mechanism, under one of our bargaining specifications.

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  - In this case, a minimum wage just restricts the lower support of the equilibrium wage offer distribution, with no impact on unemployment rates, etc.
  - Unlike our model, no mass point at the minimum wage
  - In other equilibrium models, (e.g., Albrecht and Axell, 1984), a minimum wage can improve the labor market equilibrium by selecting out low quality employers.

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  - α : Nash bargaining power parameter

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- An individual has at most 2 potential matches at any instant in time. A currently employed or unemployed individual who contacts a new firm must reject one offer immediately.
- The environment characterized by efficient mobility decisions -
  - If an individual has two potential employers at an instant in time, with match values θ' and θ, she will accept the job at which she is most productive.

The Model - no m (2)

- Nash bargaining problem:

$$S(\theta', w', \theta) = \{V_e(\theta', w', \theta) - Q(\theta)\}^{\alpha} \times \{V_f(\theta', w', \theta) - 0\}^{1-\alpha}$$

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- The outside option for the searcher/worker is

$$Q(\theta) = \begin{cases} V_n & \text{if individual is unemployed} \\ V_e(\theta, \theta, \theta) & \text{if agent currently employed} \end{cases}$$

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- The outside option for the firm is 0. This is motivated by an appeal to a free entry condition that results in the expected value of vacancies being competed down to 0.

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- The wage offer made to the individual is

$$w^*(\theta', \theta) = \arg\max_w S(\theta', w, \theta).$$

The Model - no m (4)

- Value of firm

$$
\begin{aligned}
V_f(\theta', w', \theta) = (1+\rho\varepsilon)^{-1}\{&(\theta' - w')\varepsilon + (\eta\varepsilon \times 0) \\
&+ \left(\lambda_e \varepsilon \sum_{\tilde{\theta} \in B(\theta,\theta')} V_f(\theta', w(\theta', \widetilde{\theta}), \tilde{\theta}) p(\widetilde{\theta})\right) \\
&+ \left(\lambda_e \varepsilon P(\tilde{\theta} \leq \theta) \times V_f(\theta', w', \theta)\right) + \left(\lambda_e \varepsilon P(\tilde{\theta} \geq \theta') \times 0\right) \\
&+ \left((1 - \lambda_e \varepsilon - \eta\varepsilon) \times V_f(\theta', w', \theta)\right) + o(\varepsilon)\},
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- $V_f(\theta', w(\theta', \tilde{\theta}), \tilde{\theta})$ represents the equilibrium value to a firm of the productive match θ when the worker's next best option has a match $\widetilde{\theta}$

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- $V_f(\theta', w(\theta', \tilde{\theta}), \tilde{\theta})$ represents the equilibrium value to a firm of the productive match θ when the worker's next best option has a match $\widetilde{\theta}$
- $\theta_j \in B(\theta', \theta)$ if and only if $\theta_j \leq \theta'$ and $\theta_j > \theta$.

The Model - no m (5)

- Collecting terms and taking the limit as $\varepsilon \longrightarrow 0$

$$
\begin{aligned}
V_f(\theta', w', \theta) &= \left(\rho + \eta + \lambda_e P(\tilde{\theta} > \theta)\right)^{-1} \\
&\times \{\theta - w + \lambda_e \sum_{\tilde{\theta} \in B(\theta, \theta')} V_f(\theta', w(\theta', \widetilde{\theta}), \tilde{\theta}) p(\widetilde{\theta})\}.
\end{aligned}
$$

The Model - no m (6)

- The worker's value of being employed is defined similarly. For the employee, the value of employment at a current match value θ and wage w is given by

$$V_e(\theta', w', \theta) = (1+\rho\varepsilon)^{-1}\{w\varepsilon + \eta\varepsilon V_n(m)$$

$$+\lambda_e\varepsilon[\sum_{\tilde{\theta}\in B(\theta,\theta')} V_e(\theta', w(\theta', \widetilde{\theta}), \tilde{\theta})p(\widetilde{\theta})$$

$$+\sum_{\tilde{\theta}\in C(\theta')} V_e(\widetilde{\theta}, w(\widetilde{\theta}, \theta'), \theta')P(\widetilde{\theta})) + P(\tilde{\theta} \leq \theta) \times V_e(\theta', w', \theta))]$$

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- $V_e(\theta', w(\theta', \theta), \theta)$ is the equilibrium value of employment to a worker with match value θ' when his next best option has a match value of θ
- $C(\theta')$ is the set of all $\theta_j \in \Omega_\theta$ such that $\theta_j > \theta'$.

- After rearranging terms and taking limits, we have

$$V_e(\theta', w', \theta) = \left(\rho + \eta + \lambda_e P(\tilde{\theta} > \theta)\right)^{-1} \times \{w + \eta V_n(m) +$$
$$+\lambda_e [\sum_{\tilde{\theta} \in B(\theta, \theta')} V_e(\theta', w(\theta', \widetilde{\theta}), \tilde{\theta}) p(\widetilde{\theta}) + \sum_{\tilde{\theta} \in C(\theta')} V_e(\widetilde{\theta}, w(\widetilde{\theta}, \theta'), \theta') P(\widetilde{\theta})]\}.$$

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- Specification of $Q(\theta)$

$$\begin{aligned} Q(\theta) &= \left(\rho + \eta + \lambda_e P(\tilde{\theta} > \theta)\right)^{-1} \\ &\quad \times \{\theta + \eta V_n(m) + \lambda_e \sum_{\tilde{\theta} \in C(\theta)} V_e(\widetilde{\theta}, w(\widetilde{\theta}, \theta), \theta) P(\widetilde{\theta})]\}. \end{aligned}$$

The Model - with m (8)

- Model closed with the specification of the value of unemployed search.

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V_n(m) &= \left(\rho + \lambda_n P(\tilde{\theta} \geq \theta^A(m)\right)^{-1} \\
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  - For an unemployed individual

$$\tilde{V}_e(\theta_L, w, U) = \frac{w + \lambda_e p(\theta_L) \tilde{V}_e(\theta_L, \theta_L, \theta_L) + \eta \tilde{V}_n(\theta_L)}{\rho + \lambda_e p(\theta_L) + \eta},$$

while the value to the firm is

$$\tilde{V}_f(\theta_L, w, U) = \frac{\theta_L - w}{\rho + \lambda_e p(\theta_L) + \eta}.$$

Model Analysis (2)

- The wage associated with this state is then given by

$$\tilde{w}(\theta_L, U) = \arg\max_{w} (\tilde{V}_e(\theta_L, w, U) - \tilde{V}_n(\theta_L))^{\alpha} \times \tilde{V}_f(\theta_L, w, U)^{1-\alpha}.$$

