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## The Relevance of Haavelmo's Macroeconomic Theorizing for Contemporary Macro Policy Making

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*Halvor Mehlum and Jon Vislie*

## Introduction

In December 2011 the Department of Economics, University of Oslo, hosted a symposium to commemorate Nobel Laureate Trygve Haavelmo, on the occasion of the centennial of his birth. The program was made up of eminent scholars giving presentations related to Trygve Haavelmo's contributions to econometrics and economic theory.

Trygve Haavelmo was awarded the Nobel memorial Prize in Economics in 1989 for his seminal contributions to the foundation of modern econometric theory. His numerous publications on econometrics from 1930-40's are well known to the international community. A selection of the symposium presentations on econometrics and econometric methodology will appear in a special issue of *Econometric Theory*. Beyond econometrics, Haavelmo made a lot of interesting contributions to economic theory. The present volume of *Nordic Journal of Political Economy* contains the symposium contribution related to these other contributions.

Well known to the profession is his book "A Study in the Theory of Economic Evolution", from 1954. This was a predecessor on neoclassical growth theory, rent seeking, international inequality and migration. Kalle Moene in his contribution to the present volume combines some of Haavelmo's ideas related to rent seeking and institutional quality, and their consequence for uneven development. In his other well-known book from 1960, "A Study in the Theory of Investment", Haavelmo builds a complete investment theory, from basic principles and distinguishing between flow and stock variables, incorporating not only demand for capital, but also the supply of investment goods. In this book he outlines some important consequences for the macroeconomy and macroeconomic modelling, inspired by both Wicksell and Keynes. In fact, macroeconomic theory caught Haavelmo's attention and thinking during all the years he was teaching at the University of Oslo. Some of these ideas are unfortunately not well known because they appeared in lecture notes in Norwegian. Therefore we decided to publish a translated version of a paper by Haavelmo, published in 1956 in a *Festschrift* in honor to Erik Lindahl, so as to give some flavour of Haavelmo's ideas. In the present volume some of the macro material of Haavelmo is further elaborated in one article by André K. Anundsen, Tord S. Krogh, Ragnar Nymoen and Jon Vislie, and one by Sheetal Chand. These papers are mainly discussing the interaction between monetary policy and the business cycle.

The year before Haavelmo went to USA, was spent in Århus, Denmark, in 1938-39. Niels Kærgård tells a story about the economic profession in Scandinavia at that time, and especially the influence Haavelmo had on macroeconomic thinking at the University of Århus, and perhaps vice versa.

Another issue occupying Haavelmo's mind for years, until his death in 1999, was the tension between population growth, economic progress and environmental quality. It is no exaggeration to say that Haavelmo was very pessimistic as to the future development. Rapid population growth and too high rate of growth in consumption per capita and energy consumption, would lead to environmental degradation and severe welfare loss. This issue is further discussed by Michael Hoel and Bjart Holtmark.

Halvor Mehlum  
Managing Editor

Jon Vislie  
Guest Editor

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*Sheetal K. Chand*\*

# The Relevance of Haavelmo's Macroeconomic Theorizing for Contemporary Macro Policy Making

## Abstract

This paper reviews Haavelmo's basic macroeconomic model, and argues that even though it was minted in the 1950s it remains highly relevant today. Key features that contribute to its relevance are that it integrates balance sheet transactions with flow activities such as production, consumption, and investment; allows shocks emanating from either the financial or real sides to impact on the other; and provides a unified theory of how under-employment and full employment can be generated. These features have not been adequately dealt with in the current dynamic stochastic general equilibrium (DSGE) paradigm.

**Keywords:** *Haavelmo, DSGE, financial crisis, investment, monetary and fiscal policies*

**JEL classification:** *E22, E44, E52, E63*

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## 1. Introduction

Haavelmo's macroeconomic theorizing is generally less well known than his contributions to econometrics, although here too he made important contributions. Part of the reason for their relative lack of recognition is that he expressed some of his deepest thinking on the subject in Norwegian, which few outside Norway can read. This is a pity since his theorizing addresses a central problem of contemporary macroeconomics that concerns the interaction between real and financial sectors, which he approached in a novel way.

In this paper I shall present a version of his basic model, and show how it can be used to interpret some contemporary macro policy issues. Haavelmo first formulated the model in the 1950s and he kept coming back to it over the years. Versions of this model are to be found in his treatise on investment published in 1960, henceforth IT, and in lecture notes written in Norwegian that he eventually presented in 1966 as a "Study on Macroeconomic Theory", henceforth SMT.<sup>1</sup> Significant features of this model are that it integrates balance sheet transactions with flow activities such as production, consumption, and investment; allows shocks emanating from either the financial or real sides to impact on the other; and provides a unified theory of how under-employment and full employment can be generated. It also provides a natural transition to the longer-run temporal issues involving business cycle fluctuations and secular growth.<sup>2</sup> Within its seemingly simple structure it addresses several of the problems such as the lack of an adequate real-financial integration that have been raised regarding the current dynamic stochastic general equilibrium models (DSGE) paradigm.<sup>3</sup>

As a comment on Haavelmo's style of theorizing one should note that the models he presents often appear very simple but this is deceptive. His focus is usually on conceptualizing key interactions between major behavioural drivers such as optimization and arbitrage, and institutions. In order to bring out the inherent logic of the interaction he often drastically simplifies on the grounds that if after the removal of clutter a core interaction remains this would be fundamental. For example, in the development of macroeconomics it has been widely assumed that sticky prices and wages are required in order to generate under- utilization of resources and unemployment. Haavelmo demonstrates instead that these phenomena can be generated in a neoclassical context of

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<sup>1</sup> The latter is the more complete version and I shall draw upon it, specifically the version presented in chapter 26 of SMT. In preparing this paper I have been enlightened by the penetrating discussions in Andvig (1993), Anundsen, et al., (2011), and Moene and Rødseth (1991).

