CHAPTER 7

THE SHORT-RUN DEMAND FOR HOURS PAID-FOR PER WORKER

7.1 Introduction

In the short-run production function postulated in this study the labor input variable is taken to be the number of man hours worked, $M_{2wt}H_{2wt}$. In ch. 3 a theoretical model of the short-run demand for the number of workers employed, M_{2wt}, was developed. The amount of excess labor on hand and the time stream of expected future changes in output were assumed to be significant determinants of the short-run demand for workers, and the empirical results presented in ch. 4 indicated that this is in fact the case. Because of the properties of the short-run production function, once the number of workers employed is determined, the number of hours worked per worker, H_{2wt}, is automatically determined. From eq. (3.6)[1]

$$H_{2wt} = \alpha_{2wt}\, Y_{2wt}/M_{2wt}, \tag{7.1}$$

where α_{2wt} is the production function parameter for month t. Since α_{2wt} and Y_{2wt} are taken to be exogenous, H_{2wt} is determined from eq. (7.1) once M_{2wt} is determined.

It was seen in table 2.2 that in general M_{2wt} fluctuates much less than output in the short run, and since α_{2wt} moves only slowly through time, H_{2wt} is seen from eq. (7.1) to be subject to large short-run fluctuations and to account for a large percentage of the short-run fluctuations in $M_{2wt}H_{2wt}$. In other words, a large percentage of the short-run fluctuations in labor services is accounted for by fluctuations in the number of hours worked per worker rather than by fluctuations in the number of workers employed. This, of course, does not imply that the number of hours paid-for per worker, HP_{2wt}, fluctuates to the same extent that the number of hours worked per worker does, and the model developed in ch. 3 did not provide an explanation of the short-run demand for the number of hours paid-for

[1] Remember that by definition $M_{2wt}H_{2wt}$ equals $M^*_{2wt}H^*_{2wt}$ so that eq. (3.6) can be expressed in terms of $M_{2wt}H_{2wt}$ rather than $M^*_{2wt}H^*_{2wt}$.

TABLE 7.1
Values of HP_{2wt} and H_{2wt} for 1962

	201 HP	201 H	201 HP-H	207 HP	207 H	207 HP-H	211 HP	211 H	211 HP-H
6201	39.6	38.5	1.1	39.3	28.2	11.1	36.0	36.0	0.0
02	38.7	37.7	1.0	39.4	31.4	8.0	37.8	36.7	1.1
03	39.1	39.1	0.0	39.7	30.6	9.1	38.4	38.5	−.1
04	40.1	38.1	2.0	39.1	26.7	12.4	39.3	36.6	2.7
05	41.4	37.6	3.8	39.5	22.5	17.0	39.9	38.9	1.0
06	41.5	35.8	5.7	39.7	25.5	14.2	39.7	38.0	1.7
07	41.5	34.1	7.4	a	a	a	a	a	a
08	40.5	35.0	5.5	40.3	28.1	12.2	39.2	38.9	3.4
09	40.9	35.6	5.3	41.3	41.3	0.0	40.1	38.2	1.9
10	40.9	40.2	.7	40.7	33.5	7.2	37.8	38.0	−.2
11	41.5	38.7	2.8	40.2	27.6	12.6	41.0	38.2	2.8
12	41.4	36.7	4.7	a	a	a	a	a	a

	212 HP	212 H	212 HP-H	231 HP	231 H	231 HP-H	232 HP	232 H	232 HP-H
6201	36.6	34.7	1.9	35.4	26.9	8.5	35.0	34.8	.2
02	36.8	37.1	−.3	36.1	30.1	6.0	37.6	37.3	.3
03	37.1	37.1	0.0	36.8	30.5	6.3	37.9	36.4	1.5
04	36.5	35.8	.7	37.2	32.8	4.4	37.9	35.2	2.7
05	36.4	36.5	−.1	37.5	30.5	7.0	38.0	33.8	4.2
06	36.9	37.3	−.4	37.8	30.4	7.4	38.7	34.1	4.6
07	a	a	a	a	a	a	a	a	a
08	38.0	38.8	−.8	37.7	32.4	5.3	38.7	34.0	4.7
09	38.1	37.7	.4	37.8	32.4	5.4	38.1	33.8	4.3
10	38.6	40.2	−1.6	36.7	33.6	3.1	37.6	32.6	5.0
11	39.0	36.9	2.1	37.2	31.3	5.9	37.6	32.1	5.5
12	a	a	a	a	a	a	a	a	a

	233 HP	233 H	233 HP-H	242 HP	242 H	242 HP-H	271 HP	271 H	271 HP-H
6201	32.7	26.6	6.1	35.6	30.0	5.6	35.8	31.3	4.5
02	33.9	32.6	1.3	38.7	38.7	0.0	35.8	32.8	3.0
03	35.0	33.6	1.4	38.5	37.9	.6	36.0	34.4	1.6
04	35.3	31.8	3.5	39.0	38.0	1.0	36.5	35.2	1.3
05	34.7	31.0	3.7	40.4	38.2	2.2	36.6	35.5	1.1
06	34.4	29.1	5.3	40.0	37.6	2.4	36.5	33.4	3.1
07	a	a	a	a	a	a	36.5	29.8	6.7
08	34.8	28.1	6.7	40.7	36.8	3.9	36.3	31.0	5.3
09	33.8	27.0	6.8	40.7	39.2	1.5	36.4	34.0	2.4
10	32.8	28.2	4.6	40.1	37.1	3.0	36.2	35.4	.8
11	33.6	26.7	6.9	39.3	36.1	3.2	36.6	36.0	.6
12	a	a	a	38.6	33.9	4.7	a	a	a

TABLE 7.1 (continued)

	301			311			314		
	HP	*H*	*HP-H*	*HP*	*H*	*HP-H*	*HP*	*H*	*HP-H*
6201	40.4	38.3	2.1	37.9	34.8	4.9	38.8	33.7	5.1
02	39.2	39.2	0.0	40.0	38.9	1.1	37.9	37.0	.9
03	39.5	38.2	1.3	39.8	35.8	4.0	37.6	37.2	.4
04	40.2	39.4	.8	40.0	37.7	2.3	36.5	35.5	1.0
05	41.2	38.3	2.9	40.4	37.3	3.1	36.7	32.9	3.8
06	42.5	40.7	1.8	40.5	38.3	2.2	38.1	33.8	4.3
07	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
08	40.9	33.8	7.1	40.1	35.9	4.2	37.9	35.4	2.5
09	40.8	36.5	4.3	40.3	37.3	3.0	36.5	34.9	1.6
10	40.9	39.6	1.3	40.2	37.8	2.4	35.5	33.9	1.4
11	41.1	34.5	6.6	39.9	37.1	2.8	35.9	30.9	5.0
12	41.4	34.1	7.3	40.2	34.4	5.8	[a]	[a]	[a]