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  - Then the (new) implied value of unemployed search is given by

$$\tilde{V}_n'(\theta_L) = \frac{b + \lambda_n p(\theta_L) \tilde{V}_e(\theta_L, w, U)}{\rho + \lambda_n p(\theta_L)}.$$

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  - Similar procedure for all candidate $\theta^A = \theta_j,\ j = 1, ..., L-1.$
  - Then

$$\theta^A = \theta_j \Leftrightarrow V_n^*(\theta_j) = \max\{V_n^*(\theta_k)\}_{k=1}^{L}.$$

Equilibrium Wage Matrix

Dominated Value	*Dominant Value* θ_j	θ_{j+1}	$\ldots$	θ_{L-1}	θ_L
θ_L					θ_L
θ_{L-1}				θ_{L-1}	$w(\theta_L, \theta_{L-1})$
$\vdots$				$\vdots$	$\vdots$
θ_{j+1}		θ_{j+1}	$\ldots$	$w(\theta_{L-1}, \theta_{j+1})$	$w(\theta_L, \theta_{j+1})$
θ_j	θ_j	$w(\theta_{j+1}, \theta_j)$	$\ldots$	$w(\theta_{L-1}, \theta_j)$	$w(\theta_L, \theta_j)$
U	$w(\theta_j, U)$	$w(\theta_{j+1}, U)$	$\ldots$	$w(\theta_{L-1}, U)$	$w(\theta_L, U)$

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- Same, but with $\lambda_e = 0$.

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- $\alpha = .25$, $\lambda_n = .2$, $\lambda_e = .05$, $\eta = .01$, $\rho = .01$, and $b = -5$. $P = (.1\ .2\ .25\ .2\ .15\ .1)$.
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Some Examples:

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- Same, but with $\lambda_e = 0$.
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- With binding minimum wage $m = 13$

Wage Matrix

$m = 0$

	Dominant θ Value					
Dominated θ Value	5	8	11	14	17	20
20						20
17					17.00	17.35
14				14.00	13.84	14.19
11			11.00	10.27	10.11	10.46
8		8.00	6.70	5.96	5.80	6.15
5	5.00	3.32	2.02	1.80	1.12	1.47
U	4.78	3.10	1.79	1.06	0.90	1.25

Wage Matrix

$\lambda_c = 0$

	Dominant θ Value					
Dominated θ Value	5	8	11	14	17	20
U		7.60	8.35	9.10	9.85	10.60

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U	4.82	3.32	2.02	1.50	1.50	1.50

Model with no renegotiation

- $$V_e(\theta_i) = \frac{w(\theta_i) + \eta V_n + \lambda_e \sum_{j>i} p_j V_e(\theta_j)}{\rho + \eta + \lambda_e p_i^+},$$

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  where $p_i^+ \equiv \sum_{j>i} p_j$
- Wage function is

$$w(\theta_i) = \arg\max_w \left(\frac{w + \eta V_n + \lambda_e \sum_{j>i} p_j V_e(\theta_j)}{\rho + \eta + \lambda_e p_i^+} - V_n \right)^{\alpha} \times \left(\frac{\theta_i - w}{\rho + \eta + \lambda_e p_i^+} \right)^{1-\alpha}$$

Model with no renegotiation (2)

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$$w(\theta_i) < w(\theta_{i+1}) < ... < w(\theta_L).$$

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- WIth minimum wage:

$$\begin{aligned} w_i(m) &= \max\{m, \alpha\theta_i + (1-\alpha)((\rho + \lambda_e p_i^+)V_n(m) \\ &\quad -\lambda_e \sum_{j>i} p_j V_e(\theta_j; m))\} \end{aligned}$$

Summary of model implications

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- Minimum wages may not "eliminate" otherwise acceptable match values in this case, except when m gets quite large.
- The employment effects of minimum wage changes may be very different under the two bargaining scenarios.

Data

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- Individuals 16-30 years of age, so as to increase the proportion of minimum wage workers
- Data from February 1998 through February 2000 - this to allow return to stationarity after minimum wage increase (to $5.15) in September 1997.
- As in Flinn (2006), we include students. They comprise a large proportion of minimum wage workers.

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  - If we use event history data, as in Dey and Flinn (2005), have to allow for measurement error for the model to be consistent with the data (zero probability events, like wage decreases within a job spell)
- We use characteristics of the sample in February 1998, m_{98}, and transition information from Feb 1998 to Feb 1999, $P_{99|98}$ to recover the parameters.

Stationarity Assumption

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- In the version of the paper that was circulated, we conduct a formal test for stationarity using the (point) sample characteristics m_{98} and m_{99}, and decisively reject equality.
- While the model posits an environment in which time homogeneous decision rules are optimal, the initial condition of beginning the career in U, combined with OTJ search, makes the SS assumption unattractive.

Relaxing Stationarity in the Model and the Estimator

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- Individuals facing an infinite horizon continue to use stationary policies.
- Beginning at age 16, individuals choose whether to enter the labor market. If they enter, it is as an unemployed searcher, with value $V_n(m)$. The value of being OLF at age a is

$$\frac{\xi + r(a-16)}{\rho},$$

where $r' < 0$ and $\lim_{a\to\infty} r(a) = r$. Then the age a individual enters the market iff

$$\xi + r(a-16) < \rho V_n(m).$$

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  to be free parameters.
- These parameters are estimated within the model, principally through the use of age-specific participation rates.
- Our estimates imply that the steady state participation rate approaches 1.

Participation Decision - Estimation

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Participation Decision - Estimation

- Our sample is individuals 16-30 years of age, and we set $a_1 = 16$, the first age of possible participation
- Given a minimum wage m, $\{r_a\}$ and F imply a distribution of entry times
- Longest period of participation an agent could have would be 15 years (currently 30 and enterred at age 16).
- We generate $15 \times R$ sample paths, R of which truncated at 6 months, another R at 1.5 years, up to last R truncated at 14.5 years.

Participation Decision - Estimation - 2

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- In terms of the generated sample paths for labor market experience level e, denote the analagous path characteristics by $\sigma(e)$.
- Let $B(a)$ denote the age distribution (over the interval 16-30) in the SIPP sample as of 1998.
- Then the "aggregate" simulated path characteristic is given by

$$\sigma = \sum_{t=1}^{15} \sum_{e=1}^{a_t - 15} \sigma(e)\kappa(a_t - e + 1, m)B(a_t)$$

Participation Decision - Estimation - 3

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- If an individual is in the market for τ years as of February 1998, for example, we point sample all of that individual's simulated sample paths at τ.
- Stationarity not strictly required for consistency of the estimator, but knowledge of the beginning of the labor market process would seem to be.

