

# Interpreting Gaps in Manpower Forecasting Models

---

**Lex Borghans – Ed Willems**

*Abstract.* In manpower forecasting labour market developments are analysed in terms of shortages and surpluses. Such an approach seems to neglect the flexibility of the labour market, present in most economic labour market models. It is shown that an appropriate interpretation of gaps in manpower forecasting does not exclude a full functioning of the market clearing mechanism.

## 1. Introduction

Since the 1960s economic theory has emphasised the role of education as a factor of economic growth (Schultz, 1961; Becker, 1962). Even before this in many countries analyses have been made of the future need for educated labour, to guide policies which aim to advance economic development. These so-called manpower forecasts, of which the most well-known has been the manpower requirement approach adopted in the Mediterranean Regional Project (Parnes, 1962), are often based upon the insight that for an optimal economic development not one specific type of education has to be stimulated, but that there exists a certain optimal mixture of types of education, which complement each other (see e.g. Tinbergen, 1975). This led to the practice to make forecasts of demand and supply for each educational category separately and treat the gaps between supply and demand as a guide line for educational planning (see e.g. Blaug, 1967).

The manpower requirement approach has been criticised very often. Most criticism was posed against the fact that the manpower

---

Research Centre for Education and the Labour Market, Maastricht University,  
P.O. Box 616, NL-6200 MD Maastricht, The Netherlands.

Approved by the Editorial Board on July 23, 1998.

LABOUR 12 (4) 633–641 (1998)

JEL

© Fondazione Giacomo Brodolini and Blackwell Publishers Ltd 1998, 108 Cowley Road, Oxford OX4 1JF, UK and  
350 Main Street, Malden, MA 02148, USA.

planning approach neglects the possibility of substitution between different types of educated labour. If there is a surplus for one type of labour and a shortage for another, substitution processes will occur moving people with a certain educational background to other occupations than initially might be expected. Such adjustment processes limit the extent of mismatch-unemployment (see Bean, 1991), but also, as argued, falsify the basic assumption of the manpower planning approach. Blaug (1967) claimed that implicitly the approach is based on a Leontief production function, which is too inflexible to be able to describe labour market developments adequately.

Moreover, since the 1960s the belief that it is desirable and useful to plan educational investments disappeared. On the one hand doubts have risen about the possibilities to make forecasts which are adequate enough to base the whole educational planning upon it. On the other hand there were doubts about the ability of governments to regulate the educational market according to these plans. In many western countries the government simply lacks the instruments to enforce its educational plans completely. Furthermore, more and more emphasis has been put upon the free functioning of markets. By always intervening, markets are not able anymore to reveal the value of certain types of educated labour, which in the long run hampers the further planning process.

Despite these developments, policy makers continue to analyse the relationship between education and the labour market in terms of shortages and surpluses. This persistence in using manpower planning methods might of course indicate the naiveté of policy makers, but might also indicate that even in a context of flexible labour markets manpower planning is still a useful approach. In this paper we will argue that indeed the gap between supply and demand provides useful information. We show that in a labour market model which is completely cleared by wages, manpower forecasts provide important information about future developments on this market.

The organisation of this short paper is as follows. In Section 2 we argue that while for educational planning information on required quantities of labour is needed, a policy of providing information to improve the market mechanism needs information about the development of the wages. A simple labour market model is introduced in Section 3. For this model we show in Section 4 that the traditional manpower requirement forecast – in which wage developments are neglected – provides a useful indicator to predict changes in the wages. Based on some empirical studies, an empirical

impression of the link between gaps among supply and demand and expected wage adjustments is given.

## **2. The use of information**

Since educational planning itself is not used as a policy instrument any more, the use of forecasting future developments at the labour market has changed. Instead of the need to know the required amount of educated labour to guarantee an optimal economic development by means of planning, governments nowadays have to restrict themselves to two tasks. Firstly, by anticipating future changes at the labour market, governments can inform students about the prospects of a certain educational choice. This policy of providing information for educational guidance improves the functioning of the market mechanism, since students are better able to adjust their human capital investment decisions to the labour market development (see Borghans, 1993). Secondly, if the educational choice is regulated by a free market, the governments have to be informed about the directions of these developments. Such information enables them to anticipate to these developments so that appropriate investments in the educational infrastructure can be made. Moreover, the information enables governments to influence these developments if they do not fit into other governmental policy aims.

