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WHY ARE RECESSIONS AS DEEP AS THEY ARE? THE BEHAVIOUR OVER TIME OF THE OUTFLOW FROM UNEMPLOYMENT: A NEW PERSPECTIVE

by

Robert Dixon
&
John Freebairn
&
G. C. Lim

Department of Economics
The University of Melbourne
Melbourne Victoria 3010
Australia.

Why are recessions as deep as they are? The behaviour over time of the outflow from unemployment: a new perspective. [1]

Robert Dixon, John Freebairn and G. C. Lim
Department of Economics
The University of Melbourne
Melbourne Vic. 3010

Please treat Robert Dixon as the corresponding author (postal address is given above, email is r.dixon@unimelb.edu.au and fax number is 03-8344-6899)

ABSTRACT

In this paper we deal with five related questions. What are the 'stylised facts' about the behaviour of flows into and out of unemployment and the Unemployment Rate in Australia, especially in recessions? Why does the number of persons flowing out of Unemployment (including the number flowing into employment) rise in recessions? How does outflow behaviour affect the severity of recessions? What has been the history of the probability of any one unemployed person exiting unemployment and what is the elasticity of this probability with respect to the Unemployment Rate? Has this elasticity been changing over time and, if so, what are the consequences of this for the severity of recessions?

KEYWORDS: Worker Flows Business Cycle Unemployment

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1. Introduction

Our aim in this paper is to present a fresh approach to the study of the behaviour of the Unemployment Rate, especially in recessions. We use a simple gross flows based framework to study the proximate determinants of the severity or the depth of a recession (as indicated by the extent to which the Unemployment Rate rises) and to see why this depth varies between groups and over time. We do this in part to counter the view that the severity of recessions is determined primarily with reference to GDP and technology shocks and their influence on the flow into Unemployment. Events within the labour market itself affecting the outflow from Unemployment are also very important.

The focus of this paper is on why the number of persons flowing out of Unemployment (including flowing into employment) rises in recessions. An empirical fact which has often been labelled surprising and paradoxical and which seems "surprisingly counter-intuitive"[1] to some but which is capable of very simple explanation. The natural question which then follows is: what determines the severity of recessions? In particular, for given behaviour of the Inflow Rate, what features of the labour market determine the severity of the recession by which we mean the extent of the rise in the Unemployment Rate during the recession phase of the business cycle? The paper also updates earlier estimates of the cyclical sensitivity of transition probabilities in Australia by Leeves (1997).

We deal with four related questions. What are the 'stylised facts' about the behaviour of flows into and out of unemployment and the Unemployment Rate, especially in recessions? How does outflow behaviour affect the severity of recessions?[2] What has been the history of the probability of any one unemployed person exiting unemployment

[1] Burda & Wyplosz, 1994, p 1289. Leeves (1997), refers to it as "surprising" and "counter intuitive" (1997, p 110 & 111).

[2] Again, the term recession is used in this paper to refer to the period during which there is a sustained increase in the Unemployment Rate during the contraction phase of the business cycle. This may be

and what is the elasticity of this probability with respect to the Unemployment Rate? Has this elasticity been changing over time and, if so, what are the consequences of this for the severity of recessions?

2. The data on flows and some stylized facts

Empirical work on gross labour flows data is based on information obtained from persons in the Labour Force Survey whose responses (records) can be matched across successive months. This data has been reported each month since February 1980 in the ABS publication *The Labour Force: Australia*, Cat. No. 6203.0.[3] While the flows data is representative of only 93% of the population,[4] key indices such as the Unemployment Rate and the Participation Rate calculated for the population represented by the matched sample follow the ups and downs in the same indices for the whole survey/population quite well. For example the Unemployment Rate computed from the matched records and the Unemployment Rate computed from all persons in the survey (not just those whose records could be matched across successive months) are very highly correlated even though in every month the absolute number of unemployed represented by the matched sample is smaller than the number for the whole population.[5]

In the published tables, flows estimates are reported for Males, Married Females, all Females and Persons. Also, Full-time and Part-time employment are recorded separately. In this paper we will deal with Males and (All) Females.