	324			331			332		
	HP	*H*	*HP-H*	*HP*	*H*	*HP-H*	*HP*	*H*	*HP-H*
6201	39.7	23.3	16.4	40.7	39.4	1.3	39.2	34.2	5.0
02	39.7	24.1	15.6	40.7	40.7	0.0	40.0	36.7	3.3
03	40.4	28.6	11.8	40.7	40.5	.2	40.4	38.3	2.1
04	40.9	37.0	3.9	40.5	37.1	3.4	40.5	38.0	2.5
05	41.4	41.4	0.0	38.6	31.8	6.8	40.8	35.8	5.0
06	41.2	39.3	1.9	38.3	30.3	8.0	41.6	37.0	4.6
07	42.0	38.8	3.2	[a]	[a]	[a]	[a]	[a]	[a]
08	41.7	41.7	0.0	38.1	31.4	6.7	39.9	30.6	9.3
09	41.5	40.3	1.2	38.7	32.6	6.1	40.7	35.8	4.9
10	41.1	39.7	1.4	37.9	33.8	4.1	40.5	35.5	5.0
11	41.0	35.8	5.2	38.2	35.2	3.0	40.5	35.1	5.4
12	40.4	29.1	11.3	39.1	33.8	5.3	41.0	33.4	7.6

	336			341		
	HP	*H*	*HP-H*	*HP*	*H*	*HP-H*
6201	41.2	36.5	4.7	40.8	25.6	15.2
02	41.2	38.9	2.3	41.2	27.6	13.6
03	41.2	38.1	3.1	41.4	29.4	12.0
04	41.4	38.0	3.4	41.9	30.9	11.0
05	41.1	36.2	4.9	42.2	32.1	10.1
06	41.6	38.8	2.8	43.6	34.9	8.7
07	[a]	[a]	[a]	43.8	35.4	8.4
08	40.2	31.8	8.4	43.4	41.9	1.5
09	40.8	37.9	2.9	43.5	43.5	0.0
10	40.7	37.4	3.3	41.5	31.6	9.9
11	40.8	36.5	4.3	40.4	26.8	13.6
12	41.4	34.6	6.8	41.1	27.1	14.0

[a] Excluded from period of estimation because of shutdowns.

per worker. In this chapter a model of the short-run demand for hours paid-for per worker is developed and estimated. From this model and the model of the short-run demand for workers developed in ch. 3 the model of the short-run demand for total man hours paid-for can be derived, and this is the subject matter of ch. 8.

Before developing the model explaining the short-run demand for the number of hours paid-for per worker, it is informative to see how HP_{2wt} and H_{2wt} compare. From eq. (7.1) data on M_{2wt} are available directly; data on Y_{2wt} can be approximated by the available data on Y_{dt}; and data on α_{2wt} are available from the interpolations discussed in ch. 3. Consequently, data on H_{2wt} for each industry can be constructed using eq. (7.1). Data on HP_{2wt} are available directly, and so for any one month H_{2wt} and HP_{2wt} can be compared. In table 7.1 the values for HP_{2wt}, H_{2wt}, and the difference between them, $HP_{2wt} - H_{2wt}$, are presented for each of the seventeen industries for the year 1962. 1962 was free from any significant strikes in the industries, and it was arbitrarily chosen to be used as a representative year. The July and December observations are not given in the table for those industries in which shutdowns occurred during these months, since the months were omitted from the periods of estimation and the observations for these months have little meaning.

Theoretically HP_{2wt} can never be less than H_{2wt}, since hours actually worked must be paid for, and so no negative values of $HP_{2wt} - H_{2wt}$ should be found in table 7.1. In fact, there are a few small negative values of $HP_{2wt} - H_{2wt}$ in the table. This is due to the fact that, as mentioned in § 3.6, in the interpolation work the procedure of going from peak to next higher peak was not strictly adhered to in every case. For a small fraction of the cases a particular peak seemed to be high relative to past and future values, and these peaks were not used as interpolation peaks. For these peaks, then, the computed value of H_{2wt} is greater than the actual value of HP_{2wt}, which accounts for the negative values of $HP_{2wt} - H_{2wt}$ given in table 7.1.

$HP_{2wt} - H_{2wt}$ is the number of hours which are paid-for per worker but which are not actually worked, i.e., the number of "non-productive" hours paid-for per worker. This (or the log version of it, log HP_{2wt} − log H_{2wt}) is not the measure of excess labor on hand, which is defined to be log HS_{2wt} − log H_{2wt}, where HS_{2wt} is the standard number of hours of work per worker. The excess labor variable can be positive or negative depending on whether the number of hours worked per worker is smaller or larger than the standard number of hours of work per worker, but theoretically log HP_{2wt} − log H_{2wt} is always positive. $HP_{2wt} - H_{2wt}$ should thus be interpreted as measuring the number of non-productive hours paid-for per worker, but not as the measure of excess labor. Ignoring the negative numbers in table 7.1, the values of $HP_{2wt} - H_{2wt}$ range from zero in a number of industries to 17.0 in the Confectionery industry, 207. Looking at the individual industries, the Tobacco industries, 211 and 212, appear to have the least number of non-productive hours paid-for, while the Confectionery, Cement, and Metal cans industries, 207, 324, and 341, appear to have the most, especially during certain months of the year.

One question which arises when examining the figures for $HP_{2wt} - H_{2wt}$ in the table is why firms do not allow larger fluctuations in HP_{2wt} in order to avoid paying for so many non-productive hours. This question sets the stage for the development of the model of the short-run demand for the number of hours paid-for per worker.

7.2 The theoretical model

The basic idea of the model developed here is that with respect to such things as worker morale problems and some of the others discussed in § 3.4 firms view short-run fluctuations in the number of hours paid-for per worker in a similar manner as they view fluctuations in the number of workers employed. Firms may be reluctant in periods of low output, for example, to decrease the number of hours paid-for per worker sufficiently so that they are paying for no non-productive hours. Just as with the number of workers employed, firms may subject themselves to serious worker morale problems and other costs if they allow large short-run fluctuations in the number of hours paid-for per worker.