<sup>2</sup> The presentation of Haavelmo's short-run model here uses the same terminology and is broadly similar to that contained in Anundsen, et al., (2011), but with some differences in structure and interpretation to facilitate the analysis of policy implications. The focus in Anundsen, et al., is on endogenously induced fluctuations in the business cycle for which they use a more elaborate version of the basic model.

<sup>3</sup> See especially Caballero (2010), Colander et al., (2008), De Grauwe (2010), Leijonhufvud (2009), Pesaran and Smith (2011), and Stiglitz (2011). Woodford (2010), a major progenitor of DSGE modelling, is also critical of its lack of integration with the financial side. A review of the issues is in Chand (2012).

flexible prices. He does this by noting that there may be no inherent mechanism for immediately eliminating an excess supply of the capital stock that arises when the marginal product of capital falls below the rental rate required by ultimate owners of capital.<sup>4</sup> The excess supply of capital reduces the demand for new investment, which depresses output and employment. It may be true that introducing sticky prices can reproduce the under-employment phenomena, and sticky prices may even be widespread. However, if there is a more fundamental cause, and this is not addressed, a policy of eradicating sticky prices may not be successful in overcoming the unemployment problem that is of concern.<sup>5</sup>

The paper adopts the following plan. The next section presents Haavelmo's basic model. This is followed by a section that uses his model to view recent macroeconomic developments of the G-7 countries. The conclusion presents some observations on Haavelmo's macroeconomic concerns, which remain relevant to this day.

## 2. Haavelmo's fundamental macroeconomic model: an interpretation

The objective of the model is to explain fluctuations in output and employment. To fully appreciate the model one has to go back to Wicksell, who provides the basic inspiration regarding the interplay between the banking determined interest rate and the real sector's natural rate.<sup>6</sup> Haavelmo, in a major refinement to Wicksell's original conception, incorporates a theory of capital and liquidity preference, on the basis of which he develops an endogenous theory of investment.

The actors of the economy are grouped into four categories: firms who produce output and undertake adjustments to their capital stock; households who provide labour, earn income, save, consume, and are the ultimate owners of the wealth of the economy from which they obtain returns; the banking sector, which accepts deposits and lends to wealth owners at some interest rate; and, finally, the public sector, which consumes, invests, levies taxes and borrows. The sum total of their consumption and investment activities determines national output, and the central issue is to explain how these activities, by reference to both the real and financial sides, affect output and employment.

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<sup>4</sup> Both in IT and SMT.

<sup>5</sup> Le Gall (2011) describes Haavelmo's approach to modelling as an artistic endeavour, which is apposite. He seeks a minimalist representation. One could add, since Haavelmo was also avidly interested in fishing, that he was always on the lookout for the "biggest fish" explanation. In his writings he incessantly subjects different bits of theory to searching examination. If the fish is too small, he puts it back as, for example, with Keynes's theory of investment. However, if promising, he preserves it for later use. His biggest fish was drawn from Wicksell.

<sup>6</sup> An accessible account is Wicksell (1907). The natural rate refers to the marginal product of capital, which Wicksell also referred to at times as the normal rate of profit on capital.

***The real side***

This is a one sector closed economy model with output produced, consumed, and accumulated as capital, all at a common price  $P$ .<sup>7</sup> In real terms

$$Y = C + I \quad (1)$$

$Y$  is output;  $C$  indicates consumption; and investment is  $I$ . The latter two aggregates implicitly include government outlays.

Aggregate consumption  $C$  is the sum of private consumption, which is a function  $g$  of net disposable income  $R$ , and public consumption  $C_g$  which is assumed to be exogenous.

$$C = g(R) + C_g \quad 0 < g'(R) < 1 \quad (2)$$

Net disposable income is defined as

$$R = Y - \delta K - T \quad (3)$$

Here  $\delta$  is an assumed constant rate of depreciation of capital  $K$ , and  $T$  denotes taxes levied.

Three types of investment are distinguished

$$I = I_1 + I_2 + I_g \quad (4)$$

$I_1$  refers to firms' investments to increase the capital stock given the existing technology and is directly related to profitability considerations based on a comparison of the marginal product of capital and its imputed rental rate;  $I_2$  denotes regular autonomous investment that is undertaken to exploit new technologies; and  $I_g$  represents investment undertaken by the public sector. The model treats  $I_1$  as endogenous, and  $I_2$  and  $I_g$  as exogenous.