The Estimator

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- Given a method for computing $\tilde{X}(\varphi)$, the MSM estimator of φ is given by

$$\hat{\varphi} = \arg\min_{\varphi} (X - \tilde{X}(\varphi))' A (X - \tilde{X}(\varphi)),$$

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  where A is an $K \times K$ symmetric, positive definite weighting matrix.
- We compute the weighting matrix by resampling the SIPP data matrix from which the sample characteristics, X, are computed. The matrix A is the inverse of this estimated covariance matrix.

The Estimator (2)

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- We compute the $\tilde{X}(\varphi)$ (which was called σ) as described above.
- We have computed estimates of the standard errors by bootstrapping; this involved resampling the original individual data to compute new values of X. For each bargaining structure, we generated over 100 resamples.

Identification

- First problem is identifying G, which from Flinn and Heckman (1982) we know is not nonparametrically identified. We assume θ_j mass points are known, and that

$$p(\theta = \theta_i) = \Phi(\frac{\ln c_i - \mu_\theta}{\sigma_\theta}) - \Phi(\frac{\ln c_{i-1} - \mu_\theta}{\sigma_\theta}),$$

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- We also know from FH that ρ and b are not individually identified. We fix both in this exercise ($\rho = .015/12$ and $b = -2$).

Identification (2)

- $\lambda_e, \lambda_n, \eta$ are all easily identifiable using event history data, and remain identified using point-sampled data and transition information. Reasonable estimates of these parameters were obtained, similar to those found when using event history data to estimate other types of search models.

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- α is generally difficult to estimate. Flinn (2006) showed that α was identified as long as the distribution G did not belong to a location-scale family - which is the case here.
- Moreover, this model uses OTJ search, which places more restrictions on the wage process, thus yielding potentially more information regarding α.

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- Especially for individuals coming out of state U, high match values are "paid for" by lower wages.
- Then individuals get low wages because of high growth potential
- This mimics general human capital investment argument
- But essentially no cost to individuals in this case, especially at low values of the minimum wage.

Optimal Minimum Wages

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Optimal Minimum Wages

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$$\pi_U(m) = \frac{\eta}{\eta + \lambda_n p_U(m)},$$

- The expected value of a job under m

$$EV_e(m) = \sum_{\theta'} \sum_{\theta} p_{SS}(\theta', \theta | m) V_e(\theta', w(\theta', \theta | m), \theta).$$

We can obtain an arbitrarily good approximation to $EV_e(m)$ through simulation, without explicitly having to determine $p_{SS}(\theta', \theta | m)$, fortunately.

Optimal Minimum Wages (2)

- The expected value to a firm

$$EV_f(m) = \sum_{\theta'} \sum_{\theta} p_{SS}(\theta', \theta | m) V_f(\theta', w(\theta', \theta | m), \theta).$$

Optimal Minimum Wages (2)

- The expected value to a firm

$$EV_f(m) = \sum_{\theta'} \sum_{\theta} p_{SS}(\theta', \theta | m) V_f(\theta', w(\theta', \theta | m), \theta).$$

- Then a SS social welfare function looks like

$$W(m) = p_U(m) V_n(m) + (1 - p_U(m)) EV_e(m) + (1 - p_U(m)) EV_f(m).$$

This function is egalitarian in the sense that each individual and firm is given the same weight in determining aggregate welfare.

General Equilibrium

- We close the model using the matching function approach, where

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- We allow a form of directed search. Firms create vacancies either for employed or unemployed searchers, with the two matching functions

$$\begin{aligned} M_e &= M_e(e, v_e) \\ M_u &= M_u(u, v_u) \end{aligned}$$

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  - ψ_u and ψ_e.

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- This is straightforward to compute in the SS case. Here we have nonparticipation as well.
- In the results presented, we have ignored the participation margin and defined the population proportions in E and U without reference to the birth and death process in the labor market. Not really kosher.

Table 2a

Descriptive Statistics

Individuals Aged 16-30

	Feb 1998	Feb 1999
Proportion unemployed	0.043	0.030
Mean wage	$9.47	$10.39
Standard deviation of wages	$4.67	$5.09
Proportion of minimum wage earners	0.033	0.018
Proportion earning wage greater than $20	0.043	0.053
Proportion employed in Feb 1998 that exit into unemployment within 12 months	0.064	
Proportion employed in Feb 1998 with at least one job change within 12 months	0.291	
Mean wage at initial job among individuals employed in Feb 1998 who have job-to-job transition before Feb 1999	$8.43	
Mean wage change among individuals employed in Feb 1998 who have job-to-job transition before Feb 1999	$0.90	
Standard deviation of wage change among individuals employed in Feb 1998 who have job-to-job transition before Feb 1999	$4.33	
Mean wage at first job for those unemployed in Feb 1998 who become employed within 12 months	$8.48	
Standard deviation of wages at first job for those unemployed in Feb 1998 who become employed within 12 months	$4.43	

Table 2b

Descriptive Statistics

Individuals Aged 16-30

Participation Rate for Individuals Age 16	0.209
Participation Rate for Individuals Age 17	0.253
Participation Rate for Individuals Age 18	0.392
Participation Rate for Individuals Age 19	0.480
Participation Rate for Individuals Age 20	0.593
Participation Rate for Individuals Age 21	0.672
Participation Rate for Individuals Age 22	0.671
Participation Rate for Individuals Age 23	0.803
Participation Rate for Individuals Age 24	0.801
Participation Rate for Individuals Age 25	0.833
Participation Rate for Individuals Age 26	0.890
Participation Rate for Individuals Age 27	0.844
Participation Rate for Individuals Age 28	0.864
Participation Rate for Individuals Age 29	0.853

Table 3

Model Estimates

	Without Renegotiation	With Renegotiation
m	5.15	5.15
λ_n	0.505	0.505
	(0.006)	(0.055)
λ_e	0.309	0.156
	(0.004)	(0.005)
η	0.013	0.010
	(0.001)	(0.001)
μ_θ	1.615	2.621
	(0.048)	(0.058)
σ_θ	0.846	0.175
	(0.026)	(0.059)
α	0.380	0.320
	(0.010)	(0.012)

Note: Instantaneous value of search, b, set equal to -2 in both estimations

Table 4

Sample and Simulated Moments

Individuals Aged 16-30

	Sample	Model Without Re-negotiation	Model Without Renegotiation
Proportion unemployed	0.043	0.046	0.017
Mean wage	$9.47	$9.01	$8.67
Standard deviation of wages	$4.67	$3.48	$2.99
Proportion of minimum wage earners	0.033	0.031	0.024
Proportion earning wage greater than $20	0.043	0.000	0.000
Proportion employed in Feb 1998 that exit into unemployment within 12 months	0.064	0.084	0.071
Proportion employed in Feb 1998 with at least one job change within 12 months	0.291	0.141	0.147
Mean wage at initial job among individuals employed in Feb 1998 who have job-to-job transition within 12 months	$2.34	$1.01	$1.48
Mean wage change among individuals employed in Feb 1998 who have job-to-job transition within 12 months	$0.25	$0.614	$0.54
Standard deviation of wage change among individuals employed in Feb 1998 who have job-to-job transition within 12 months	$2.31	$1.60	$1.45
Mean wage at first job for those unemployed in Feb 1998 who become employed within 12 months	$1.18	$0.83	$0.54
Standard deviation of wages at first job for those unemployed in Feb 1998 who become employed within 12 months	$3.18	$2.06	$1.40
Value of criterion function at solution vector		743.77	1216.34

Note: Wage moments conditional on transition within 12 months defined using size of full sample.

