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## Real exchange rate as an unobservable variable

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REAL EXCHANGE RATE AS AN UNOBSERVABLE VARIABLE

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## ABSTRACT

The Finnish real exchange rate is estimated as a latent variable in a model of current account determination. The measure thus constructed behaves in the 70's much like the measures most often used (relative unit labour costs and relative consumer prices) but in the 80's there are considerable differences. This could be interpreted as indicating a structural change in the Finnish open sector.

## TIIVISTELMÄ

Selvityksessä on arvioitu Suomen hintakilpailukyyn (reaalisen valuuttakurssin) kehitystä 1970-luvun alusta alkaen käyttäen menetelmää, jossa hintakilpailukykyä on pidetty "havaitsemattomana" muuttujana. Olemme estimoineet yhtälön vaihtotaseen kehitykselle, jossa reaalin valuuttakurssi selittää sitä kehitystä, mitä koti- ja ulkomaisten bruttokansantuotteiden, vaihtosuhteen, öljynhinnan ja ulkomaisen koron muutokset eivät pysty selittämään. Tärkein tulos on, että näin saatu reaalin valuuttakurssin arvio antaa samanlaisen kuvan 1970-luvun kehityksestä kuin tavanomaiset mittarit (suhteelliset yksikkötyökustannukset ja suhteelliset kuluttajahinnat) mutta 1980-luvulla ne eroavat toisistaan jyrkästi. Kun muut mittaukset näyttävät hintakilpailukyyn heikentyneen, osoittaa tässä työssä rakennettu mittari sen keskimäärin lievästi parantuneen. Yksi tulkinta on, että Suomen talous on käynyt 1980-luvulla läpi voimakkaan rakennemuutoksen.



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## I. INTRODUCTION

The problem of how to measure properly the impact of relative price changes on the international flows of goods, services, and capital has been one of the main areas of empirical research in international economics (for a survey see Goldstein & Khan (1985)). This type of research runs into serious difficulties already at the beginning when one tries to find proper measures of relative prices. One has used relative GDP deflators, relative CPI deflators, relative unit labour costs, etc. All of these can be defended and in many cases it has turned out that they all give roughly the same description of the relative competitive position of the country studied. Yet, they do not always conform to each other and it has also turned out to be difficult to find non-zero price elasticities except for the long run. Another difficulty with the conventional measures is the choice of weights to be used in the indices.

To alleviate the problems of choosing between various price indices and to evaluate what the potential role of price changes in external adjustment can be we have estimated a model of current account adjustment where the measure of the price competitiveness, the real exchange rate, is treated as an unobservable variable. In this we follow Becketti and Hakkio (1987), who estimated US export and import equations in this fashion. Their results turned out to be encouraging, since while their measure of the US real exchange rate differed quite considerably from the more standard measures it had at least an equally good predictive power as they had.

The idea is to allow the data to construct the real exchange rate after the influence of other exogenous variables on the endogenous variable has been taken into account. The real exchange rate is then



regarded as a latent variable. The exact statistical method of estimation we have used corresponds to the unobservable components model developed by Watson and Engle (1983).

While our basic philosophy in measuring the real exchange rate is the same as in Becketti and Hakkio, our view of the role of the real exchange rate differs considerably from theirs. Becketti and Hakkio regard the real exchange rate as a variable which equilibrates the markets for exports and imports. We have evaluated the real exchange rate as a variable, which accounts for the adjustment of the current account when the effect of other relevant variables has been accounted for.

Our approach is based on the observation (see also Haaparanta (1988)) that the long run external equilibrium of a country requires that its external debt (assets) relative to its GDP should be stable. From this it follows that the problems of external equilibrium can be looked from the ratio of the current account deficit to the change in the GDP. If the long run equilibrium is to be achieved then this ratio must become stable. After allowing for the influence of other variables the real exchange rate must adjust to achieve the equilibrium.

## II. THE MODEL

The estimated model is given by the following equation:

$$(1) \text{ ca/dy} = f(\text{rer}, \text{dy/y}, \text{dy}^*/\text{y}^*, \text{p}^0/\text{p}^x, \text{i}^*, \text{tot})$$

where  $\text{ca}$  = current account,  $\text{rer}$  = real exchange rate,  $\text{y}$  = domestic GDP,  $\text{y}^*$  = GDP in countries serving as markets for domestic exports,  $\text{p}^0$  = price of oil,  $\text{p}^x$  = unit value index of exports,  $\text{i}^*$  = foreign rate of interest, and  $\text{tot}$  = external terms of trade,  $\text{dy}$  = change in  $\text{y}$  etc. In addition several lags of the explanatory variables were included in the estimation to account for slow adjustment of the current account to changes in exogenous variables. The use of Kalman filter means that also the real exchange rate adjusts slowly.