Output is produced in accordance with a production function where  $N$  denotes the labour input and  $K$  is the given stock of capital.

$$Y = \phi(N, K) \quad (5)$$

The production function has standard properties of substitutability, increasing returns and technical complementarities between the two inputs.<sup>8</sup>

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<sup>7</sup> All flow terms refer to a period  $t$ , while stock terms and balance sheets refer to a point in time in relation to the period. To save on terminology time referents are suppressed. Haavelmo did present an open economy version in SMT, which dealt with small open economies operating under fixed exchange rates, but this was not fully developed. Opening up raises several issues which are beyond the scope of this paper.



Haavelmo distinguishes between two types of production situations.

(i) *Alternative A – the full employment regime*

In this regime, firms find demand for output to be adequate, for example as indicated by the behaviour of the inventories that they hold. They are assumed to be perfectly competitive price takers i.e. they are “quantity producers” in Haavelmo’s description, and produce as much as they profitably can in accordance with their profit function

$$\Pi = PY - r^*PK - \delta PK - wN \quad (6)$$

Here  $r^*$  is the (required) rate of return i.e. the rental rate that owners of capital demand from firms for the use of their capital,  $w$  is the given wage rate, and  $P$  is the given price level.

The firm’s optimal strategy is to hire as much labour as is economically feasible for the installed capital stock, with a view to ensuring that the latter’s marginal product equals or exceeds the imputed rental rate  $r^*$ . If too few workers are applied to the capital stock in place, the marginal product of capital would be low while that of an additional worker would be high. Hiring more workers will raise the marginal product of capital but the decision of how many to hire will depend on their wage demands. If labour accepts a wage that is always at or below the marginal product of labour, firms will hire the maximum available labour force  $H$ , and in the process will bid up and pay a wage equal to the full employment marginal product. However, if labour insists on a higher wage, firms will employ less labour  $N$  than the maximum available. Unemployment is then voluntary and is an outcome enforced by labour and not by inadequate demand.

Unless the context requires otherwise, it will be assumed that under *Alternative A* the maximum available labour  $H$  is applied to the given capital stock  $K$ . This is given by part (i) of the condition stated in (7), while part (ii) refers to a situation of below full employment.

$$(i) \quad \frac{\partial \phi}{\partial N} = \frac{w}{P}, \text{ and } N=H \quad \text{or} \quad (ii) \quad \frac{\partial \phi}{\partial N} < \frac{w}{P} \text{ and } N < H \quad (7)$$

Whenever the first part of (7) applies, the resulting maximum net marginal product of capital i.e. the natural rate is

$$r = \frac{\partial \phi(H, K)}{\partial K} - \delta \quad (8)$$

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<sup>8</sup>  $\frac{\partial \phi}{\partial N} > 0$ ,  $\frac{\partial \phi}{\partial K} > 0$ ,  $\frac{\partial^2 \phi}{\partial N^2} < 0$ ,  $\frac{\partial^2 \phi}{\partial K^2} < 0$ ,  $\frac{\partial^2 \phi}{\partial K \partial N} > 0$

Haavelmo contrasts this rate with the rental rate  $r^*$  that is determined on the financial side, and which is examined later in this section. If for the installed capital stock the natural rate  $r$  exceeds the rental rate  $r^*$ , firms will be making excess profits. This situation leads firms and owners of capital to desire more capital stock  $K^*$  up to the point where the net marginal product equals the required rental rate.<sup>9</sup>

$$r = \frac{\partial \phi(H, K^*)}{\partial K^*} - \delta \equiv r^* \quad (9)$$

Should an excess stock demand for capital result i.e.  $(K^* - K) > 0$  owners will at first attempt to acquire the additional capital from each other. However, at each point in time the capital stock is given in the aggregate, and the result will be merely to drive up the price of capital  $P$ , which for the basic model is also the price of output. Haavelmo demonstrates on bringing in the financial side (see the discussion surrounding equations (10) to (13) below) that there is an alternative way of ensuring a temporary equilibrium for the holding of  $K$ , without recourse to unrealistic jumps in  $P$ . Note that the temporary equilibrium concerning the wealth owner's portfolio balance need not imply that the aggregate excess stock demand or supply for capital has also been eliminated. In a closed economy the capital stock imbalance can only be eliminated over time through investment flows. As Haavelmo pointed out, the instantaneous rate of investment would have to be infinite in continuous time to meet a discrete excess stock demand for capital, which is not possible. Hence, a mechanism is needed for determining observed finite investment flows.

The mechanism that Haavelmo adopts in his basic model, and which also closes the real part of the model, is to postulate simply that firms accept as investment  $I_1$  any surplus output that is left over after meeting consumption, public sector requirements, and other demands.<sup>10</sup> Hence, there is no need for the price level or interest rates, or even wages, to adjust to ensure equilibrium in the output market. With the output market automatically equilibrated, attention can be more readily focused on the financial side and its implications for the real side.

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<sup>9</sup> For example, if  $r > r^*$  and the production function is Cobb-Douglas, the desired stock of capital is  $K^* = \frac{r}{r^*} K$ . This follows since the elasticity of output with respect to the capital stock is invariant – a larger capital output ratio for example being offset by a lower marginal product of capital. Thus if  $r$  is, say, 6 percent and  $r^*$  is, say, 3 percent the desired capital stock would be double the current one. If the existing annual capital output ratio is 2, the desired capital output ratio at the existing level of output would be 4. If  $I_1$  is, say, 10 percent of  $Y$  it would take 20 years to attain the desired capital output ratio. Hence, relatively small changes in the gap between the rental rate and the marginal product of capital can cause big changes in the desired capital stock and the investment flow needed to eliminate the imbalance.