Table 5: Point Estimates of Demand-Side Parameters

	Without Renegotiation	With Renegotiation
Vacancy Rate		
Unemployed	0.009	0.004
Employed	0.092	0.024
Flow Vacancy Cost		
Unemployed	$92.45	$137.85
Employed	$54.26	$30.75

Figure 1
Sample Wage Changes
for Individuals Making a Job-to-Job Transition

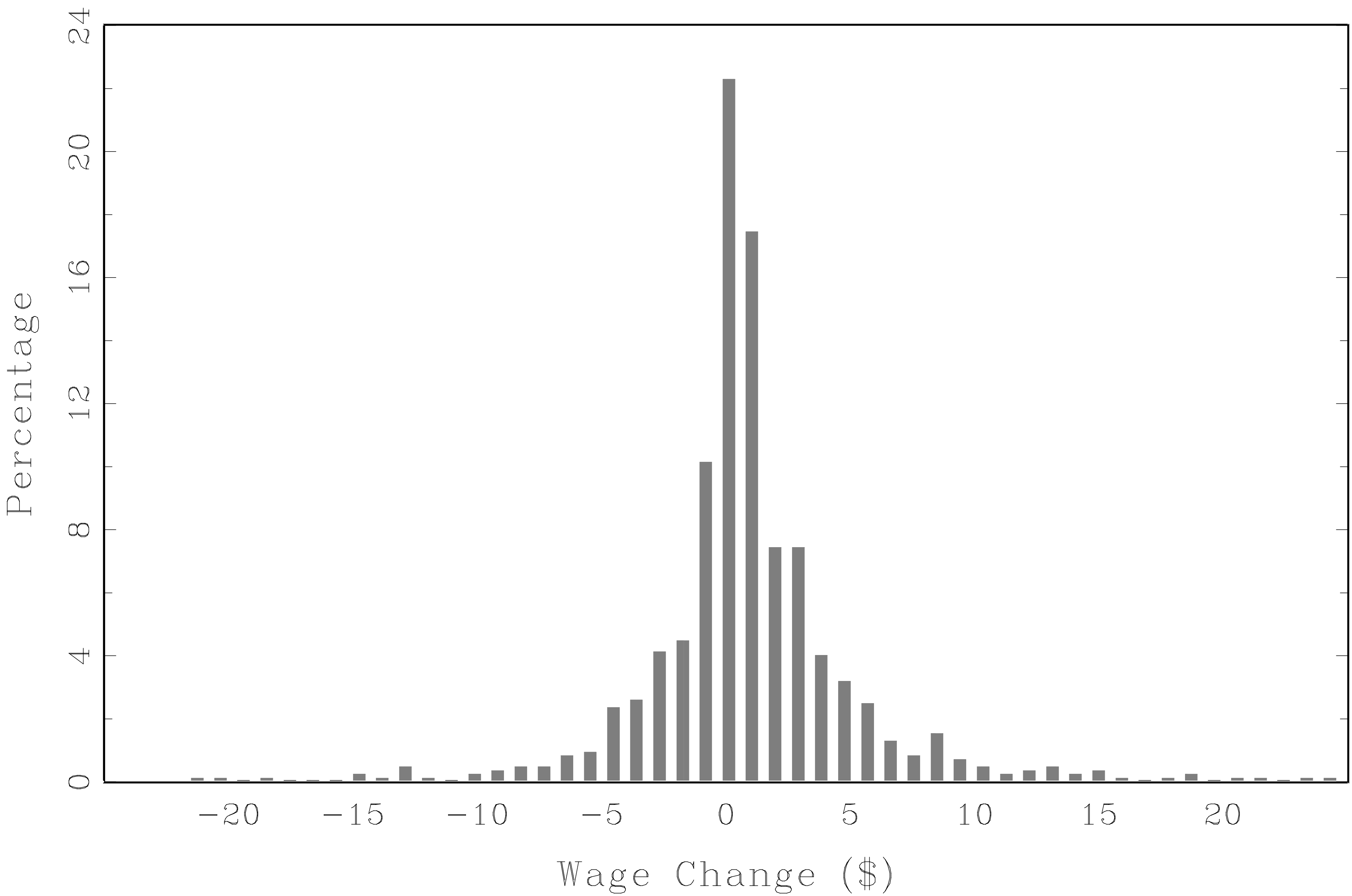

Figure 2.a
Estimated Wage Function
(Without Renegotiation)

