CHAPTER 11

SUMMARY AND CONCLUSIONS

11.1 Summary

One of the objectives of this study was to provide an explanation of the widely observed phenomenon of increasing returns to labor services or of increasing short-run returns to scale. It was seen in ch. 2 that the basic model of previous studies, which is based on the postulation of a short-run production function and a lagged adjustment process, yielded unrealistically large estimates of the production function parameter α of the labor input variable. These results achieved in ch. 2 using seasonally unadjusted monthly data for the seventeen three-digit United States manufacturing industries considered in this study were not unique to the type of data used; the same kinds of results have also been achieved in previous studies using seasonally adjusted quarterly data for more aggregated industry groups. Previous studies which have not developed a model of short-run employment demand but have examined the short-run relationship between output and output per man hour directly have found the relationship to be positive in almost all cases. Further results presented in ch. 3 showed that the short-run relationship between output and output per man hour was positive in most cases even at high rates of output, where presumably there should be very little slack. All of these findings appear to be inconsistent with the law of diminishing marginal productivity of classical economic theory.

The explanation of these results which was given in this study is based on the idea that firms hold positive amounts of "excess labor" during much of the year and that the true production function inputs are not observed. It was contended that the observed number of hours paid-for per worker is a poor proxy for the unobserved number of hours actually worked per worker except perhaps at peak rates of output. If this is true, then the properties of the short-run production function cannot be estimated from the available data, and the estimates obtained in previous studies and the estimates obtained in ch. 2 should not be interpreted as estimates of production function parameters.

Another objective of this study was to develop a model of the short-run

demand for the number of workers employed. The model was based on the idea that firms do hold both positive and negative amounts of excess labor during much of the year, and the demand for workers was assumed to be a function of the amount of excess labor on hand and of expected future output changes. The model was not derived from the minimization of a short-run cost function, but it did rely heavily on the idea that there are serious costs involved (including such things as worker morale problems) in changing the size of the work force in the short run. There have been many reasons put forth as to why these adjustment costs are likely to be large, some of which were listed in § 3.4. In the model developed here the firm was conceived as attempting to smooth the fluctuations in its work force relative to fluctuations in output under the constraint that holding either positive or negative amounts of excess labor is costly.

Before the model could be estimated and tested, the amount of excess labor on hand had to be measured, and assumptions about how expectations are formed had to be made. Much of ch. 3 was concerned with these two points. The amount of excess labor on hand was defined to be the (logarithmic) difference between the actual number of workers employed and the desired number, where the desired number of workers employed was assumed to be equal to total man-hour requirements divided by the standard number of hours of work per worker. In order to get an estimate of man-hour requirements, assumptions about the properties of the short-run production function had to be made, since the properties could not be estimated because the appropriate data were not available. The short-run production process was assumed to be of such a nature that a fixed number of workers is required per machine and that there are constant returns to scale both with respect to changes in the number of workers and machines used and with respect to changes in the number of hours worked per worker and machine. In other words, the short-run production function was assumed to be one of fixed proportions.

Using these assumptions, estimates of man-hour requirements were made by interpolating plots of output per paid-for man hour from peak to next higher peak, assuming that at the peaks output per paid-for man hour equals output per worked man hour so that an estimate of the production function parameter α of the labor input variable is available at each of the peaks, assuming that α moves smoothly through time from peak to peak, and then using the estimates of α and the data on output to compute estimates of man-hour requirements. Assuming that the standard number of hours of work per worker is a smoothly trending variable, estimates of the desired

number of workers employed were then available, and so from these estimates and the data on the number of workers employed, estimates of the amount of excess labor on hand were available. It was shown in ch. 3 that the logarithmic difference between the number of workers employed and the desired number is equal to the logarithmic difference between the standard number of hours of work per worker and the actual number of hours worked per worker. The amount of excess labor on hand can thus be looked upon in two different ways. No direct verification of the accuracy of the estimates of the amount of excess labor on hand could be made, and only the indirect verification of how well the over-all model performs was available.

With respect to the assumptions about how expectations are formed, two basic expectational hypotheses were proposed and tested. One of the hypotheses was that expectations are perfect, that firms are quite accurate in forecasting the amount of output they are going to produce over the next few months. The other hypothesis was that firms expect output in a future month to be what output was during the same month of the previous year, adjusted by a factor to take into account whether output has been increasing or decreasing in the current year relative to the previous year. Again, no direct verification of these hypotheses was available, but only how well each of them does when used in the estimation of the over-all model.