<sup>10</sup> This procedure rules out a conflict between saving and investment plans, but it is not an essential requirement for his model. A slightly more complex model could be set up with a separate equilibration mechanism for the flows. This is to be found, for example, in his two-sector versions (see, II).

(ii) *Alternative B – the under-employment regime*

The other situation that Haavelmo considers is a low output regime. In this situation firms produce to “orders” i.e. in accordance with their order books so as to avoid risking the piling up of excess inventories. This is because of inadequate aggregate demand, which Haavelmo attributes to a fall in investment as a consequence of the net marginal product of capital being lower than the required rental rate i.e.  $r < r^*$ . This could occur, for example, if the authorities were to tighten monetary policy thereby raising  $r^*$ . Owners will then want to reduce capital but since investment cannot be negative they have to rely on the natural depreciation of the capital stock.

With output lower than that under *Alternative A*, not all of the available labour force, even if they were willing to work at a wage lower than their marginal product, would be employed. This is a consequence of deficient aggregate demand and corresponds to Keynesian under-employment.<sup>11</sup> Haavelmo notes that since less labour is needed to produce the smaller output level,  $r$  will be lowered. The latter occurs because less labour is being applied to the given capital stock. A fall in  $r$  further reduces desired capital stock and hence investment.

It might be noted that with less output and hence less labour being hired for the given capital stock, the marginal product of labour will be higher than the real wage that would have prevailed for the same capital stock under the full employment of *Alternative A* i.e.  $\frac{\partial \phi}{\partial N} > \frac{w}{P}$ , where more output is being produced. Thus reducing wages to help increase employment in *Alternative B* would not help, since the amount of employment needed has already been determined by the order book, and provided the substitutability of labour for installed capital is limited. It might even be harmful if it further reduces demand and the order book. In this situation, reducing wages, as is often recommended to increase employment, would only buttress profits of the firm at the expense of labour.

***The financial side and its integration with the real side***

The next step is to examine how the rental rate  $r^*$  is determined, and how gaps can arise between  $r$  and  $r^*$ . This is done from the financial side. Here Haavelmo focuses on two key balance sheets. The first is a combined one for the household and public sectors i.e. the non-banking sector, while the second is for the banking sector.

Table 1 portrays the balance sheet for the non-banking sector. Households own the capital  $K$ , the nominal value of which is  $PK$ . They also hold all the money stock issued

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<sup>11</sup> However, note that unemployment does not depend on sticky prices and wages, but arises in a classical context with deficient demand. It is simply a consequence of their being less investment and smaller order books because the net marginal product of capital is less than the required rental rate.

$M$ , the counterpart to which is the loans  $L$  they contracted.<sup>12</sup> In the assumed closed economy setting net worth of the non-banking sector is always non negative, since  $M$  must equal  $L$ .

**Table 1 Balance Sheet for Non-Banking Sector**

Assets	Liabilities
PK	$L$
M	Net Worth= $\mathcal{W}$

Table 2 presents the balance sheet for the banking sector, which consolidates the central bank with the commercial banks. Its liabilities comprise deposits  $M$ , which funds the loans that it provides at some interest rate  $i$ . The sector's net worth is zero, which is a convenient simplification.<sup>13</sup>

**Table 2 Balance Sheet for the Consolidated Banking Sector**

Assets	Liabilities
$L$	$M$
	Net Worth=0

Certain features of the financial sector setup which is on Wicksellian lines should be noted. The banking sector engages in leveraged lending. Money is created through the issuance of loans, which in principle is the same as an open market operation.<sup>14</sup> The

<sup>12</sup> The entry shown in the table comprises the non-interest bearing component, since Haavelmo assumes that any interest bearing money is netted against loans  $L$  contracted from the banking sector.

<sup>13</sup> However, this could be still be construed as a capital requirement condition. More realistic alternative conditions could be introduced, but the essentials of the argument to be made remain unchanged.

<sup>14</sup> The model abstracts from flow injections of money, for example from financing a government budget deficit. Haavelmo (1978) construes such injections as an income statement entry and not a balance sheet

household sector contracts loans to finance capital acquisitions or cash holdings. Since the economy is closed all loan proceeds have to be deposited with the banks (Haavelmo abstracts from the complications of introducing currency). This creates potential for another round of loans, money, and so on.

Haavelmo considers the problem of why non-interest bearing money should be held, and argues that it is because it has liquidity value. Different goods, even if they have the same nominal value, may face varying difficulties in how readily they may be converted into cash, which is the most liquid asset and therefore desirable for contingency and other reasons. He notes that when liquidity preferences change, transactors can acquire their desired amounts of money but only by adjusting the loans outstanding with the banks. They cannot effect changes in their money holdings by adjusting their holdings of claims on capital, since this would merely redistribute money balances and capital claims within the sector, leaving the latter two aggregate totals intact.