Based on this idea, it would appear that some of the same factors which determine the change in the number of workers employed, $\log M_{2wt} - \log M_{2wt-1}$, might also determine the change in the number of hours paid-for per worker, $\log HP_{2wt} - \log HP_{2wt-1}$. Indeed, when $\log HP_{2wt} - \log HP_{2wt-1}$ was regressed on $\log M_{2wt} - \log M_{2wt-1}$ for each industry, the coefficient of $\log M_{2wt} - \log M_{2wt-1}$ was nearly always significant and positive, which tends to confirm this conclusion.

One would thus expect that the amount of excess labor on hand and expected future changes in output would contribute significantly to the determination of short-run changes in the number of hours paid-for per worker. Firms may be reluctant, for example, to decrease the number of hours paid-for per worker because of such things as worker morale problems and the like, but they may be more likely to do this if there is much excess labor on hand and if the amount of output to be produced is expected to decrease over the next few months than if there is little excess labor on hand and output is expected to increase over the next few months.

There is, however, one main difference between hours paid-for per worker and workers, which is probably best summarized by Kuh: "The main determinant of hours to be worked is a convention established through bargaining and a variety of social and institutional forces".[1] Unlike the number of workers employed, which can move steadily upward or downward over time, the number of hours paid-for per workers fluctuates around a relatively constant level of hours (such a 40 hours per week). If the number of hours paid-for per worker is greater than this level, this should, other things being equal, bring forces into play causing it to decline back to this level. Therefore, the difference between the number of hours paid-for per worker during the second week of month $t-1$ and the standard number of hours of work per worker for that week, $\log HP_{2wt-1} - \log HS_{2wt-1}$, should be a significant factor in the determination of $\log HP_{2wt} - \log HP_{2wt-1}$.

The following equation might thus be considered to be the basic equation determining the change in the number of hours paid-for per worker:

$$\log HP_{2wt} - \log HP_{2wt-1} =$$

$$\alpha_1(\log M_{2wt-1} - \log M^d_{2wt-1}) + \alpha_2(\log HP_{2wt-1} - \log HS_{2wt-1})$$

$$+ \sum_{i=1}^{m} \beta_i(\log Y_{2wt-i} - \log Y_{2wt-i-1}) + \gamma_0(\log Y^e_{2wt} - \log Y_{2wt-1})$$

$$+ \sum_{i=1}^{n} \gamma_i(\log Y^e_{2wt+i} - \log Y^e_{2wt+i-1}). \tag{7.2}$$

As was the case in eq. (3.9) for workers, the past output change variables are added to eq. (7.2) on the hypothesis that they may help depict the reaction of firms to the amount of excess labor on hand.[2] The coefficient α_1 of the excess labor variable and the coefficient α_2 of the variable depicting the difference between the number of hours paid-for per worker and the

[1] KUH (1965b, p. 253). Kuh, of course, does not make a distinction between hours paid-for per worker and hours worked per worker.

[2] See the discussion in § 3.7.

standard number of hours of work per worker are expected to be negative in eq. (7.2).

Because adjustment costs for the firm are likely to be smaller with respect to the number of hours paid-for per worker than with respect to the number of workers employed, one would expect that the size of the γ_i coefficients of the expected future output change variables would be smaller in eq. (7.2) than in the corresponding equation for workers, eq. (3.9). In general, one would expect that the adjustment of the number of hours paid-for per worker to the standard level would be more rapid than the adjustment of the number of workers employed to its desired level.

There is a problem which may arise in estimating eq. (7.2) for hours paid-for per worker which did not arise in estimating eq. (3.9) for workers. As mentioned above, one of the constraints implied by the model developed in this study is that the number of hours paid-for per worker can never be less than the number of hours worked per worker; the number of hours worked must be paid-for. At least during certain times of the year, HP_{2wt} is likely to be equal to H_{2wt}, and depending on M_{2wt}, Y_{2wt}, and α_{2wt} [see eq. (7.1)], eq. (7.2) could call for an HP_{2wt} which is less than H_{2wt}, which cannot happen. This possible constraint would not be taken into account if eq. (7.2) were estimated as it is.

Another way of looking at this problem is the following. When the number of hours paid-for per worker, HP_{2w}, equals the number of hours worked per worker, H_{2w}, the production function constraint becomes binding on HP_{2w} and it is no longer free to fluctuate as much as it is when it is greater than H_{2w}. When HP_{2w} equals H_{2w}, HP_{2w} can only decrease as fast as H_{2w} decreases, and it must increase if H_{2w} increases and as fast as H_{2w} increases. The behavior of $\log HP_{2wt} - \log HP_{2wt-1}$ may be different, therefore, when it equals $\log H_{2wt} - \log H_{2wt-1}$ than otherwise.

Fortunately, a test of this possible difference in behavior can be made. It was seen at the beginning of this chapter that estimates of H_{2wt} are available for each industry and that these estimates can be compared with the actual values of HP_{2wt} for any one period of time. From these data the following dummy variable, denoted as $B1_t$, was constructed. When both $HP_{2wt} - H_{2wt}$ and $HP_{2wt-1} - H_{2wt-1}$ were less than 1.0, $B1_t$ was set equal to one, otherwise it was set equal to zero. In other words, $B1_t$ was set equal to one when $\log HP_{2wt} - \log HP_{2wt-1}$ seemed to be equal or nearly equal to $\log H_{2wt} - \log H_{2wt-1}$. If $\log HP_{2wt} - \log HP_{2wt-1}$ behaves differently when it equals $\log H_{2wt} - \log H_{2wt-1}$ than otherwise and if $B1_t$ adequately reflects the cases where $\log HP_{2wt} - \log HP_{2wt-1}$ equals $\log H_{2wt} - \log$

H_{2wt-1}, then adding $B1_t$ to eq. (7.2) should result in a significant coefficient estimate for $B1_t$. If, for example, $\log HP_{2wt} - \log HP_{2wt-1}$ responds more to current output changes when it equals $\log H_{2wt} - \log H_{2wt-1}$ (due to the fact that the production function constraint is binding on H_{2w}) than otherwise, then the coefficient estimate for $B1_t$ should be positive and the estimate of the coefficient γ_0 of $\log Y_{2wt} - \log Y_{2wt-1}$ should be smaller when $B1_t$ is included in the equation than otherwise.