The results of estimating the model using the estimates of the amount of excess labor on hand under the different expectational hypotheses were presented in ch. 4. The model was estimated using seasonally unadjusted monthly data for seventeen three-digit United States manufacturing industries. There are strong reasons for using seasonally unadjusted data when estimating models which are based either directly or indirectly on a production function, and the use of monthly as opposed to quarterly data has obvious advantages in a study of short-run behavior. Likewise, the use of three-digit industry data should lessen the problems of aggregating vastly dissimilar firms. The results presented in ch. 4 appeared to be an important confirmation of the model. The results indicated rather strongly that both the amount of excess labor on hand and the time stream of expected future output changes are significant determinants of the short-run demand for workers, and the model produced substantially better fits than did the basic model of previous studies. The excess labor variable definitely appeared to be significant in its own right and not merely because it is of the nature of a lagged dependent variable. With respect to the expecta-

tional hypotheses, the perfect expectational hypothesis gave somewhat better over-all results than did the hypothesis which assumed perfect expectations for the current level of output but non-perfect expectations for the future levels of output. The latter gave slightly better results for six of the fourteen industries where future output expectations were significant, however, and it was chosen to be used for these industries.

In ch. 5 various hypotheses regarding the short-run demand for workers were developed and tested, and for the most part they were rejected. Briefly, the previous level of hours paid-for per worker did not appear to be a significant determinant of the short-run demand for workers, which was as expected; the behavior of firms did not appear to be different during general contractionary periods of output or during general expansionary periods of output from what the model predicted it should be; the reaction of firms to the amount of excess labor on hand appeared to be adequately specified in the model, as tests of more complicated reaction behavior did not yield significant results; and the behavior of firms did not appear to be different, other things being equal, at high rates of output than otherwise. The one hypothesis which had some evidence in its favor was the hypothesis that in tight labor markets fluctuations in the number of workers employed are damped and that in loose labor markets the fluctuations are increased, although the evidence on this score was not strong.

In ch. 6 the question of whether production decisions should be assumed to be exogenous in a study of short-run employment behavior was examined. The Holt, Modigliani, Muth, and Simon (HMMS) model, which treated sales instead of production as exogenous and which was based on the minimization of a short-run cost function, was introduced, and it was seen to be based on an unrealistic approximation to overtime costs. An alternative model to the one developed in ch. 3 was developed which incorporated the HMMS idea that sales rather than production should be treated as exogenous but avoided their overtime cost approximation. These models were estimated using data on shipments and inventories for four of the seventeen industries, and the alternative model developed in ch. 6 produced better results than the HMMS model, as expected, but neither of the models produced results as good as the results achieved using the model developed in ch. 3 in which production was assumed to be exogenous. Similar results were also achieved using Bureau of Census data. The major conclusion of ch. 6 was thus that models which specify a one-way causality from decisions on production to decisions on employment appear to be more realistic than models which assume that production and employment decisions are made simultaneously.

In ch. 7 a model of the short-run demand for the number of hours paid-for per worker was developed and estimated. Because of the properties assumed about the short-run production function, once the change in the number of workers employed has been determined, the change in the number of hours worked per worker is automatically determined. This, however, does not mean that the change in the number of hours paid-for per worker is then determined as well. The model of the short-run demand for hours paid-for per worker was based on the idea that with respect to such things as worker morale problems 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 and thus that many of the same factors which influence the short-run demand for workers are also likely to influence the short-run demand for the number of hours paid-for per worker. Reasons were also advanced as to why the difference between the number of hours paid-for per worker and the standard number of hours of work per worker is likely to be a significant factor in determining the short-run demand for hours paid-for per worker, and why the condition of the labor market is likely to be a significant factor as well.

The short-run demand for the number of hours paid-for per worker was thus taken to be a function of the amount of excess labor on hand, the time stream of expected future output changes, the difference between the past level of hours paid-for per worker and the standard number of hours of work per worker, and the degree of labor market tightness as measured by the unemployment rate. The unemployment rate variable was added 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 of estimating the model were quite good. The amount of excess labor on hand definitely appeared to be a significant determinant of the short-run demand for hours paid-for per worker, as did the amount by which the past level of hours paid-for per worker differs from the standard number of hours of work per worker. The current output change variable was highly significant, as in many cases were the expected future output change variables, and the unemployment rate variable appeared to be significant as well. Two further hypotheses regarding the short-run demand for hours paid-for per worker were developed and tested, and neither one appeared to be confirmed. The change in the number of hours paid-for per worker did not appear to be different than the model predicted it should

be when it also equaled or nearly equaled the change in the number of hours worked per worker, and it did not appear to be different during general expansionary periods of output or during general contractionary periods of output than the model predicted it should be

Comparing the demand for workers and the demand for hours paid-for per worker in ch. 8, it was seen that the reaction of firms to the amount of excess labor on hand (with respect to changing the number of workers employed) is smaller than the reaction of firms to the amount by which the level of hours paid-for per worker differs from the standard number of hours of work per worker (with respect to changing the number of hours paid-for per worker). It was also seen that expected future changes in output are more significant in determining the short-run demand for workers than in determining the short-run demand for hours paid-for per worker, which was as expected.