We have included the external terms of trade to make it reasonable to interpret the estimated real exchange rate as the relative price between the closed and open sectors.

The expected signs of the coefficients in (1) are as follows: we expect that an increase in the domestic economic activity increases the current account deficit and that an increase in foreign economic activity reduces the deficit; we also believe that an increase in the foreign interest rate should reduce foreign borrowing i.e. reduce the deficit. The signs of the other effects seem to be ambiguous on a priori reasoning. The effects of changes in the terms of trade have been intensively debated lately (Obstfeld (1982), Svensson & Razin (1985), Persson & Svensson (1986), Matsuyama (1988), Haaparanta (1987)) and no unambiguous effect has been found. The same conclusion holds for the changes in oil prices (e.g. Svensson (1984), Marion & Svensson (1984), van Wijnbergen (1985)).

In (1) the real exchange rate is treated as an unobservable variable. Its behaviour over time is assumed to be characterized by equation (2):

$$(2) \text{rer}_t = \sum_{i=1}^T a_i \text{rer}_{t-i} + \varepsilon_t,$$

where  $\varepsilon$  is a white noise disturbance term.

In terms of a state space model equation (2) can be regarded as a state equation and equation (1) as a measurement equation.

## III THE RESULTS

Results of a representative estimation are presented in table 1. The estimations turned out to be quite robust in the sense that varying the lags did not change the results considerably. This was in particular true for the estimation of equation (2) where several lags were tried and only the first turned out to be significant in all the estimations.

TABLE 1  
Estimation of equation (1):

	coefficient	standard error
explanatory variable		
dy/y (-2)	-.30895	.98895
dy/y (-3)	-1.7816	.98278
dy*/y* (-3)	.004347	.021166
dy*/y* (-4)	.0061894	.021419
p <sup>0</sup> /p <sup>x</sup> (-4)	-.063084	.13271
tot (-3)	-.26998	.20404
tot (-4)	-.079374	.099632
i*	.020181	.010155
estimation of equation (2):		
rer (-1)	.67030	.16200
Period of Estimation 1971:1 - 1988:2, 67 observations		
Adjusted R <sup>2</sup> = .215858, F(11,56) = 2.676705, Durbin-Watson = 1.996018		
Ljung-Box = 15.686390, LR = 82.362		

The operationalization of the variables was as follows:

ca/dy = period t nominal current account deficit divided by the period t annual change in nominal income; the reason for this choice was that experiments to use the quarterly change in income failed,

since the residuals turned out to be badly behaved

$dy/y$  = period  $t$  annual growth rate of the real GDP

$dy^*/y^*$  = period  $t$  annual growth rate of the real GDP of Finland's major trading partners with their share in Finnish exports as the weight

$tot$  = unit value of imports divided by the unit value of exports  $i^*$   
= 3 month eurodollar interest rate

$po/p_x$  = period  $t$  unit oil import price divided by the unit value of exports.

#### IV. THE ESTIMATED REAL EXCHANGE RATE AND OTHER REAL EXCHANGE RATE INDICES

In figure 1 the estimated real exchange rate is drawn together with the real exchange rate calculated on the basis of the unit labour costs, in figure 2 it is drawn together with the real exchange rate calculated on the basis of consumer prices. The most startling feature in both of the figures is that in the 70's all the three measures behaved in much the same way whereas in the 80's our measure gives a completely different view of the open sector competitiveness. The two standard measures indicate that the competitiveness has in the 80's declined dramatically almost in a trend like fashion. Our measure sees a sudden loss of competitiveness at the beginning of the decade after which there has been a very slow recovery even though competitiveness has varied a lot.

Another notable feature is that our measure appears to "lead" the other measures whenever the measures are indicating a change in the same direction. This is especially clear for the 70's when all the measures move in a similar fashion. For the 80's this is not so clear since the measures tend to move in opposite directions. This difference between the measures in the 80's in contrast to the similarity in the 70's may indicate that there has been a structural change in the Finnish economy in the end of 70's. The ordinary measures indicate a steady loss of competitiveness which should have been reflected as a bad export performance and as a deterioration in the position of the import competing sector. Nothing like this has happened, however. This is much in the line with the picture that the measure constructed here gives. The method used in construction takes into account the possible structural changes in the economy.