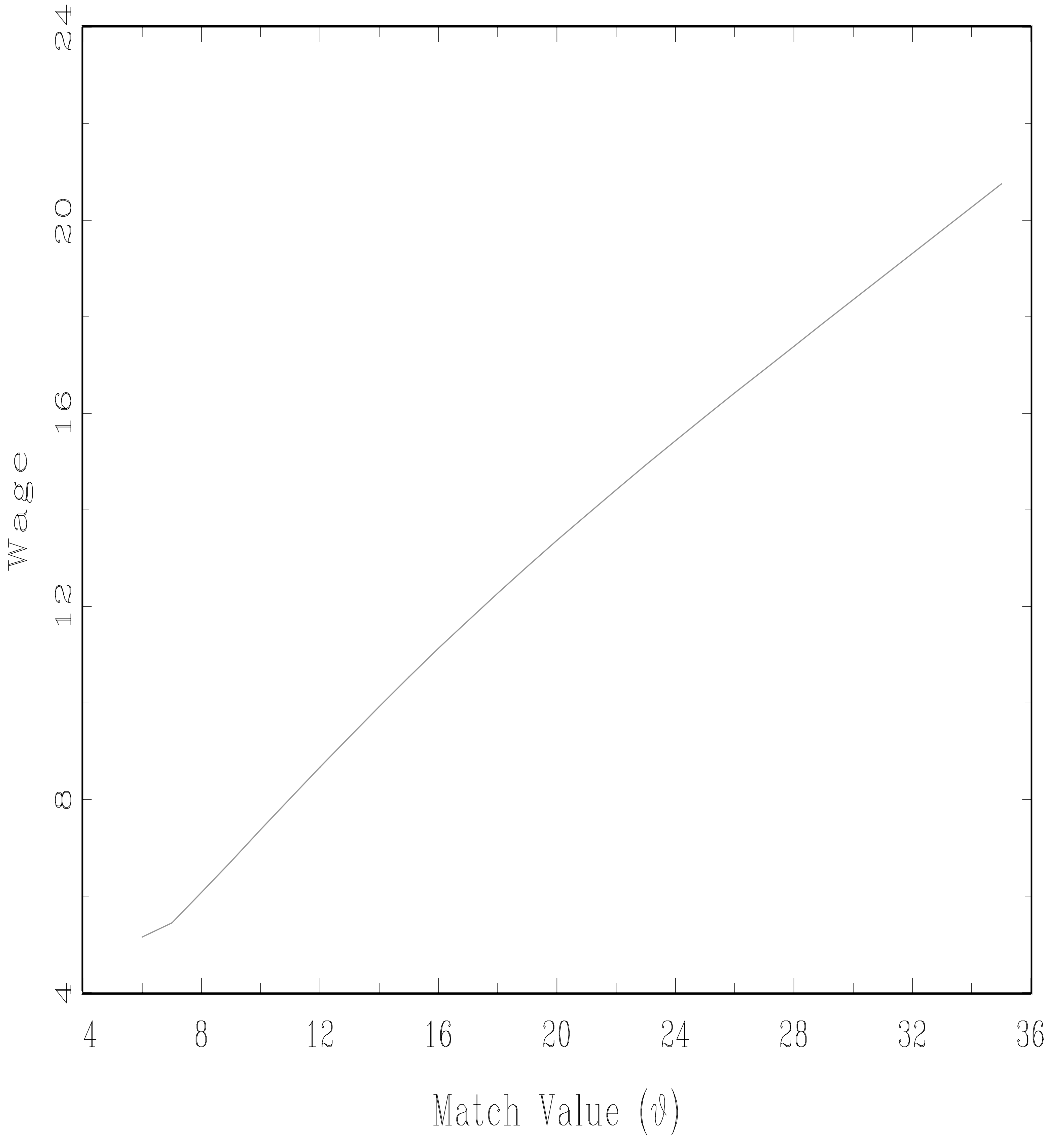

Figure 2.b
Estimated Wage Function
(With Renegotiation)

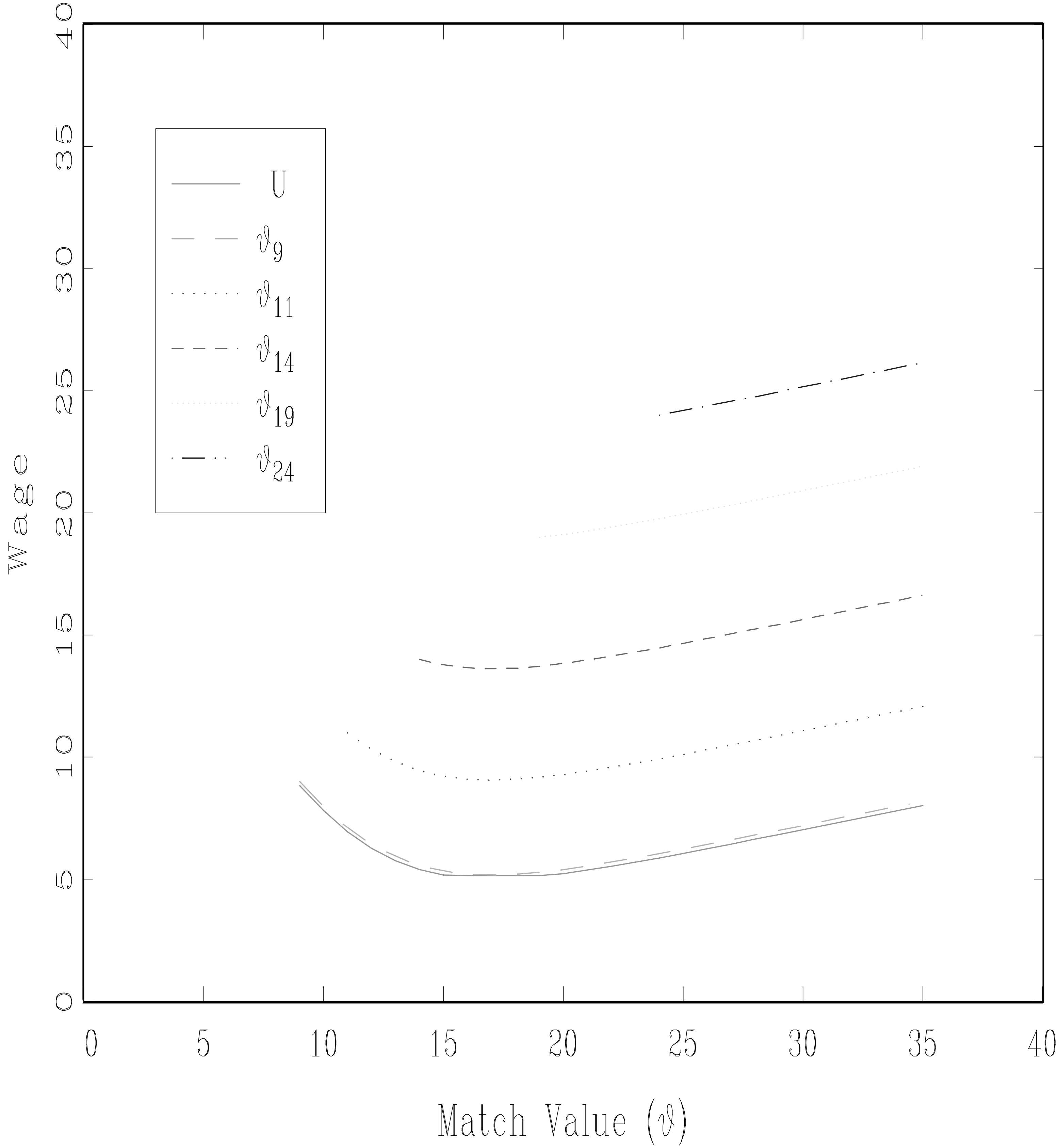

Figure 3.a
Average Wage over First Employment Spell
(No Wage Renegotiation Allowed)