For industries 207, 231, 233, 311, and 341 the estimated values of H_{2wt} were such that only one or two observations were found where both $HP_{2wt} - H_{2wt}$ and $HP_{2wt-1} - H_{2wt-1}$ were less than 1.0, and so for these industries the 1.0 figure was increased. For 233 and 311 the figure was taken to be 2.0, and for 207, 231, and 341 it was necessary to raise the figure to 5.0 before a non-negligible number of observations was available. The dummy variable for 233 and 311 is denoted as $B2_t$, and for 207, 231, and 341 it is denoted as $B5_t$. While it may be unreasonable with respect to the last three industries to suppose that the "true" $\log H_{2wt} - \log H_{2wt-1}$ is equal to $\log HP_{2wt} - \log HP_{2wt-1}$ when the "estimated" values of H_{2wt} and H_{2wt-1} are about 4 or 5 hours less than HP_{2wt} and HP_{2wt-1} respectively, adding $B5_t$ to eq. (7.2) for these industries can at least be taken to indicate whether the behavior of $\log HP_{2wt} - \log HP_{2wt-1}$ is different during those times when it is "most nearly equal" to $\log H_{2wt} - \log H_{2wt-1}$.

One other factor which has not yet been considered as a possible determinant of the short-run demand for hours paid-for per worker is the degree of labor market tightness. According to the hypothesis discussed in § 5.4, a tight labor market (measured by a negative $\log U_{2wt} - \log \bar{U}$, where U_{2wt} is the unemployment rate prevailing from the end of the second week of month $t-1$ to the end of the second week of month t and where $\bar{U}$ is the rate at which the market switches from being tight to being loose) leads to fewer workers hired and fired in the short run, and a loose labor market (measured by a positive $\log U_{2wt} - \log \bar{U}$) leads to more workers hired and fired in the short run. In other words, in tight labor markets short-run fluctuations in the number of workers employed are damped, while in loose labor markets the fluctuations are increased. In eq. (5.1) $\log U_{2wt} - \log \bar{U}$ enters the equation determining the short-run demand for production workers in a non-linear way. The results presented in § 5.4 provided some support for this hypothesis, but the evidence was not very strong.

Considering the constraint on HP_{2w} just discussed and the fact that the same factors which determine the short-run demand for workers may also influence the short-run demand for hours paid-for per worker, an argument can be made why $\log U_{2wt} - \log \bar{U}$ should enter eq. (7.2) in a simple linear way and have a negative effect on $\log HP_{2wt} - \log HP_{2wt-1}$.

Consider, first of all, what happens in a tight labor market. The number of workers hired and fired fluctuates less, and so the number of hours worked per worker, H_{2w}, fluctuates more. For those cases where HP_{2w} equals H_{2w}, HP_{2w} should then fluctuate more when the labor market is tight. Since it has been postulated above that firms are reluctant to lay off workers or have workers quit when labor markets are tight, an added inducement to keep workers from moving to other jobs might be to keep the level of hours paid-for per worker high. This "inducement effect" should lead, then, to larger increases and smaller decreases in HP_{2w} when labor markets are tight. This "inducement effect" reinforces the "production function constraint effect" (i.e., the effect when HP_{2w} equals H_{2w}) for increases in HP_{2w}, but runs counter to it for decreases in HP_{2w}. (The production function constraint implies that when HP_{2w} equals H_{2w}, HP_{2w} should decrease *more* when labor markets are tight, while the inducement effect implies that HP_{2w} should decrease *less* when labor markets are tight.) Since HP_{2w} seems to be equal to H_{2w} only for at most a few months out of the year, it seems likely that the counter influence of the production function constraint effect for decreases in HP_{2w} will be outweighed by the inducement effect. Thus in tight labor markets HP_{2wt} is likely to increase more and decrease less, and so $\log U_{2wt} - \log \bar{U}$ (which is negative when labor markets are tight) should have a negative influence on $\log HP_{2wt} - \log HP_{2wt-1}$.

A similar reasoning holds for loose labor markets. The production function constraint effect implies that, since H_{2w} fluctuates less in loose labor markets due to the number of workers fluctuating more, HP_{2w} should fluctuate less (increase less and decrease less) when HP_{2w} equals H_{2w}. The inducement effect implies that HP_{2w} should increase less and decrease more (less inducement needed to keep the workers). The conflict between the two effects occurs for decreases in HP_{2w} when HP_{2w} equals H_{2w}. Again if this conflict is not significant, $\log U_{2wt} - \log \bar{U}$ should have a negative influence on $\log HP_{2wt} - \log HP_{2wt-1}$ during loose labor markets as well. Therefore, if $\log U_{2wt} - \log \bar{U}$ is added to eq. (7.2), its coefficient estimate should be negative if the above hypothesis is valid.

Eq. (7.2) is not in a form which can be estimated since many of the variables in the equation are not directly observed. The observed Y_d variable can be used as the output variable in the equation (in place of Y_{2w}), and from eq. (3.12) the excess labor variable in the equation, $\alpha_1(\log M_{2wt-1}$ $\log M^d_{2wt-1})$, is equal to $\alpha_1(\log M_{2wt-1} - \log M^*_{2wt-1}H^*_{2wt-1}) + \alpha_1 \log \bar{H} +$

$\alpha_1 \mu t$. Data on $M^*_{2wt-1}H^*_{2wt-1}$ are available from the interpolation work in ch. 3. From the assumption made about HS_{2wt-1} in eq. (3.11) [namely, that it is a slowly trending variable], the term $-\alpha_2 \log HS_{2wt-1}$ in eq. (7.2) is equal to $-\alpha_2 \log \bar{H} - \alpha_2 \mu t$. With respect to the unemployment rate variable, as was done in § 5.4, the BLS data on the unemployment rate prevailing during the second week of month t can be taken as a proxy for the rate prevailing during the period from the end of the second week of month $t-1$ to the end of the second week of month t.