The model's financial side is formalized by setting up a preference function for the non-banking sector (on analogy with that for the individual portfolio owner) as to the composition of its portfolio.<sup>15</sup> This is maximized with respect to the balance sheet constraint

$$\begin{aligned} \underset{\frac{K, M, L}{P, P, P}}{\text{Max}} : & \quad U\left(K, \frac{M}{P}, \frac{L}{P}; \frac{W}{P}, r^*, i, Y\right) \\ \text{wrt} : & \quad W = PK + M - L \end{aligned} \quad (10)$$

The following demand functions, denoted with the superscript  $d$ , result

$$K^d = k\left(\frac{W}{P}, r^*, i, Y\right) \quad (11)$$

$$\left(\frac{L}{P}\right)^d = l\left(\frac{W}{P}, r^*, i, Y\right) \quad (12)$$

$$\left(\frac{M}{P}\right)^d = m\left(\frac{W}{P}, r^*, i, Y\right) \quad (13)$$

These are functions of real wealth, rental rates, bank interest rates, and output, and have standard interpretations. Thus the demand for capital ownership increases with the

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one as is done here. Which of the two is undertaken will bear different consequences for the macro economy.

<sup>15</sup> Haavelmo, both in IT and SMT was concerned about the aggregation problem. In the end he decided to adopt the procedure of reasoning by analogy as a convenient way of retaining the insights from individual behaviour, while at the same time allowing for macroeconomic interactions between groupings of individuals.

rental rate  $r^*$  that can be charged for the use of capital but declines if costs of borrowing,  $i$ , to finance the acquisition of capital increase; demand for loans to finance capital acquisitions increases with the rental rate for capital but declines if borrowing costs rise; while liquidity preference declines with increases in the rental and borrowing rates, insofar as they raise the opportunity costs of not investing or paying down debt.

Haavelmo then proceeds to consider how optimal portfolio demands for a given constellation of determining values are reconciled with their supplies. The issue is that of the macroeconomic conditions for temporary equilibrium of the financial side. Haavelmo notes that if the desired stock of money is equal to the amount of loans outstanding, it follows from the non-banking sector's balance sheet constraint stated in (10) that the available stock of capital would also be held, since  $W$  is given at a point in time. Thus only one equilibrium condition,  $M$  equals  $L$ , is needed for the financial side to be in equilibrium, which from (11) and (12) follows as

$$m(K, r^*, i, Y) = l(K, r^*, i, Y) \quad (14)$$

The adjustment variable for ensuring equilibrium in (14) is  $r^*$ . For any interest rate  $i$  that the monetary authorities and the banking system specify, there is a rental rate of capital that will ensure equilibrium. From (14) a solution for  $r^*$  can be expressed as

$$r^* = f(i, K, Y) \quad (15)$$

An increase in the banking sector's loan rate will increase  $r^*$ . Since changes in  $K$  or  $Y$  have largely offsetting effects on the demand for loans and for real balances that feature in the equilibrium condition (14), the relationship (15) will be largely governed by  $i$ .

The rental rate  $r^*$  is usually higher than the loan rate  $i$ , because the latter represents a contractual requirement whereas the former takes account of the greater risk associated with production. Hence, the opportunity cost for liquidity preference is likely to be dominated by  $r^*$ . For portfolio balance to prevail, for example, if the demand for money is reduced,  $r^*$  will have to fall so as to provide some offset to the former, while lowering the demand for loans.

In the basic model the price level  $P$  is treated as a state variable that changes over time but not in discrete jumps. Haavelmo adopted a Wicksellian approach for determining the rate of inflation. Under *Alternative A*, when the marginal product of capital exceeds the rental rate, pressure on full employment output will be present. If sustained over time because of increased investment demand, this would result in inflation, which Haavelmo expresses on Wicksellian lines

$$\frac{dP}{dt} = \gamma P(r - r^*) \quad (16)$$

However, he does not specify in the basic model precisely how the inflationary adjustment in prices occurs. In Wicksell's case inflation is determined in the market for output, whereas in the basic model this market is characterised by investment passively absorbing the excess supply of output. This suggests that the inflationary impulse would have to come from inputs, for example, labour demanding higher wages, which becomes more likely under conditions of persistent full employment.

### 3. Haavelmo's contemporary Relevance

In its evaluation of the recent Great Financial Crisis and Recession, the International Monetary Fund noted that it began in the financial sector, and then proceeded to adversely impact output (IMF, 2009). This section reviews the recent experience of the G-7 countries through the lens of Haavelmo's model. The argument presented here is that unlike the DSGE paradigm, which has difficulty explaining the outcomes and rationalizing the measures that were taken, Haavelmo's model, even in its present rudimentary form provides a better way of conceptualizing the principle forces at work.

#### *The G-7 experience*

The focus in Haavelmo's model is on the linkages between the financial and real sectors, essentially through deviations between the required rental rate  $r^*$  determined from the financial side and the marginal product of capital  $r$  that is determined from the real side. From the discussion in the preceding section, the latter components can be summarized as follows:

$$r^* = f(i), \quad f'(i) \geq 0$$

$$r = \frac{\partial \varphi(N, \bar{K})}{\partial K} - \delta, \quad \frac{\partial r}{\partial N} = \frac{\partial^2 \varphi(N, \bar{K})}{\partial N \partial K} > 0 \quad (17)$$

The dominant influence on the required rental rate is the banking system's effective interest rate  $i$ , while for the marginal product of capital, it is the application of labour to the stock of installed capital  $\bar{K}$  that is decisive. In particular, and of relevance to recessions, a reduction in employment reduces the marginal product of capital as is indicated by the cross partial derivative in (17).