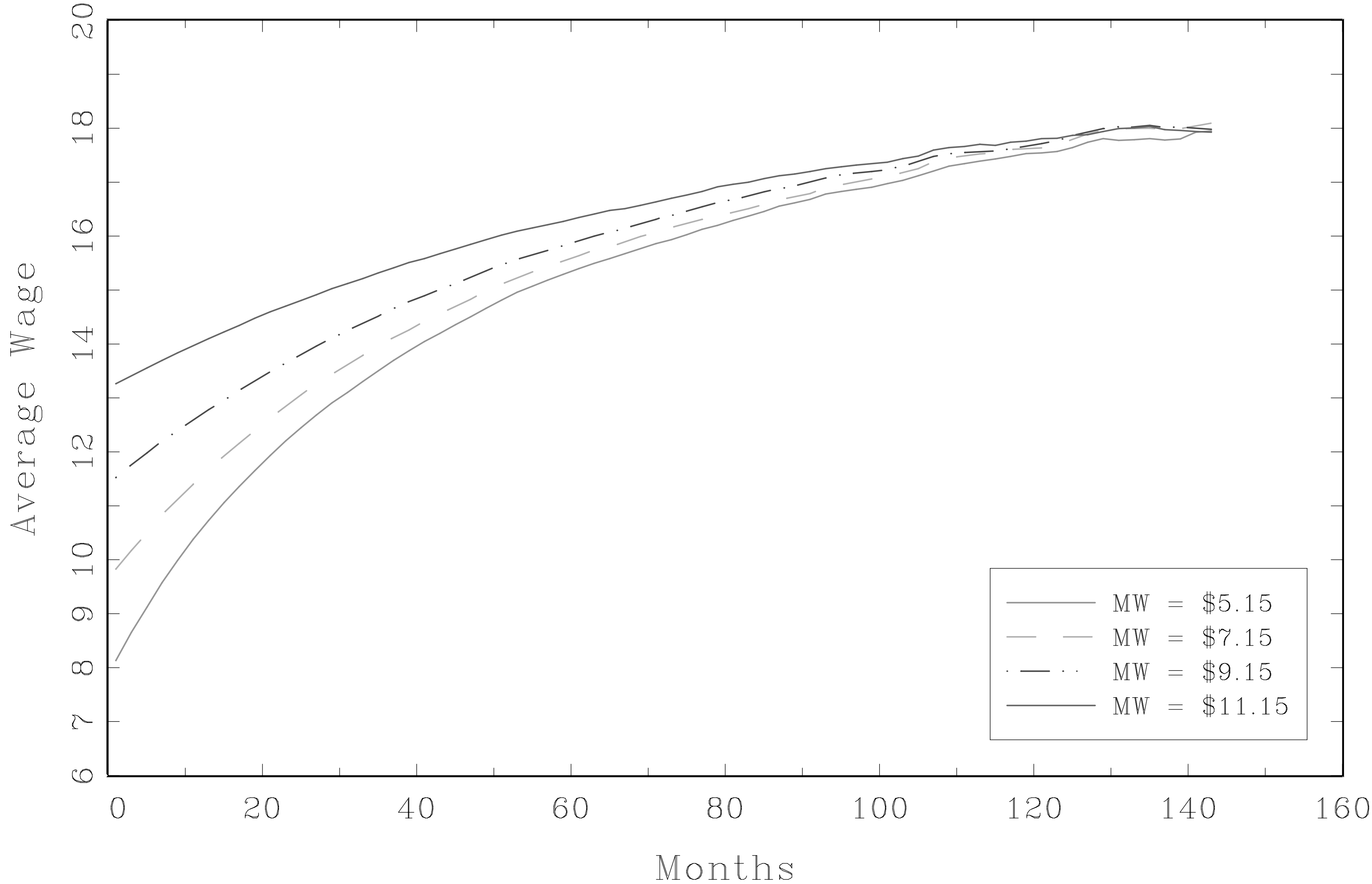

Figure 3.b
Average Wage over First Employment Spell
(Wage Renegotiation Allowed)

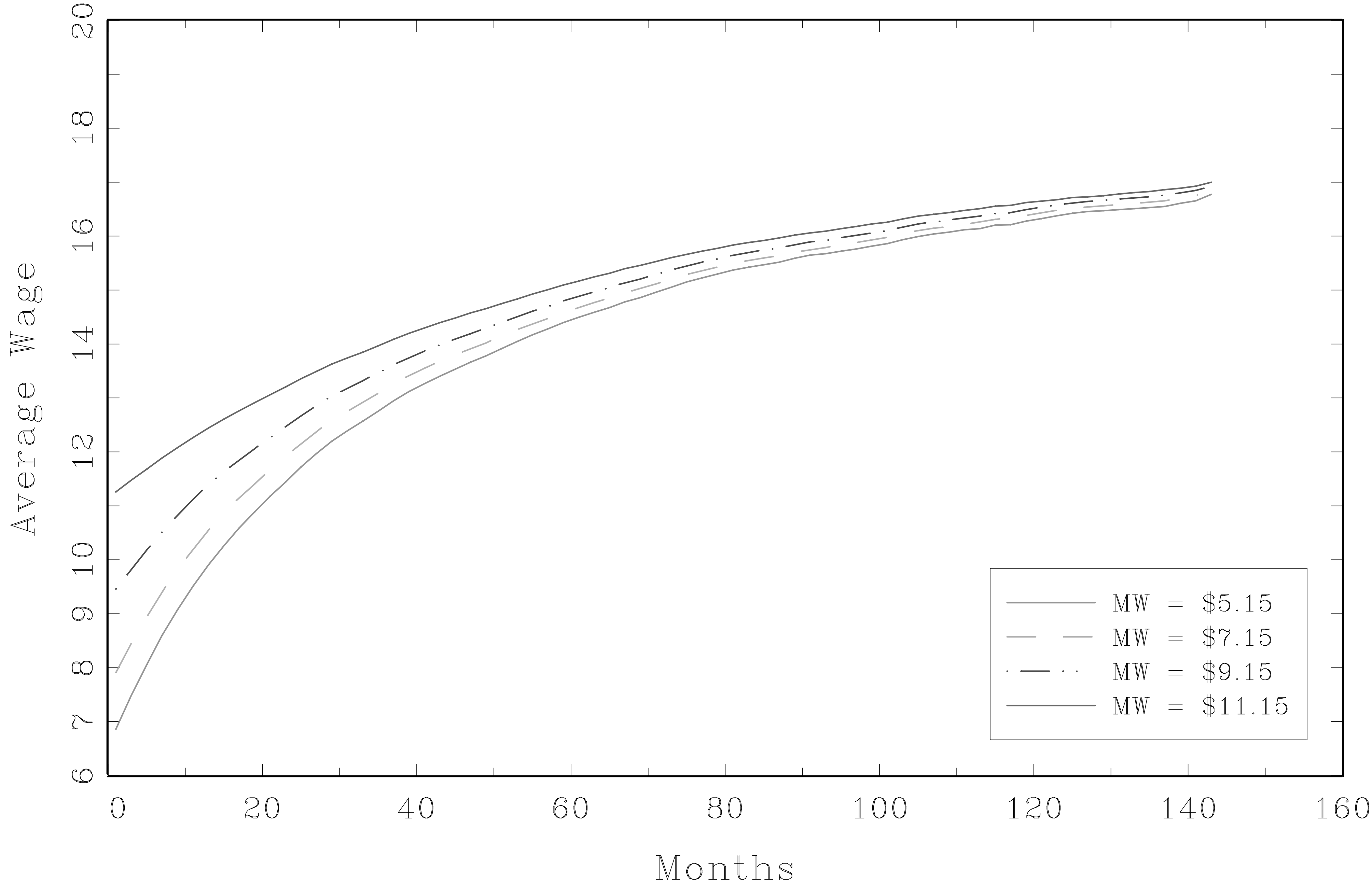

Figure 4.a
Average Wage over Labor Market Career
(No Wage Renegotiation Allowed)