Adding the term $\psi_1(\log U_{2wt} - \log \bar{U})$ to eq. (7.2) [the addition of $B1_t$ to the equation will be discussed later] and using these approximations, eq. (7.2) becomes

$$\log HP_{2wt} - \log HP_{2wt-1} = \alpha_1(\log M_{2wt-1} - \log M^*_{2wt-1}H^*_{2wt-1}) + \alpha_2 \log HP_{2wt-1} + [(\alpha_1 - \alpha_2)\log \bar{H} - \psi_1 \log \bar{U}] + (\alpha_1 - \alpha_2)\mu t + \sum_{i=1}^{m} \beta_i(\log Y_{dt-i} - \log Y_{dt-i-1}) + \gamma_0(\log Y^e_{dt} - \log Y_{dt-1}) + \sum_{i=1}^{n} \gamma_i(\log Y^e_{dt+i} - \log Y^e_{dt+i-1}) + \psi_1 \log U_{2wt}. \qquad (7.2)'$$

Eq. (7.2)′ is different depending on which expectational hypothesis is assumed. Remember also that the use of data on Y_d rather than on Y_{2w} gives an additional reason why $\log Y_{dt-1} - \log Y_{dt-2}$ may be significant in the determination of $\log HP_{2wt} - \log HP_{2wt-1}$.[1]

7.3 The basic results

The results of estimating eq. (7.2)′ are presented in table 7.2. For each industry the expectational hypothesis which gave the better results for eq. (3.9)′ in table 4.3 was assumed to be the correct one for that industry and was used in the estimation of eq. (7.2)′. As was done for eq. (3.9)′, the past output change variables were carried back and the expected future output change variables were carried forward until they lost their significance. The same periods of estimation were used here as were used for eq. (3.9)′ in

[1] See the discussion in § 4.2.

table 4.3. $\hat{\delta}$ in table 7.2 denotes the estimate of the coefficient of $\log Y_{dt-1} - \log Y_{dt-13}$ for those industries in which the non-perfect expectational hypothesis was used.

The results presented in table 7.2 appear to be quite good. For every industry the estimate of the coefficient α_2 of $\log HP_{2wt-1}$ is negative, as expected, and highly significant. For every industry the estimate of the coefficient α_1 of the excess labor variable is negative and is significant for every industry except 242, where two of the past four output change variables are significant. These results rather strongly indicate that the amount of excess labor on hand is a significant factor determining the short-run demand for hours paid-for per worker, and they support the results presented in table 4.3 which indicate that the amount of excess labor on hand is a significant factor determining the short-run demand for workers. The significance of all of the estimates of α_2 in table 7.2 indicates that the amount by which HP_{2wt-1} differs from the standard number of hours of work per worker is also an important factor determining the short-run demand for hours paid-for per worker.

With respect to the past output change variables, only for industries 201 and 242 are any of them significant in table 7.2. These variables do not appear to be of much help in depicting the reaction of firms to the amount of excess labor on hand with respect to changes in the number of hours paid-for per worker. A similar conclusion was also reached in ch. 4 with respect to changes in the number of workers employed.

The estimate of the coefficient γ_0 of the current output change variable in table 7.2 is positive and significant for every industry, and many of the estimates of the γ_i coefficients of the expected future output changes variables are significant as well. The size of the estimate of γ_i for the most part decreases as i increases. The time stream of expected future output changes thus appears to be a significant determinant of the short-run demand for hours paid-for per worker. Taken together, the over-all results strongly confirm the hypothesis that many of the same factors which influence changes in the number of workers employed also influence changes in the number of hours paid-for per worker, i.e., that firms view fluctuations in the number of hours paid-for per worker in a similar manner as they view fluctuations in the number of workers employed.

Turning now to the unemployment rate variable, the estimate of the coefficient ψ_1 of $\log U_{2wt}$ in table 7.2 is negative, as expected, for fifteen of the seventeen industries and significantly negative for eleven of these fifteen. For the two industries where the estimate of ψ_1 is positive – 211 and 314 –

TABLE 7.2

Parameter estimates for eq. (7.2)'

Industry	No. of obs.	$\widehat{(\alpha_1-\alpha_2)\log \bar{H}-\psi_1 \log \bar{U}}$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\widehat{1000(\alpha_1-\alpha_2)\mu}$	$\hat{\beta}_4$	$\hat{\beta}_3$	$\hat{\beta}_2$	$\hat{\beta}_1$	$\hat{\gamma}_0$
201	192	2.119	−.118	−.458	−.028			.118	.051	.251
		(4.46)	(2.38)	(7.15)	(1.16)			(5.14)	(2.20)	(7.77)
207	136	2.433	−.052	−.456	.034					.094
		(6.83)	(3.05)	(6.79)	(1.51)					(10.29)
211	136	1.330	−.387	−.612	.024					.503
		(3.05)	(5.70)	(7.87)	(0.44)					(8.93)
212	136	2.464	−.177	−.583	.103					.232
		(6.29)	(4.07)	(7.00)	(2.52)					(7.92)
231	136	1.129	−.264	−.439	.022					.183
		(2.68)	(6.83)	(6.82)	(0.68)					(5.58)
232	136	1.404	−.129	−.355	.007					.127
		(4.35)	(6.10)	(6.58)	(0.25)					(7.55)
233	136	3.839	−.084	−.733	−.057					.095
		(8.26)	(2.86)	(8.64)	(1.22)					(4.53)
242	154	2.254	−.045	−.417	.005	.052	.031	.065	.021	.123
		(5.47)	(1.23)	(6.79)	(0.19)	(3.23)	(1.75)	(3.18)	(0.79)	(6.30)
271	166	1.492	−.054	−.304	−.081					.081
		(5.71)	(2.72)	(6.31)	(5.29)					(4.45)
301	134	1.294	−.169	−.370	.052					.149
		(4.08)	(5.58)	(5.92)	(1.25)					(4.46)
311	170	1.589	−.114	−.372	.035					.119
		(5.35)	(4.69)	(6.80)	(2.16)					(5.80)
314	136	1.203	−.190	−.393	.061					.416
		(2.39)	(3.12)	(4.53)	(2.25)					(11.43)
324	187	3.290	−.032	−.574	−.034					.042
		(8.62)	(5.71)	(8.68)	(2.64)					(7.55)
331	128	2.764	−.182	−.633	.113					.192
		(7.88)	(6.82)	(8.18)	(4.66)					(9.09)
332	170	.995	−.109	−.265	.063					.126
		(4.77)	(6.72)	(6.60)	(3.21)					(7.29)
336	170	2.035	−.043	−.371	.050					.078
		(6.51)	(3.23)	(6.79)	(2.92)					(5.33)
341	191	3.603	−.071	−.660	.092					.095
		(10.07)	(6.37)	(10.02)	(3.84)					(13.09)

t-statistics are in parentheses.