One can also notice that our measure gives even in the 70's a somewhat different picture of the recovery of the competitiveness after 1976 than the other measures. While the standard measures indicate that the

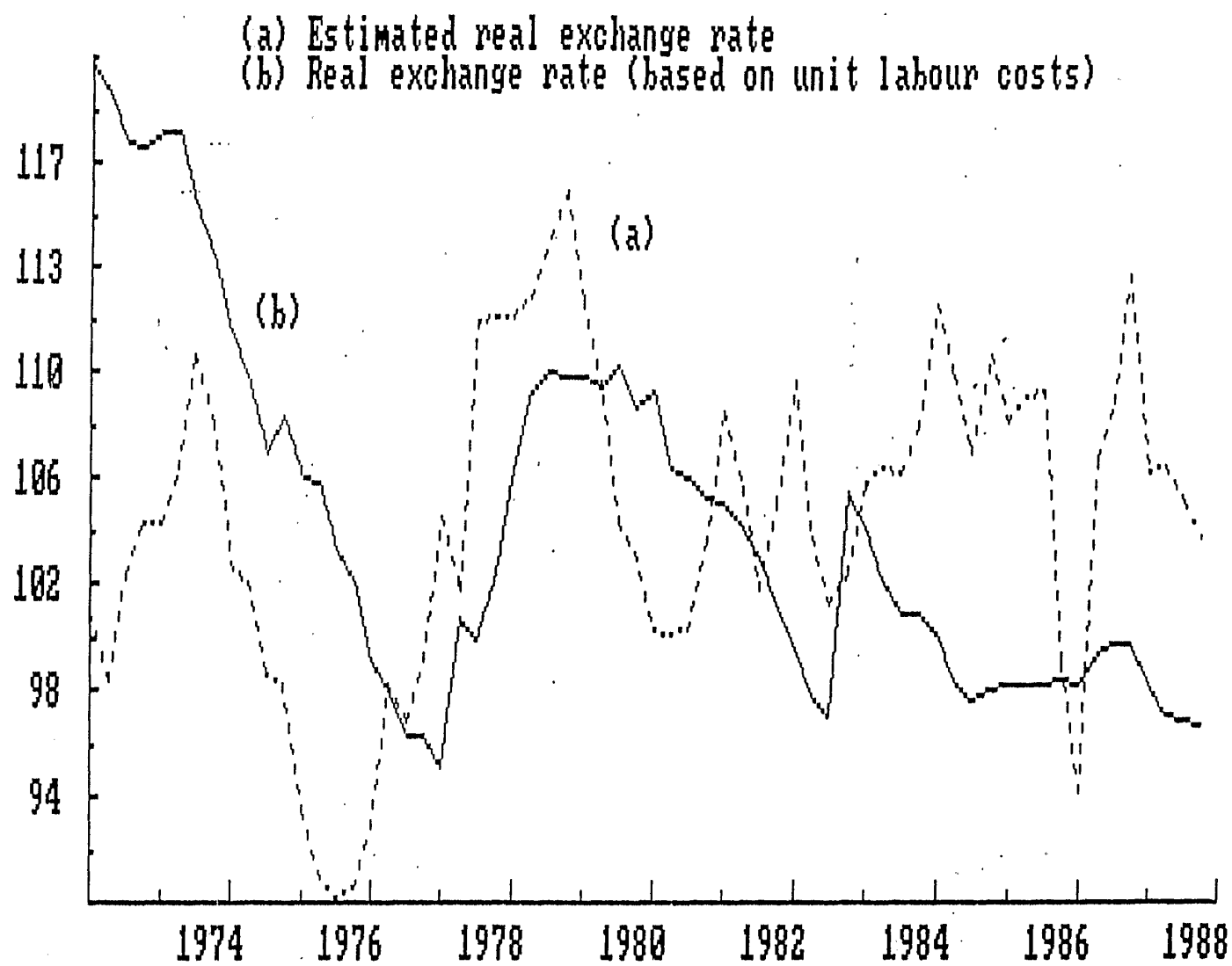


Fig. 1

Sample Period is 1972( 1) - 1987( 4)