Both purposes of insight in future labour market developments require different information. In a situation in which the market is completely cleared by wages, the wage is the most important information for individual educational decisions. Total quantities of supply or demand will not be very useful for individuals. For government policies information should, however, in the first place be devoted to the developments of the quantities on the labour market.

## **3. A labour market model**

Consider the following simple model as a description of the labour market for a certain type of education:

$$D_t = C_t^d - \beta_d W_t \quad (1)$$

$$S_t = C_t^s + \beta_s W_t \quad (2)$$

$$D_t^{eq} = S_t^{eq}. \quad (3)$$

Equations (1) and (2) describe linear supply and demand curves, in which both supply and demand are regulated by the wage  $W_t$ .  $C_t^d$  and  $C_t^s$  can be viewed upon as respectively demand and supply at a zero wage. It is assumed that the market is always in equilibrium, i.e. the wage is chosen such that equation (3), the equilibrium condition, holds. It follows directly from this model that:

$$W_t^{eq} = \frac{C_t^d - C_t^s}{\beta_s + \beta_d} C_t^d \quad (4)$$

and:

$$D_t^{eq} = S_t^{eq} = \frac{\beta_d}{\beta_s + \beta_d} C_t^s + \frac{\beta_s}{\beta_s + \beta_d} C_t^d. \quad (5)$$

This implies that the equilibrium wage is proportional to the difference between demand and supply at zero wage, while the equilibrium quantity ( $D_t^{eq}$  or  $S_t^{eq}$ ) can be viewed upon as a weighted average of the zero-wage supply and demand.

#### 4. Manpower forecasting

In the introduction the manpower requirement approach has been characterised as a forecast method which neglects adjustment and substitution processes at the labour market. In this section it is taken into account what value a forecast which neglects the functioning of the wage mechanism might have for the purposes of educational policy nowadays. The assumption is made that in year  $t-1$  a forecast is made of the labour market situation in year  $t$ . Neglecting the fact that the wage might change ( $W_t = W_{t-1}^{eq}$ ), demand is forecasted as:

$$\begin{aligned} \hat{D}_t &= C_t^d - \beta_d W_{t-1}^{eq} \\ &= C_t^d - \beta_d \frac{C_{t-1}^d - C_{t-1}^s}{\beta_s + \beta_d} \end{aligned} \quad (6)$$

while supply is forecasted as:

$$\hat{S}_t = C_t^s + \beta_s \frac{C_{t-1}^d - C_{t-1}^s}{\beta_s + \beta_d}. \quad (7)$$

In general  $\hat{S}_t$  will not equal  $\hat{D}_t$ . Only if  $C_{t-1}^d - C_{t-1}^s = C_t^d - C_t^s$  this identity holds.

The demand forecasts are usually based upon calculation of the effects that changes in the industrial structure will have. Normally it is assumed that a growth of a certain industry will lead to proportional growths of the demand for each educational type within this industry (the fixed coefficient model, see e.g. BLS, 1992). In more sophisticated manpower models also other variables are incorporated (see e.g. Beekman *et al.*, 1991). However, the starting point is always the employment structure of the past, while demand and supply are forecasted separately, neglecting interactions between both as described in the labour market model (1)–(3). Exogenous changes are incorporated, but wages are kept constant. Supply forecasts are often based upon trends in educational outflow and trends in withdrawals from the labour market, also assuming constant wages.

If the labour market model (1)–(3) describes the actual adjustment process adequately the gap between demand and supply, based on the manpower forecasts:

$$G_t = \hat{D}_t - \hat{S}_t \tag{8}$$

can not exist. If  $G_t > 0$  it is said that demand is larger than supply or that there is a labour market shortage, and v.v. If  $G_t < 0$  there is said to be a surplus of labour. Actually, however, in these cases wages will go down if  $G_t < 0$  and will go up if  $G_t > 0$ . This change in wages appears to be proportional to the gap between demand and supply:

