A VINTAGE MODEL
OF GROWTH, EMPLOYMENT AND INFLATION**

BY

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1 INTRODUCTION

In theoretical literature important macro-economic phenomena such as growth, unemployment and inflation are nearly always simultaneously investigated by assuming the stock of capital to be homogeneous. This applies to post-keynesian (e.g. [7], [13], [14], [21]) as well as to neo-classical literature (e.g. [11], [15], [17], [18], [19]). On the other hand, models in which the assumption of capital jelly is abandoned are usually full-employment models (e.g. [6], [9], [10], [16]).

The aim of this paper is to fill the gap between these two trends in theoretical literature by developing a model of growth, employment and inflation in which capital is heterogeneous in time. It will be assumed that neither \textit{ex ante} nor \textit{ex post} substitution between capital and labour is possible. The production model is thus a clay-clay type of vintage model. Full \textit{ex ante} complementarity may be too extreme an assumption with respect to the \textit{ex ante} substitutability of labour and capital. Relaxing this assumption, however, strongly enlarges the complexity of the model, as the investment decisions do not depend solely on what happens in the present period any longer, but on what will happen in the future as well. To avoid that the model will become too complex, the assumption of \textit{ex post} as well as \textit{ex ante} complementarity will be made.

Developing such a model has as a side-advantage that it fits very well in the exchange of views on the problem of structural unemployment in the Netherlands nowadays ([2], [3], [5], [8]). According to these views, inflation does not so much lead to unemployment through an accelerating process of direct substitution of capital for labour, but rather via an accelerating process of scrap-

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1 An exception is found in [1]. This analysis is, however, restricted to near-steady-state growth.
ping old, labour-intensive, vintages of capital goods. As younger vintages are as a rule less labour intensive than older ones, this may lead to a loss of employment.

The plan of this paper is as follows. After having defined the symbols in section 2, the model will be developed in section 3. In section 4 the steady-state properties of the model will be investigated, whereas in section 5 some comparative dynamic questions will be answered. Due to the complexity of a heterogeneous-capital model the non-steady-state analysis in section 6 is necessarily tentative. Finally, in section 7 some conclusions will be drawn.

2 LIST OF SYMBOLS

\( a \) capital-capacity output ratio in each vintage;
\( b_t \) labour-output ratio in vintage \( t \);
\( C_t \) real consumption demand at time \( t \);
\( c \) average propensity to consume;
\( I_t \) stock of capital goods of vintage \( t = \) gross investment at time \( t \);
\( K_t \) the stock of capital at time \( t \);
\( m_t \) life span of the capital goods of the oldest vintage in use at time \( t \);
\( N_t \) total demand for labour at time \( t \);
\( N^{\tau t} \) labour combined with capital goods of vintage \( \tau \) at time \( t \);
\( N_t \) total labour supply at time \( t \);
\( P_t \) price level;
\( r^{\tau t} \) rate of profit of capital goods of vintage \( \tau \) at time \( t \);
\( S_t \) gross total real savings at time \( t \);
\( s \) average propensity to save;
\( u_t \) rate of unemployment at time \( t \);
\( W_t \) nominal wage rate at time \( t \);
\( X_t \) gross total output at time \( t \);
\( X^{\tau t} \) output by means of capital goods of vintage \( \tau \) at time \( t \);
\( X^* \) gross capacity output at time \( t \);
\( Y_t \) total real demand for produced goods at time \( t \);
\( z_t \) labour share in the national income;
\( \beta \) rate of embodied labour-augmenting technical progress;
\( \theta \) adjustment parameter in the investment equation;
\( \theta_1, \theta_2 \) parameters in the investment equation;
\( \lambda_1, \ldots, \lambda_4 \) coefficients in the wage equation;
\( \mu_1, \ldots, \mu_4 \) coefficients in the price equation;
\( \bar{\nu} \) growth rate of the labour force;