[a] $\hat{\delta}$ is the coefficient estimate of $\log Y_{at-1} - \log Y_{at-13}$ under the non-perfect expectational hypothesis.

$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$	$\hat{\gamma}_5$	$\hat{\gamma}_6$	$^a\hat{\delta}$	$\hat{\psi}_1$	R^2	SE	DW
.064	.069	.058	.145	.015	.068	−.001	−.0068	.635	.0145	2.33
(2.18)	(2.40)	(2.45)	(6.88)	(0.75)	(2.82)	(0.05)	(1.72)			
.023	.010	.039				.007	−.0027	.639	.0116	2.16
(1.46)	(0.96)	(7.43)				(0.52)	(0.76)			
							.0071	.607	.0340	1.93
							(0.70)			
							−.0174	.462	.0232	2.13
							(2.37)			
.046	.047	.038				−.003	−.0132	.563	.0200	2.29
(2.06)	(2.90)	(3.66)				(0.16)	(2.00)			
.095	.080	.046					−.0123	.479	.0145	1.88
(5.38)	(6.20)	(4.71)					(2.47)			
							−.0100	.487	.0256	2.15
							(1.20)			
							−.0067	.490	.0153	2.19
							(2.22)			
.055	.023	.046	.017	.044			−.0005	.521	.0151	1.79
(3.02)	(1.46)	(3.34)	(1.38)	(3.96)			(0.37)			
.068	.033	.067					−.0199	.283	.0232	1.90
(2.29)	(1.21)	(2.59)					(2.38)			
.043	.061	.032	.020	.018			−.0093	.369	.0097	2.04
(2.80)	(4.68)	(2.69)	(1.90)	(1.93)			(3.25)			
.141	.150	.092				.133	.0017	.737	.0169	1.84
(4.56)	(6.15)	(4.24)				(4.60)	(0.30)			
							−.0057	.430	.0088	2.25
							(3.50)			
							−.0158	.532	.0137	2.39
							(3.89)			
.033	.045	.040	0.23				−.0132	.377	.0133	2.29
(2.75)	(4.38)	(4.19)	(2.45)				(3.71)			
.034	.030	.035					−.0168	.347	.0111	2.26
(3.10)	(3.06)	(4.34)					(5.50)			
.022							−.0088	.595	.0159	1.91
(3.02)							(3.23)			

it is not significant. These results indicate that the degree of labor market tightness is a significant factor affecting the short-run demand for hours paid-for per worker – that the "inducement effect" does appear to exist. The evidence is much stronger here regarding the influence of the unemployment rate on changes in the number of hours paid-for per worker than it was in table 5.5 regarding the influence of the unemployment rate on changes in the number of workers employed. When $\log U_{2wt} - \log \bar{U}$ was added to eq. (3.9) in the manner depicted in eq. (5.1), its coefficient estimate was positive, as expected, for all but three of the industries, but was only significant for four of them. The results achieved in table 7.2 add some support to the idea that labor market conditions affect employment decisions, but this effect seems to be more pronounced with respect to decisions on the number of hours to pay each worker for than with respect to decisions on the number of workers to hire or lay off.

As mentioned above, the behavior of $\log HP_{2wt} - \log HP_{2wt-1}$ may be different when it equals $\log H_{2wt} - \log H_{2wt-1}$ than otherwise, and this possibility has not been allowed for in the estimates presented in table 7.2. In order to test for this possible difference in behavior the dummy variable $B1_t$ described above was added to eq. (7.2)′.[1] The results are presented in table 7.3. The coefficient of $B1_t$ is denoted as α_3, and the estimate of α_3 is presented in the table for each industry along with the estimate of the coefficient γ_0 of $\log Y_{dt} - \log Y_{dt-1}$. If in fact $\log HP_{2wt} - \log HP_{2wt-1}$ responds to current output changes more when it equals $\log H_{2wt} - \log H_{2wt-1}$, the estimate of α_3 should be positive and the estimate of γ_0 should be smaller when $B1_t$ is included in the equation than otherwise. Presented also in table 7.3 for each industry is the percentage of the observations for which $B1_t$ (or $B2_t$ or $B5_t$) was set equal to one.

For thirteen of the seventeen industries the estimate of α_3 is negative, contrary to what might be expected, but it is significant for only four of the thirteen industries. Of the four industries where the estimate of α_3 is positive, it is significant for only one of them – industry 271. The estimates of γ_0 are little changed from those in table 7.2 and there is certainly no consistent pattern of them being smaller when $B1_t$ is added than otherwise. No specific interpretation can be given as to why so many of the estimates of α_3 are negative, but given the insignificance of most of the estimates, the results

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[1] For industries 233 and 311 $B2_t$ was added instead of $B1_t$, and for industries 207, 231, and 341 $B5_t$ was added instead of $B1_t$. See the discussion of these variables in § 7.2.

TABLE 7.3

Parameter estimates for eq. (7.2)′ with the additional term $\alpha_3 B1_t$.[a] Estimates presented for γ_0 and α_3 only

Industry	No. of obs.	$\hat{\gamma}_0$	$\hat{\alpha}_3$	SE	DW	[b]%
201	192	.258	−.022	.0143	2.30	1.6
		(8.05)	(2.48)			
207	136	.094	−.001	.0117	2.19	10.3
		(9.83)	(0.32)			
211	136	.509	−.005	.0341	1.93	8.8
		(8.77)	(0.40)			
212	136	.241	−.012	.0229	2.14	16.9
		(8.27)	(2.18)			
231	136	.199	−.012	.0197	2.23	19.1
		(6.03)	(2.23)			
232	136	.127	−.002	.0140	1.90	3.7
		(7.51)	(0.24)			
233	136	.095	.005	.0257	2.17	6.6
		(4.48)	(0.54)			
242	154	.119	−.010	.0152	2.16	5.8
		(6.07)	(1.64)			
271	166	.076	.003	.0050	1.77	16.9
		(4.19)	(2.01)			
301	134	.154	−.011	.0232	1.91	6.0
		(4.59)	(1.16)			
311	170	.118	.000	.0097	2.06	6.5
		(5.61)	(0.12)			
314	136	.433	−.014	.0164	1.78	14.0
		(12.12)	(2.92)			
324	187	.043	−.002	.0088	2.31	15.0
		(7.64)	(1.00)			
331	128	.194	−.007	.0137	2.41	11.7
		(9.23)	(1.55)			
332	170	.123	.004	.0133	2.30	2.9
		(7.04)	(0.60)			
336	170	.081	−.006	.0111	2.28	4.1
		(5.44)	(1.21)			
341	191	.095	−.003	.0159	1.97	6.3
		(12.90)	(0.51)			

t-statistics are in parentheses.