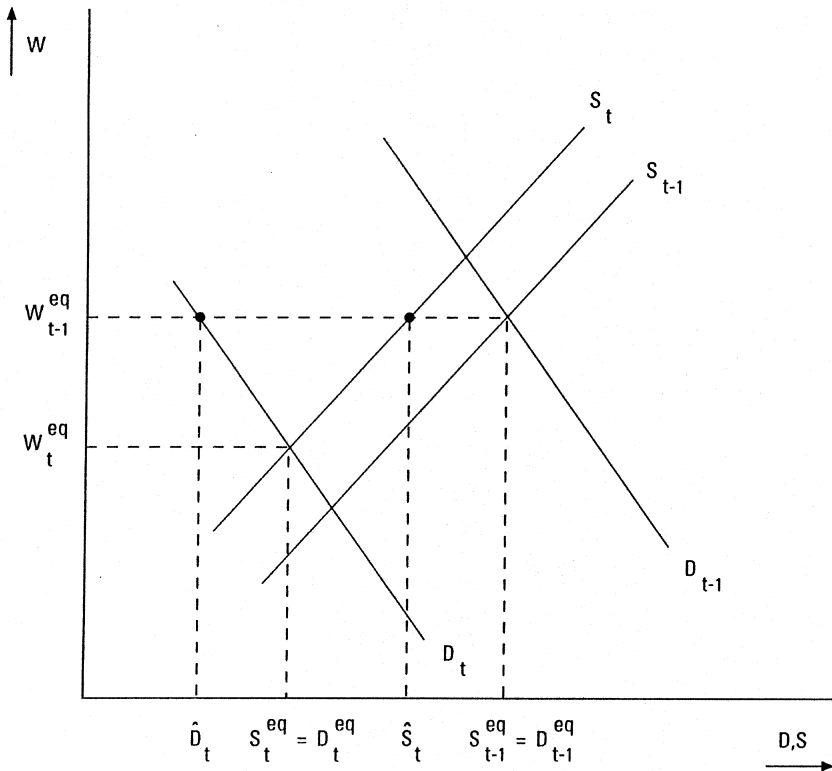
$$\begin{aligned} W_t^{req} - W_{t-1}^{req} &= \frac{C_t^d - C_t^s}{\beta_s + \beta_d} - \frac{C_{t-1}^d - C_{t-1}^s}{\beta_s + \beta_d} \\ &= \frac{G_t}{\beta_s + \beta_d}. \end{aligned} \tag{9}$$

Figure 1 illustrates this relationship. In this figure both the supply and the demand curve shifted from  $t-1$  to  $t$ . Based on the equilibrium wage of year  $t-1$  supply ( $\hat{S}_t$ ) and demand ( $\hat{D}_t$ ) have been forecasted. This leads to a gap,  $G_t$ . This gap indicates in the quantity dimension however the wage adjustment  $W_t^{req} - W_{t-1}^{req}$  that has to take place to clear the market again.

This implies that although taken literally within the context of a model in which the wage clears the market ‘surpluses’ and ‘shortages’ make no sense, they are a good indicator of changes in

wages. Paradoxically, an indicator which is formulated in quantities of labour provides information about the other dimensions of the model, the wages. For that reason the gap between demand and supply is suited in the first place for the first policy target mentioned above, the provision of information to students who have to make their educational choice. The only unknown aspect in (9) concerns the elasticities of supply and demand. The sum of these elasticities determines the influence the gap might have on wage development. Table 1 provides estimates of these elasticities, taken from various empirical studies. The table shows that there is a wide variety in this sum of elasticities. The factor varies from 0.75 to 13.0, which means that the effect of the ex ante gap on the wage adjustments necessary varies enormously between the samples distinguished.

**Figure 1.** The relationship between gaps between supply and demand in manpower forecasts and wage adjustments



**Table 1.** Estimates of the elasticity of supply and demand for higher education in response to wages

Study	Sample	$\beta_s$	$\beta_d$	$\beta_s + \beta_d$	$\frac{\beta_s}{\beta_s + \beta_d}$
Freeman (1971)	US, engineers	3.0	10.0	13.0	0.23
Freeman (1975a)	US, lawyers	2.25	10.0	12.25	0.18
Freeman (1975b)	US, physics	1.05 to 3.64	7.14 to 3.85	4.90 to 10.78	0.21 to 0.41
Scott (1979)	US, PhD economists	0.89	4.38	5.27	0.17
Hansen <i>et al.</i> (1980)	US, economists	0.73	0.087 to 0.015	0.745 to 0.817	0.89 to 0.98
Huffman and Orazem (1985)	US, agricultural economists	0.43 to 0.48	0.65 to 0.59	1.02 to 1.13	0.72 to 0.74