Since direct information on  $r^*$  and  $r$  are not readily available, their behaviour will have to be inferred. For viewing recent developments affecting these two variables it is

convenient to divide the data into the two periods of 2005-2008 and 2009-2011, which straddle the crisis.<sup>16</sup>

Table 3 presents data on output gaps. For the first period these gaps were positive for all the G-7 countries, indicating that actual outputs exceeded the potential levels attainable when available productive sources are fully utilized. Such a period would correspond to Haavelmo's *Alternative A-the full employment regime*. In contrast, the second or crisis period reveals a consistently different pattern of negative output gaps, indicating that actual output fell well below their potential levels. The G-7 countries would now be operating in Haavelmo's *Alternative B-the under employment regime*.

**Table 3 G-7 Countries: Output Gaps and Haavelmo's Classification**  
(In percent)

	Output Gaps	<i>H</i>	Output Gaps	<i>H</i>
	<i>Averages</i> 2005-2008		<i>Averages</i> 2009-2011	
<b>USA</b>	0.8	<i>A</i>	-4.0	<i>B</i>
<b>Japan</b>	0.9	<i>A</i>	-5.2	<i>B</i>
<b>Germany</b>	0.3	<i>A</i>	-2.6	<i>B</i>
<b>France</b>	0.1	<i>A</i>	-3.9	<i>B</i>
<b>UK</b>	1.8	<i>A</i>	-3.7	<i>B</i>
<b>Italy</b>	1.1	<i>A</i>	-3.8	<i>B</i>
<b>Canada</b>	1.6	<i>A</i>	-1.8	<i>B</i>

*H* = Haavelmo; *A* = full employment regime; *B* = under-employment regime

Source: OECD Economic Outlook Database.

The employment situation portrayed in Table 4 is generally consistent with the output gap profiles. In the first period, unemployment ratios, with the notable exception of Germany, were substantially lower than in the second period.<sup>17</sup> In the latter period

<sup>16</sup> The averages for 2009-2011 are either based on the IMF's WEO of 2011, or the OECD economic outlook forecasts for 2011.

<sup>17</sup> For those countries that exhibited high rates of absolute unemployment in the first period, it is likely that they result from wage demands exceeding full employment marginal products of labour, given the positive output gaps. The exception of Germany, with its lower unemployment ratio in the second period could be attributed to the sustained demand for its exports from the BRICs, especially China, who were relatively less affected by the crisis.



there were substantial increases in the unemployment rate for several countries, in particular the US and the UK. Tables 3 and 4 indicate that for the given installed capital there was a decline in output that was accompanied by a reduction in the numbers employed. This suggests, in accordance with (17), that the marginal product of capital  $r$  would have fallen from period 1 to period 2.

**Table 4**      **G-7 Countries: Unemployment**  
(Percent ratio)

	<i>Averages</i> 2005-2008	<i>Averages</i> 2009-2011
<b>USA</b>	5.0	9.3
<b>Japan</b>	4.1	5.0
<b>Germany</b>	9.5	6.9
<b>France</b>	8.7	9.6
<b>UK</b>	5.3	7.7
<b>Italy</b>	6.9	8.1
<b>Canada</b>	6.4	8.0

*Sources: IMF, World Economic Outlook Database;  
OECD, Economic Outlook Database.*

Turning to the rental rate  $r^*$ , it should first be noted that effective interest rates were exceptionally low in the aftermath of the dot.com bubble, at the beginning of the millennium, largely as a consequence of the easy money policies that the US Federal Reserve pursued. Several studies indicate that their effect was to lower the risk premium on loans granted by the banking system and its affiliates<sup>18</sup>. This led to a sharp increase in leveraged borrowing for financing assets, which suggests that the rental rate must have been reduced in the earlier years of the 2000 decade. An indication that this is likely to have occurred is the low yields on corporate bonds and their high levels of issuance in the years leading up to the great financial crisis (IMF, 2010).

However, from 2006 onwards, banks were exposed to greater liquidity and credit risks and increasingly curtailed lending. When the crisis broke, high grade corporate bond yields, both in the US and Europe, spiked upwards by some 500 basis points. These developments indicate a drying up of credit availability, and that the limited available financing commanded a much higher premium than before. Hence,  $r^*$  will have risen in the 2009-2011 period.

<sup>18</sup> See for example Altunbas et al (2010), the IMF (2010) report on global financial stability, and (IMF, 2009).

It is, therefore, reasonable to conclude that in the first, pre-crisis period the differential  $r - r^*$  is positive, and that there was an excess demand for capital  $K$ , which resulted in buoyant investment. However, during the second period, the differential turned negative, which implies an excess supply of the capital stock, and a reduction in investment.