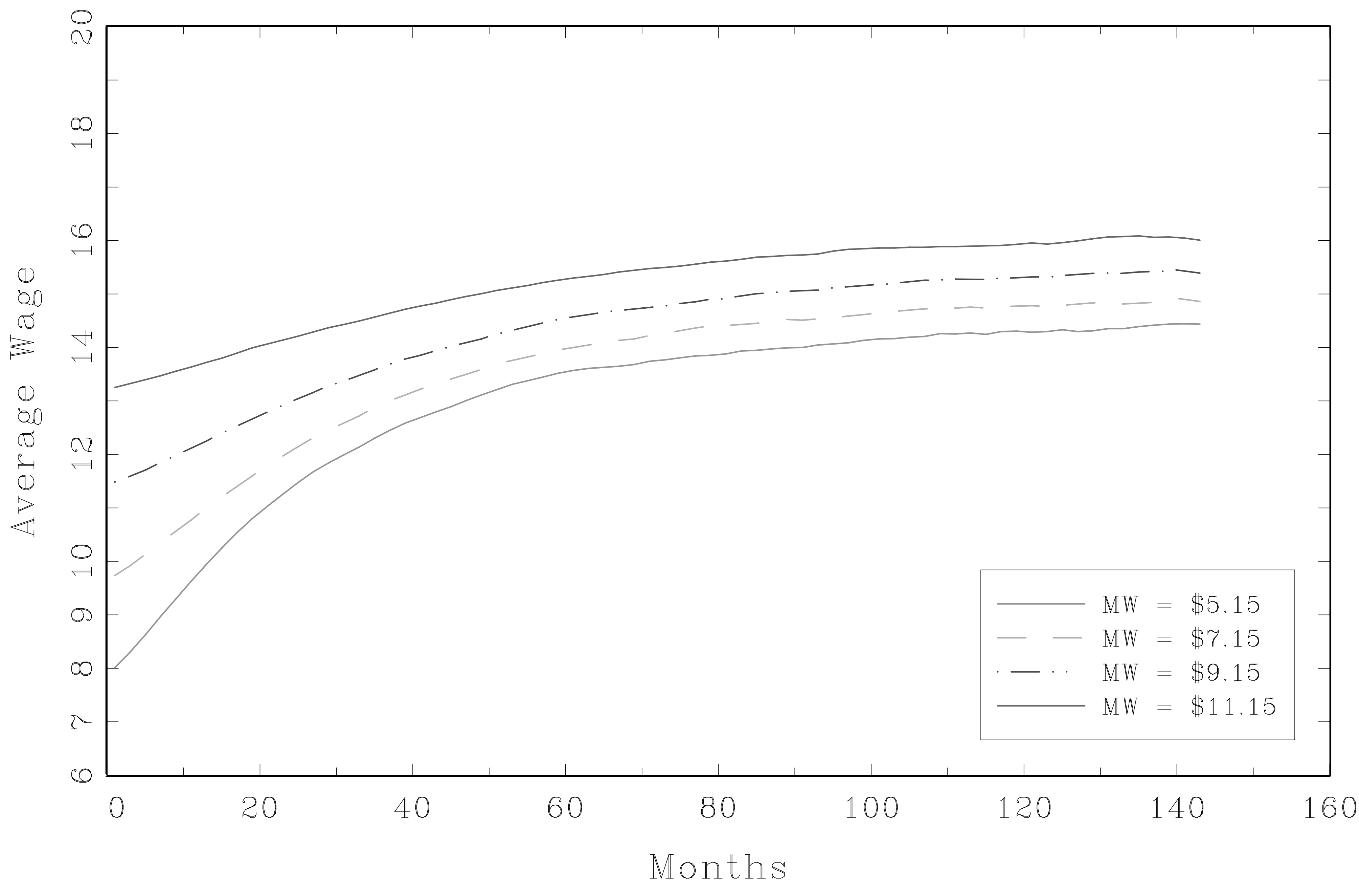

Figure 4.b
Average Wage over Labor Market Career
(Wage Renegotiation Allowed)