A change in wage will however also imply that actual demand will adjust to the new situation. It can be shown that the difference between actual and predicted supply equals:

$$S_t^{eq} - \hat{S}_t = C_t^s + \beta_s \frac{C_t^d - C_t^s}{\beta_s + \beta_d} - C_t^s - \beta_s \frac{C_{t-1}^d - C_{t-1}^s}{\beta_s + \beta_d}$$

$$= \frac{\beta_s}{\beta_s + \beta_d} G_t. \quad (10)$$

It provides the distance of the supply forecast from equilibrium. In general the actual change in quantities is smaller than the gap between demand and supply itself. The factor  $\beta_s/(\beta_s + \beta_d)$  which relates the distance from equilibrium with the gap varies less than the factor in the wage equation. Table 1 shows that it varies from 0.17 to 0.98. Neglecting the two outlier studies, this decreases to a variation from 0.17 to 0.41. These figures provide a useful indication of the expected employment changes due to adjustment processes even without additional information of the exact elasticities for the type of education under consideration.

To illustrate the adjustment processes it is interesting to write (10) as follows:

$$D_t^{eq} = S_t^{eq} = \frac{\beta_d}{\beta_s + \beta_d} \hat{S}_t + \frac{\beta_s}{\beta_s + \beta_d} \hat{D}_t. \quad (11)$$

This equation shows that after market adjustments, the new equilibrium can be viewed upon as a weighted average between the manpower forecasts of supply and demand. The figures presented above indicate that the weight for supply is larger than the weight for demand, which implies that supply has a larger contribution to adjustment than demand.

## 5. Conclusions

It is often argued that making manpower forecasts is not useful, because the models used neglect the market clearance by means of the wages. This paper has indicated how the gap between forecasted demand and supply has to be interpreted. It is shown that by incorporating the elasticities of demand and supply into the model

the gap can be viewed upon as the 'distance to the equilibrium'. This implies that the most important criticism on the theory of manpower forecasting does not hold, as with a minor adaptation of the interpretation of the results the market mechanism can be included on the model, which makes that the model outcomes, are informative for public policy.

## References

- Bean, C. R. (1991) 'European Unemployment: A Survey', *Journal of Economic Literature* 32, 573–629.
- Becker, G. S. (1962) 'Investment in Human Capital: A Theoretical Analysis', *Journal of Political Economy* 70, 9–49.
- Beekman, T. B. J., Dekker, R. J. P., de Grip, A. and Heijke, J. A. M. (1991) 'An Explanation of the Educational Structure of Occupations', *Labour* 5, 151–163.
- Blaug, M. (1967) 'Approaches to Educational Planning', *The Economic Journal* 76, 262–287.
- Borghans, L. (1993) 'Educational Choice and Labour Market Information', dissertation, Research Centre for Education and the Labour Market, Maastricht.
- Bureau of Labor Statistics (1992) 'Outlook 1990–2005', Bulletin 2402, Government Printing Office, Washington D.C.
- Freeman, R. B. (1971) 'The Market for College-Trained Manpower: A Study in the Economics of Career Choice', Harvard University Press, Cambridge (Mass.).
- Freeman, R. B. (1975a) 'Legal "Cobwebs", A Recursive Model of the Market for New Lawyers', *Review of Economics and Statistics* 57, 171–179.
- Freeman, R. B. (1975b) 'Supply and Salary Adjustments to the Changing Science Manpower Market, Physics 1948–1973', *American Economic Review* 65, 27–39.
- Hansen, W. L., Newburger, H. B., Schroeder, F. J., Stapleton, D. C. and YoungDay, D. J. (1980) 'Forecasting the Market for New PhD Economists', *American Economic Review* 70, 49–63.
- Huffman, W. E. and Orazem, P. (1985) 'An Econometric Model of the Market for New PhD's in Agricultural Economics in the United States', *American Journal of Agricultural Economics* 67, 1207–1214.
- Parnes, H. S. (1962) 'Forecasting Educational Needs for Economic and Social Development', OECD, Paris.
- Schultz, T. W. (1961) 'Investment in Human Capital', *American Economic Review* 51, 1–17.
- Scott, C. E. (1979) 'The Market for PhD Economists: The Academic Sector', *American Economic Review* 69, 137–143.
- Tinbergen, J. (1975) 'Income Distribution, Analysis and Policies', North-Holland, Amsterdam.