**Table 5**      **G-7 Countries: Investment**  
(Percent of GDP)

	<i>Averages</i> 2005-2008	<i>Averages</i> 2009-2011
<b>USA</b>	19.6	15.6
<b>Japan</b>	23.7	20.8
<b>Germany</b>	17.8	17.0
<b>France</b>	21.4	19.5
<b>UK</b>	17.4	14.6
<b>Italy</b>	21.4	19.7
<b>Canada</b>	22.9	21.6

*Sources: IMF, World Economic Outlook Database;  
OECD, Economic Outlook Database.*

The investment experience in these two periods is shown in Table 5. It is consistent with the inferences drawn above. In all of the G-7 countries investment levels were higher in the first period than in the second period. For the US it was some 4 percent of GDP higher, with varying amounts for the other countries. The subsequent sharp falls of the second period for most of the G-7 countries, Germany being the exception, would have contributed to a substantial contraction in aggregate demand.

### ***G-7 stabilization policies***

In response to the great financial crisis and its recessionary consequences, the G-7 countries embarked initially on a series of monetary actions. Short-term nominal interest rates were sharply reduced as is indicated in Table 6. However, despite approaching the zero bound the lower interest rates did not appear effective. Additional monetary measures were taken, involving notably quantitative easing and the monetization of various categories of financial assets, together with the recapitalization of financial institutions. The objectives were to place a floor under falling asset values and to overcome the lending shortage and the spike in borrowing costs, so as to get credit moving (IMF, 2009, 2010). Nonetheless, these policies also appeared inadequate. They

neither succeeded in reversing the large and precipitate falls in investment nor the decline in consumption as households deleveraged and increased their savings.

**Table 6 G-7 Countries: Monetary Policy and Interest Rates**  
(Annual percent)

	Nominal short-term interest rate	
	<i>Averages</i> 2005-08	<i>Averages</i> 2009-11
<b>USA</b>	4.3	0.8
<b>Japan</b>	0.4	0.3
<b>Germany</b>	3.5	1.1
<b>France</b>	3.5	1.1
<b>UK</b>	5.2	0.9
<b>Italy</b>	3.5	1.1
<b>Canada</b>	3.8	1.1

*Sources: IMF, World Economic Outlook Database September 2011;  
OECD, Economic Outlook Database.*

In an apparently desperate search for an antidote, it was decided to depart from the long standing aversion against the use of fiscal policy for stabilization purposes. There was a dramatic discretionary increase in fiscal stimulus for several countries. Table 7 shows that the deficit on the structural budget balance, which controls for the cyclical effects of falling output on the budget and proxies the discretionary change in the budget, increased by large amounts during the second period for all the G-7 countries. Especially big increases were recorded for the US and the UK. For the US the structural budget deficit was an average of five percent higher during the second period, while for the UK they were some four percent higher.

The fiscal actions represent substantial additional contributions to aggregate demand. Ricardians could claim that these effects would have been diluted by the crowding out of investment. However, the sequencing of events indicates that the investment falls occurred first. Nor is it reasonable to claim that investors anticipated the future widening of budget deficits and therefore reduced their outlays, given that policy makers were for many years opposed to the stabilization use of fiscal policy. Nonetheless, although the fiscal stimulus may have helped contain the recessions, they did not avert them. This points to the difficulty of reversing an unfavourable  $r - r^*$  differential.

**Table 7 G-7 Countries: Use of Fiscal Policy**

<b>Structural Budget Balance</b> (percent of potential GDP)		
	<i>Averages</i> 2005-08	<i>Averages</i> 2009-11
<b>USA</b>	-4.0	-8.9
<b>Japan</b>	-3.5	-6.8
<b>Germany</b>	-1.1	-2.0
<b>France</b>	-2.9	-4.8
<b>UK</b>	-4.2	-8.1
<b>Italy</b>	-3.5	-2.5
<b>Canada</b>	1.0	-3.7

*Sources: IMF, World Economic Outlook Database September 2011;  
OECD, Economic Outlook Database.*

A striking feature of the G-7 policy response to a rapidly deteriorating situation, is that the measures taken were not based on the application of an integrated policy framework, but were ad hoc responses. The prevailing orthodoxy for policy analysis and prescriptions relies on the DSGE framework, which as many commentators have noted (see footnote 3 above) is ill-suited for handling the great financial crisis and recession. In large part this is attributable to its foundational assumptions of intertemporal optimization and perfect markets. Such assumptions are not appropriate for acute crisis situations when immediate balance sheet, liquidity, and cash flow considerations become paramount and financial markets for effecting intertemporal trade are disrupted.

However, the policy measures can be rationalized in the context of Haavelmo's model, which even in its present rudimentary state provides a useful integrating framework. Thus the monetary measures taken would constitute essential steps for reducing borrowing costs,  $i$ , and hence the required rental rate  $r^*$ , while the stimulative fiscal policy is needed to help raise the marginal product of capital  $r$ . Together, and if they form part of a credible causal plan that serves to reduce uncertainty, these measures should help incentivize investment. The latter is needed for sustained stabilization and the resumption for growth.

## 4. Conclusion

Haavelmo developed his model in the 1950s, a period during which financial and other markets were heavily regulated.<sup>19</sup> Norway, for example, engaged in stringent credit budgeting, which was not fully lifted until the 1980s. This makes his model all the more prescient with regard to the conditions that would operate under free financial markets. Issues of liquidity preference and portfolio balance had become more prominent since Wicksell's time, and Haavelmo incorporated these into the Wicksellian framework.<sup>20</sup> While these extensions influence the transmission mechanisms between the financial and real sides, underlying it all is the critical role played by the bank determined supply of credit.