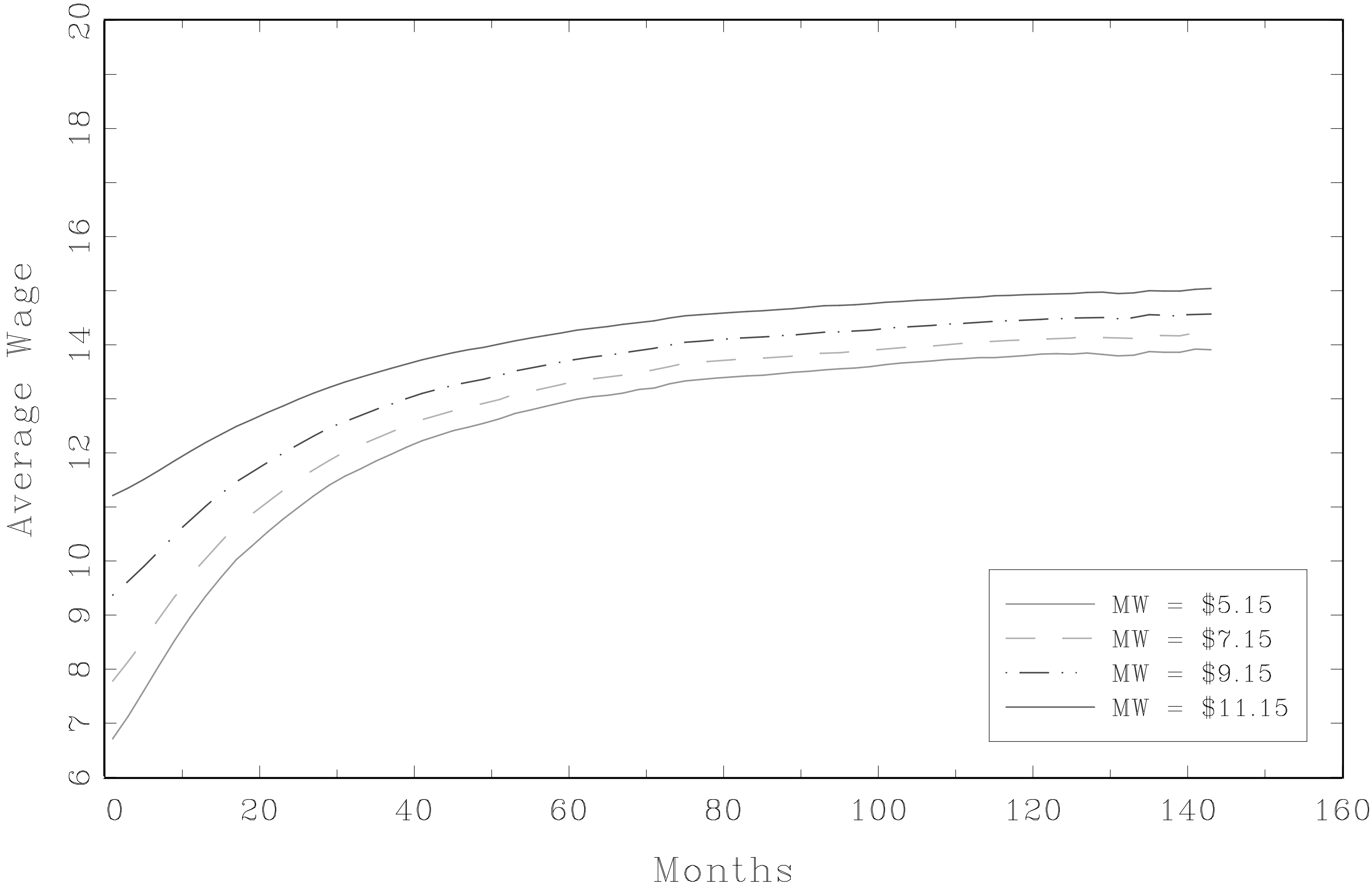

Table 6

Policy Experiments: Exogenous Contact Rates

	Unemployed Workers	Employed Workers	Firms with Filled Vacancies	Out of the Labor Force Workers	Aggregate Labor Market
Without Renegotiation					
Optimal m	\$12.05	\$17.50	\$17.55	\$12.05	\$12.05
Percent Change With Respect to Baseline ($m = \$5.15$)	0.017	0.050	0.348	0.184	0.017
Unemployment Rate (Baseline = 0.051)	0.140	0.246	0.303	0.140	0.140
With Renegotiation					
Optimal m	\$14.05	\$14.30	\$5.15	\$14.05	\$14.05
Percent Change With Respect to Baseline ($m = \$5.15$)	0.048	0.040	0.00	0.247	0.035
Unemployment Rate (Baseline = 0.022)	0.042	0.047	0.058	0.042	0.042

Table 7

Policy Experiments: Endogenous Contact Rates

	Unemployed Workers	Employed Workers	Firms with Filled Vacancies	Out of the Labor Force Workers	Aggregate Labor Market
Without Renegotiation					
Optimal m	\$4.70	\$4.70	\$17.55	\$4.70	\$4.70
Percent Change With Respect to Baseline ($m = \$5.15$)	0.006	0.005	0.338	0.066	0.005
Unemployment Rate (Baseline = 0.051)	0.046	0.046	0.404	0.046	0.046
With Renegotiation					
Optimal m	\$13.30	\$13.30	\$17.85	\$13.30	\$13.30
Percent Change With Respect to Baseline ($m = \$5.15$)	0.046	0.037	0.224	0.240	0.033
Unemployment Rate (Baseline = 0.022)	0.035	0.035	0.809	0.035	0.035

Figure 5a
Steady State Proportion of Unemployed
(Exogenous Contact Rates)

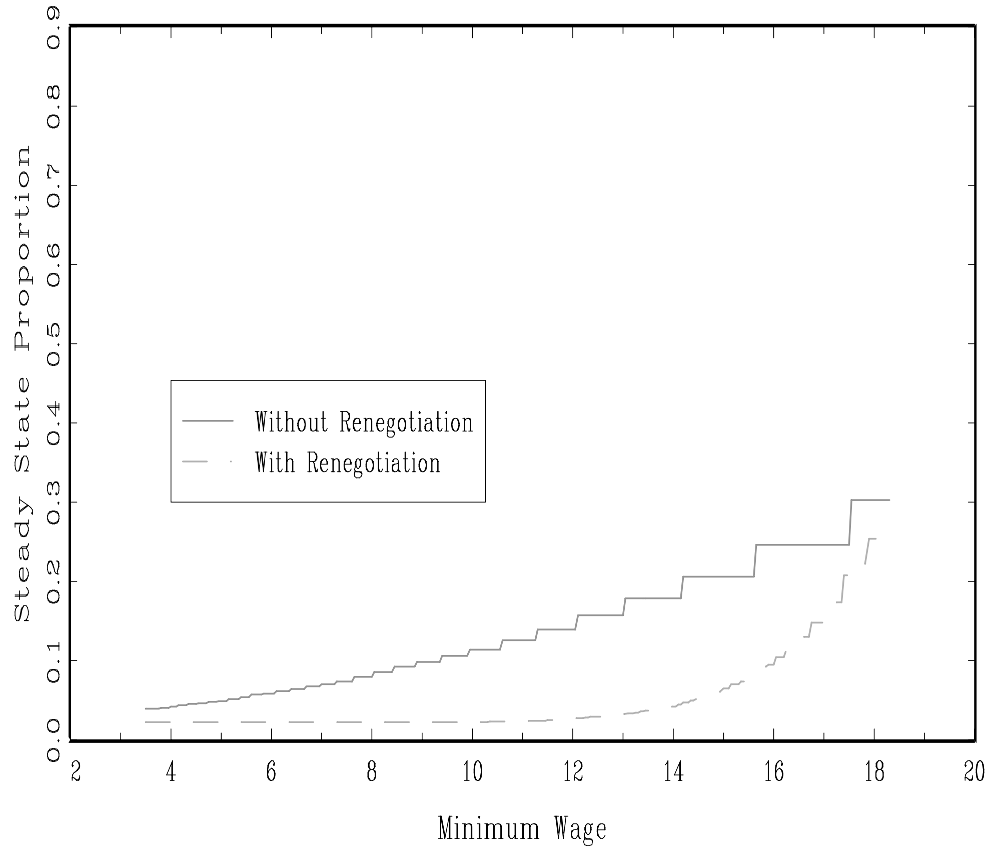

Figure 5b
Steady State Proportion of Unemployed
(Endogenous Contact Rates)