[a] For 233 and 311 $\hat{\alpha}_3$ is the coefficient estimate of $B2_t$ rather than $B1_t$, and for 207, 231, and 341 $\hat{\alpha}_3$ is the coefficient estimate of $B5_t$.

[b] Percentage of observations for which $B1_t$ (or $B2_t$ or $B5_t$) was set equal to one.

seem to indicate either that log HP_{2wt} – log HP_{2wt-1} does not behave differently when it equals log H_{2wt} – log H_{2wt-1} or, perhaps more likely, that $B1_t$ (or $B2_t$ or $B5_t$) overestimates those times when log HP_{2wt} – log HP_{2wt-1} equals log H_{2wt} – log H_{2wt-1}, so that the test is not valid. The test is crude because the construction of $B1_t$ was crude, and there is no way of knowing whether $B1_t$ adequately reflects those times when log HP_{2wt} – log HP_{2wt-1} is equal to or nearly equal to log H_{2wt} – log H_{2wt-1}. The "production function constraint" may be binding on HP_{2w} for such a small fraction of the time, for example, as to have negligible effects on the equation determining log HP_{2wt} – log HP_{2wt-1}. The results achieved here are certainly not inconsistent with this idea.

It thus appears that eq. (7.2)′ adequately explains the short-run demand for hours paid-for worker. The amount by which HP_{2wt-1} differs from the standard number of hours of work per worker, the amount of excess labor on hand, the time stream of expected future changes in output, and the condition of the labor market all appear to be significant determinants of this demand. In the next section possible "cyclical" variations in log HP_{2wt} – log HP_{2wt-1} which have not been accounted for by eq. (7.2)′ will be examined.

7.4 Tests for cyclical variations in the short-run demand for hours paid-for per worker

As was done for eq. (3.9)′ for production workers, a test was performed to see if eq. (7.2)′ for hours paid-for per worker predicts differently than expected during general contractionary periods of output or during general expansionary periods. First, the variables (log P_{dt} – log $P_{dt-1})_+$ and (log P_{dt} – log $P_{dt-1})_-$ were added to eq. (7.2)′ to determine whether the equation overpredicts during contractions and underpredicts during expansions. These two variables were described in § 5.3. Briefly, log P_{dt} is the residual from the regression of log Y_{dt} on twelve seasonal dummy variables and time, and the notation (log P_{dt} – log $P_{dt-1})_+$, for example, indicates that this variable was set equal to log P_{dt} – log P_{dt-1} when the latter was positive and set equal to zero otherwise.

In table 7.4 the results of adding (log P_{dt} – log $P_{dt-1})_+$ and (log P_{dt} – log $P_{dt-1})_-$ to eq. (7.2)′ are presented. The coefficients of these two variables are denoted as α_4 and α_5 respectively, and estimates of α_4 and α_5 are presented in table 7.4 along with the estimate of the coefficient γ_0 of log Y_{dt} – log Y_{dt-1}. The estimates of α_4 and α_5 are expected to be negative if in fact eq. (7.2)′ underpredicts during expansions and overpredicts during contractions.

TABLE 7.4

Parameter estimates for eq. (7.2)′ with the additional terms $\alpha_4(\log P_{dt}-\log P_{dt-1})_+$ and $\alpha_5(\log P_{dt}-\log P_{dt-1})_-$. Estimates presented for γ_0, α_4, and α_5 only

Industry	No. of obs.	$\hat{\gamma}_0$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	SE	DW
201	192	.270	−.058	.009	.0145	2.35
		(6.86)	(0.99)	(0.18)		
207	136	.091	.066	−.003	.0115	2.23
		(9.90)	(2.29)	(0.09)		
211	136	.334	.210	.359	.0331	1.89
		(4.29)	(1.42)	(2.68)		
212	136	.241	−.072	.080	.0232	2.13
		(5.41)	(0.88)	(1.22)		
231	136	.201	.029	−.045	.0201	2.31
		(4.38)	(0.48)	(0.94)		
232	136	.132	−.004	−.011	.0146	1.87
		(5.63)	(0.10)	(0.34)		
233	136	.120	−.080	−.010	.0256	2.16
		(4.12)	(1.35)	(0.18)		
242	154	.091	.052	.096	.0152	2.15
		(3.57)	(0.88)	(1.72)		
271	166	.079	−.031	.072	.0051	1.84
		(4.13)	(0.73)	(1.31)		
301	134	−.033	.292	.300	.0212	2.17
		(0.71)	(3.47)	(3.66)		
311	170	.004	.166	.123	.0094	2.19
		(0.12)	(3.26)	(2.55)		
314	136	.418	−.032	.015	.0170	1.84
		(10.67)	(0.34)	(0.19)		
324	187	.041	.010	.001	.0089	2.32
		(6.34)	(0.42)	(0.04)		
331	128	.157	−.008	.087	.0138	2.44
		(3.53)	(0.16)	(1.21)		
332	170	.023	.149	.100	.0129	2.44
		(0.61)	(3.22)	(1.96)		
336	170	.017	.062	.116	.0108	2.29
		(0.71)	(1.54)	(3.07)		
341	191	.102	−.007	−.024	.0159	1.93
		(10.90)	(0.27)	(1.15)		

t-statistics are in parentheses.

The estimate of α_4 is negative for only seven industries, and the estimate of α_5 is negative for only six industries. In none of these twelve cases is the estimate significant. Of the ten industries where the estimate of α_4 is positive, it is significant for four of them, and of the eleven industries where the estimate of α_5 is positive, it is significant for four of them. For industries 301, 311, 332, and 336 the estimate of γ_0 has decreased in size from that in table 7.2 and is no longer significant. For all four of these industries the estimates of α_4 and α_5 are positive and, except in two cases, significant. For these industries the introduction of the "cyclical" variables $(\log P_{dt} - \log P_{dt-1})_+$ and $(\log P_{dt} - \log P_{dt-1})_-$ has considerably reduced the influence of the current change in output variable, $\log Y_{dt} - \log Y_{dt-1}$.