FIGURE 1

FIGURE 2

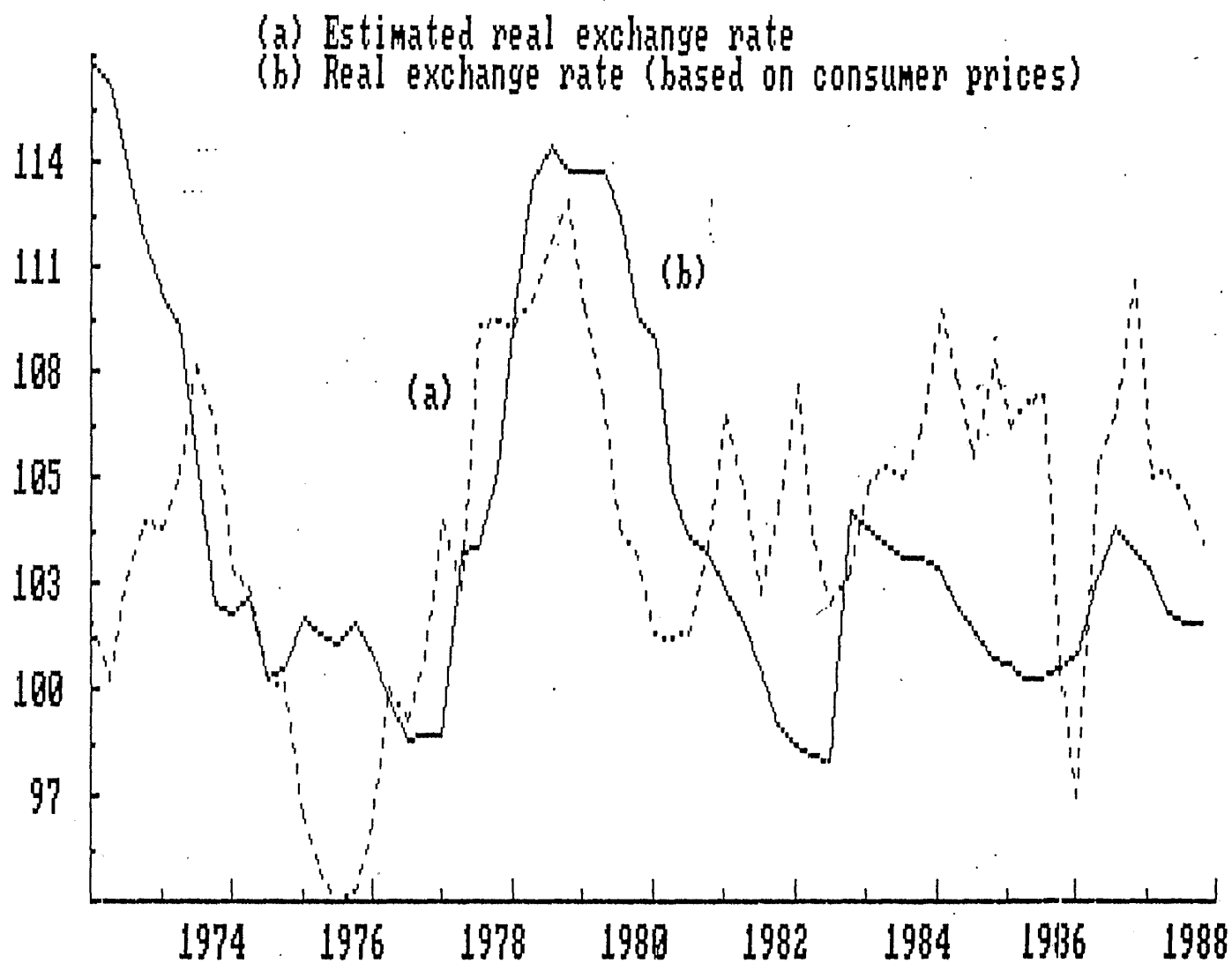


Fig. 2

Sample Period is 1972( 1) - 1987( 4)



level of competitiveness that was reached in the early 70's has never been reached since then our measure indicates that the competitiveness was highest in 1978 and has in the 80's been on the average at the same level as in the 70's.

Finally, an important characteristic of the real exchange rate constructed here is that it shows price competitiveness to incur much sharper changes and to be much more volatile than the more traditional measures. It thus behaves to some extent like the nominal exchange rates behave in a flexible rate system.

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