Haavelmo (1987) counselled that destabilizing crises could be mitigated, if not avoided, provided the banking system engaged in prudent lending. He shared Wicksell's view that there was little to restrain leveraged bank lending in a credit economy. The key role of the central bank should be to restrain excessive lending both to, and by, the banks. This requires the prudent use of both interest rate instruments and quantitative controls on the supply of bank credit.<sup>21</sup>

However, Haavelmo was critical of frequent changes in central bank determined interest rates and fine-tuning attempts (1987 op.cit). Interest rates will need to be adjusted from time to time, but this should be done carefully, since even small interest rate changes could induce big jumps in the excess demand for capital, resulting in excessive investment volatility (see footnote 9 above). To this he would have added the difficulty in specifying the precise level of interest rate needed. His basic prescription was that interest rates should be consistent with some notion of an average marginal product of capital (1987, op.cit).

Haavelmo was profoundly interested in macroeconomics which he viewed very broadly as the study of the economics of a society that caters to the well being of its people. As he put it, 'Society' is of critical importance for without it "we would probably all be dead in a few weeks" (Nobel lecture, 1990). By society he meant an arrangement of rules and regulations that governs interactions between individual entities, with the distinctive characteristic that the rules are manmade, and are subject to an inherent dynamic: they change when people are dissatisfied with perceived outcomes (either because preferences have changed or outcomes have deviated from intended ones or because they sense scope for improvement) and use their influence in the political

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<sup>19</sup> His earlier exposure to the freer markets of the US is likely to have been helpful (see Bjerkholt (2007))

<sup>20</sup> In recent years, deregulation of financial markets and transactions, and the rise to prominence of secondary markets for capital claims, has greatly increased speculative behaviour. This poses more acutely problems involving balance sheet shocks, which can constrain spending behaviour, affect the required rental rate, and adversely impact the macro economy. For an extension of Haavelmo's model to cover the latter phenomena see Chand (2012).

<sup>21</sup> See Laidler (2009) for an excellent discussion of Wicksell's views on this topic.

arrangements to modify them. This is an incessant activity which generates feedback effects on the economic system. Therefore, he argued, one has to be very careful when theorizing about macroeconomics, since its relationships are not immutable (SMT). However, this very fact could also be used to advantage, since it presents opportunities for modifications so as to better achieve societal goals.

Haavelmo claimed that an adequate macroeconomic theory is one that realistically describes and simulates an economic society that would be feasible under some economic policy (SMT). Econometrics is needed to help quantify the magnitude and net effect of forces that generate a set of economic observations. However, it can only function properly if the underlying economic theory is adequate (2009, op. cit). He lamented the limited progress of macroeconomic theory and worked to improve it.

While emphasising the importance of models for organized thinking and improved analysis, and the desirability for axiomitization as an aid to rigorous analysis, he cautioned against premature axiomitization (SMT). In particular, he was concerned that the micro-foundations of neoclassical theory implied a macro economy that bore little resemblance to the real world. Instead he wondered if it might not be better to start with a realistic conception of the macro economy and ask what sort of micro-foundations would support it. Achieving the latter would then provide the basis for an appropriate axiomitization.

Haavelmo's macroeconomic theorizing thus starts from a different point than what is customary with, say, DSGE. His criticism with starting from the full blown neoclassical conception, to which limitations are then added so as to better approximate reality, is that the procedure lacks a natural motive force to explain the roles of these limitations and frictions (SMT). In particular, it misses out on the inherent dynamics and the striving, some of which may even be directed to realizing some of the optimal fruits that the neoclassical mode of organization promises.

My interpretation of Haavelmo's concern is as follows: the same specific macroeconomic outcome, with its deviations from neoclassical optimality, can be viewed as a fall from grace – the neoclassical position – or as the outcome of interacting motive forces and the current state of play in the evolutionary development of institutions. Which starting point one adopts has profound implications for the conduct of macroeconomic policy and for the exercise of surveillance. From a neoclassical vantage point, macroeconomic policies should be directed at removing impediments to attaining the neoclassical optimum, while surveillance would consist of identifying and anticipating possible deviations from that optimum. The neoclassical assumption is that, if not impeded, primal motive forces would lead in a beneficial manner to the neoclassical welfare optimum. However, surveillance should try to identify possible disruptions and innovations to the present state, which is where we are in; the reactions of primal forces to them; and whether or not these would bring about a better or worse outcome. The role of macroeconomic policy, which I believe Haavelmo's work implies, is that of preventing deterioration in current and prospective outcomes, while working towards future improvements.

Finally, it should be noted that Haavelmo was concerned with fashions in macro theorizing and the tendency to accept uncritically whatever happens to be the dominant theory. As he put it (p. 14 of SMT, my translation) "...the best models of the day will be viewed as a hopeless joke in the not too distant future. Every author will obviously try as hard as he can to give the reader the impression that his conceptual apparatus and analysis is the best possible, which applies also to the present author ...However, these remarks are not the author's attempt to show appropriate modesty but an urgent appeal to students to quickly contribute to making existing models obsolete."

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