The results indicate, then, that for at least four of the industries the behavior of firms with respect to short-run changes in the number of hours paid-for per worker is different during contractions and expansions than predicted by eq. (7.2), but in the opposite direction than that suggested above, i.e., for these industries the number of hours paid-for per worker appears to decrease more or increase less during contractions than predicted and conversely during expansions. The results also indicate, however, that for the majority of the industries there does not appear to be any difference in predicted behavior during the two periods.

In another test of the hypothesis that firms behave differently during contractions than predicted, the dummy variable D_t was added to eq. (7.2)′. The construction of D_t was described in § 5.3; it was set equal to one during the NBER defined contractions (NBER peak to trough) and zero otherwise. The results of adding D_t to eq. (7.2)′ are presented in table 7.5. The coefficient of D_t is denoted as α_6, and the estimate of α_6 is presented in table 7.5 for each industry along with the estimate of γ_0. The estimate of α_6 is expected to be positive if firms do in fact decrease hours paid-for per worker less or increase them more during contractions than eq. (7.2)′ predicts they should.

The estimate of α_6 is not positive for any industry; it is zero for one industry and negative for the other sixteen. Of the sixteen industries for which it is negative, it is significant for three of them – 207, 332, and 336. For all of the industries the effect on the standard error is small. These results indicate that, if anything, hours paid-for per worker decrease more or increase less during contractions than predicted, rather than the opposite, but generally the results seems to indicate that firms do not behave differently than predicted during the NBER defined contractions.

As was the case for workers, these two tests give no indication that firms "hoard" hours paid-for per worker during contractions or "dis-hoard"

TABLE 7.5

Parameter estimates for eq. (7.2)′ with the additional term $\alpha_6 D_t$. Estimates presented for γ_0 and α_6 only

Industry	No. of obs.	$\hat{\gamma}_0$	$\hat{\alpha}_6$	SE	DW
201	192	.242	−.004	.0145	2.30
		(7.43)	(1.58)		
207	136	.100	−.007	.0114	2.15
		(10.82)	(2.63)		
211	136	.501	−.006	.0341	1.91
		(8.85)	(0.72)		
212	136	.232	−.002	.0233	2.14
		(7.90)	(0.37)		
231	136	.189	−.008	.0199	2.32
		(5.77)	(1.58)		
232	136	.124	−.002	.0146	1.88
		(7.19)	(0.54)		
233	136	.093	−.012	.0253	2.13
		(4.47)	(1.96)		
242	154	.123	−.001	.0154	2.20
		(6.18)	(0.24)		
271	166	.083	.000	.0051	1.83
		(4.32)	(0.39)		
301	134	.136	−.008	.0232	1.87
		(3.90)	(1.23)		
311	170	.114	−.003	.0097	2.05
		(5.55)	(1.68)		
314	136	.412	−.004	.0169	1.84
		(11.20)	(0.95)		
324	187	.042	−.002	.0088	2.34
		(7.41)	(0.94)		
331	128	.181	−.004	.0137	2.43
		(7.61)	(0.94)		
332	170	.105	−.010	.0130	2.40
		(5.79)	(2.97)		
336	170	.069	−.006	.0109	2.29
		(4.62)	(2.24)		
341	191	.095	−.005	.0158	1.96
		(13.08)	(1.62)		

t-statistics are in parentheses.

them during expansions in the sense of eq. (7.2)′ overpredicting during contractions and underpredicting during expansions. If anything, the opposite appears to be true for a few industries, butf or most industries there is little evidence that firms behave differently than predicted during expansions or contractions. The crudeness of these tests should again be emphasized, however.

7.5 Summary

The major conclusion of this chapter is that many of the same factors which influence the change in the number of workers employed also influence the change in the number of hours paid-for per worker. An equation similar to eq. (3.9) for workers was developed for hours paid-for per worker in which the change in the number of hours paid-for per worker was taken to be a function of the amount of excess labor on hand, the amount by which HP_{2wt-1} differs from the standard number of hours of work per worker, the time stream of expected future changes in output, and the condition of the labor market as measured by the unemployment rate. Firms were assumed because of worker morale problems and other possible adjustment costs to view fluctuations in the number of hours paid-for per worker in a similar manner as they view fluctuations in the number of workers employed. The unemployment rate variable was added to the equation on the hypothesis that in tight labor markets an added inducement to keep workers from looking for other jobs is to keep the number of hours paid-for per worker high while in loose labor markets less of this kind of inducement is needed.

The results presented in table 7.2 appear to be an important confirmation of the model. All of the factors listed above appear to be significant. The fact that the excess labor variable is highly significant in table 7.2 is especially important in that it adds support to the results presented in ch. 4 which indicate that the amount of excess labor on hand has a significant influence on a firm's employment behavior. The fact that the unemployment rate is significant in table 7.2 for most of the industries indicates that labor market conditions have more of an effect on the short-run demand for hours paid-for per worker than on the short-run demand for workers.

Two further tests were performed on eq. (7.2)′. The equation was tested to see if the behavior of $\log HP_{2wt} - \log HP_{2wt-1}$ is different when it equals $\log H_{2wt} - \log H_{2wt-1}$ than otherwise. This does not appear to be the case, although the test was quite crude since it was not clear whether $\log HP_{2wt} - \log HP_{2wt-1}$ was equal to $\log H_{2wt} - \log H_{2wt-1}$ enough times to insure an adequate test. Eq. (7.2)′ was also tested to see whether it overpredicts during contractions and underpredicts during expansions, and the results indicated that this is not the case. For a few industries the equation appeared to underpredict in contractions and overpredict in expansions, which is contrary to the hypothesis that firms "hoard" hours paid-for per worker in contractions and "dis-hoard" them in expansions. The evidence was not strong that this is in general true, however, although again these two tests were rather crude.

This concludes the discussion of the model of the short-run demand for hours paid-for per worker. In the next chapter a comparison of the results achieved in this chapter and the results achieved for workers in chs. 4 and 5 is made, and the short-run demand for total man-hours paid-for is discussed.