The equation determining the change in total man hours paid-for can be derived by adding the equations determining the change in the number of workers employed and the change in the number of hours paid-for per worker, and the results of adding the two estimated equations together were presented in ch. 8. It was seen from these results that firms react more strongly in changing total man hours paid-for when the number of hours paid-for per worker differs from the standard number of hours of work per worker than when the number of workers employed differs from the desired number of workers employed. This was seen to mean that the reaction of firms to the amount of "excess man hours" on hand (man hours paid-for less man-hour requirements) depends on how the amount is distributed between the amount of excess labor on hand and the amount by which the number of hours paid-for per worker differs from the standard number of hours of work per worker.

The economy-wide implications of the results achieved in this study were described in § 8.4, and since this was a summary in itself, it will not be summarized further. The implications for what should happen during economy-wide contractions and expansions did appear to be consistent with the results obtained by Hultgren and others.

In ch. 9 some further statistical results were presented. The workers equation and the hours paid-for per worker equation were examined for first-order serial correlation of the residuals. There was no evidence that the residuals of the workers equation were serially correlated, but there was some evidence that for a few industries the residuals of the hours paid-for per worker were serially correlated, with negative first-order serial correlation

being more pronounced than positive serial correlation. None of the conclusions reached in chs. 7 and 8 regarding the hours paid-for per worker equation or the total man-hours paid-for equation was modified for these industries, however, and for the majority of the industries serial correlation did not appear to be a problem for the hours paid-for per worker equation either.

The possible correlation of the residuals of the workers equation with those of the hours paid-for per worker equation for each industry was examined in ch. 9, as well as the possible correlation of the residuals of the workers or hours equation of one industry with those of the workers or hours equation of another industry. These correlations were positive, as expected, and in an attempt to achieve more efficient estimates, the equations were estimated using the two-stage Aitken estimator developed by Zellner. There was very little gain in efficiency when the Zellner technique was used to estimate the workers and hours equations together for each industry, which was as expected since the number of different independent variables in the two equations was small. The gain in efficiency appeared to be greater when the technique was used to estimate the equations of different industries together, although even here the gain was not substantial. None of the conclusions reached in earlier chapters needed modification from the results achieved using the two-stage Aitken estimator.

Finally in ch. 9 a comparison of the short-run demand for workers across industries was made using the estimates presented in table 4.3 as a starting point. The size of an industry's employment reaction to current output changes appeared to be inversely related to the amount of specific training required in the industry, but it did not appear to be related to the degree of union pressure in the industry nor to the average wage level in the industry. All of the results were based on small samples, however, and not too much reliance should be put on the conclusions.

Short-run fluctuations in the number of non-production workers employed are quite small, but in ch. 10 a model similar to the model developed for production workers was developed for non-production workers to see if the small short-run fluctuations in the number of non-production workers employed could be explained by any of the same factors which explain fluctuations in the number of production workers employed. The short-run demand for non-production workers was assumed to a function of the amount of excess non-production labor on hand and of expected future changes in output. The empirical results suggested that the amount of excess non-production labor on hand is a significant determinant of the

change in the number of non-production workers employed and that the current and expected future changes in output in some industries are significant as well. The change in the number of non-production workers employed was only marginally influenced by these factors, however, and for most industries only a small percentage of the variance of this series was explained.

11.2 Concluding remarks

In conclusion, it should be emphasized that in this study an attempt was made to *explain* the short-run fluctuations in the number of workers employed and the number of hours paid-for per worker and to *explain* how the number of workers employed, the number of hours paid-for per worker, and the number of hours worked per worker are related to each other in the short run, but that no attempt was made to develop a model which was capable of *predicting* these variables *ex ante*. In order to use the model of the short-run demand for workers developed in this study for prediction purposes, for example, it would be necessary to know the expected future changes in output in advance, and at least for those industries in which expectations appear to be quite accurate (and not based merely on past output behavior) this would require knowledge of the industry which an economic forecaster (as opposed to an individual manager in the industry) does not have at his disposal. Also, in this study an effort was made to use as disaggregate and homogeneous a body of data as possible to lessen the problems of aggregating vastly dissimilar firms, but to forecast aggregate employment from the three-digit industry level would be a tremendous task, even if all of the necessary data were available. For forecasting aggregate employment more aggregated data would have to be used.

Nevertheless, if the model developed in this study can be taken to be a valid representation of the structure of the employment sector of the economy with respect to short-run fluctuations in the number of workers employed and the number of hours paid-for per worker, then the information contained in this model should be of considerable use to someone attempting to develop an aggregate forecasting model of the employment sector of the economy. It was seen in § 8.4, for example, that the model developed in this study provides an explanation of the relationship between seasonally adjusted output and seasonally adjusted output per paid-for man hour which has been observed by Hultgren and others during economy-wide contractions and expansions.