The data allows us to measure the size of both the Inflow into Unemployment and the Outflow from Unemployment over any month. However, there is a lot of 'noise' and 'seasonality' in the data.[6] Seasonal adjustment has been undertaken using the ratio to

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associated with periods of very low but positive rates of GDP growth and is not confined to periods of negative GDP growth.

[3] Extensive discussion of the source of the data and the method used by the ABS to translate sample data into 'population equivalents' may be found in Dixon et al, (2002) and in the references cited therein.

[4] In 6203.0 we are told that the population represented by the matched sample is approximately 80% of the total population but that the characteristics of 2/3 of the remainder are also likely to be in common with these (ABS, 6203.0, p 58). See Dixon (2001) for an exploration of the representativeness of the matched records.

[5] The correlation coefficient for the Unemployment Rate computed from the whole of the labour force survey and that computed from the matched records alone over the period 1980:01 – 2001:03 is (r =) 0.99 for Males and 0.98 for Females.

[6] Also there are periods every now and again when the sample is unusually small. Most commonly this occurs as the composition of the sample is updated following each population census. Where this is the

moving average - multiplicative method in EViews. To better reveal the underlying cycles and trends we have also smoothed the flows data. Smoothing was accomplished by applying a centered 13 period (simple) moving average to the deseasonalised data.[7] We end up with seasonally adjusted and smoothed flows between four states (Employed full-time, Employed part-time, Unemployed and Not in the labour force) on a monthly basis over the period 1980:01 – 2001:03. All ratios and proportions are computed using this data.

The charts in Figure 1 depict the (beginning of the month) Unemployment Rate (*UR*) and the monthly Inflow and Outflow Rates for Males and for Females in Australia over the period 1980:01 – 2001:03. The Inflow Rate (*INR*) is defined as the sum of the flows from Employment (both FT and PT) and Not in the labour force into Unemployment over the month expressed as a proportion of the Labour Force. The Outflow Rate (*OUTR*) is defined as the sum of the flows from Unemployment to Employment (both FT and PT) and to Not in the labour force over the month expressed as a proportion of the Labour Force. The reason for expressing Inflow and Outflow relative to the size of the Labour Force is that cyclical movements in the Unemployment Rate are driven by the size of the Inflow into Unemployment expressed as a proportion of the Labour Force relative to the size of the Outflow from Unemployment expressed as a proportion of the Labour Force.[8]

[FIGURE 1 NEAR HERE]

The Unemployment Rate (*UR*) is the uppermost series depicted in the charts and is recorded on the RH scale. The Inflow Rate (*INR* - solid line) and the Outflow Rate (*OUTR* - dashed line) are the two inter-twined series depicted below the Unemployment Rate series in each of the charts and are recorded on the LH scale. All variables are measured as proportions, not percentages - so an Unemployment Rate of (say) 8% would be recorded as 0.08 on the RH scale on each chart.

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case we have adjusted all the flows for that period by the ratio of the 'trend' value of the Population Represented by the Matched Sample to the actual Population Represented by the Matched Sample for that period.

[7] This means losing seven observations at the beginning and end of the data series which could be dealt with by using non-symmetric Henderson-type moving averages. However, given that our focus is on the two deep recession episodes losing the most recent seven monthly observations is not a problem.

[8] See Dixon (2002) for a formal proof and a statement of the assumptions under which this statement is true.

For Males the Unemployment Rate, the Inflow Rate and the Outflow rate appear to be cycling around an upwards trend whilst the rates for Females appear to be cycling around a downwards trend. Both Inflow and Outflow rates for Females are higher than for Males. Of more importance for this paper is that the Inflow and Outflow Rates for both Males and Females have been highly and positively correlated with each other and both have been positively correlated with the Unemployment Rate.[9] The (contemporaneous) correlation coefficients for the Outflow and Inflow Rates and the Unemployment Rates for Males and Females over the period 1980:01 – 2001:03 in Table 1 confirm the high positive correlation.[10]

[TABLE 1 NEAR HERE]

In the next section we draw attention to an empirical regularity which seems to have escaped the attention of many previous writers on flows and yet is so fundamental to the understanding of unemployment dynamics that the remainder of this paper will draw on it time and time again. Its importance and role is such that it deserves the status of a law – the law of flows.

3. The relationship between *INR* and *OUTR*, Cointegration and Causation

An important question concerns the relationship (and, in particular the long-run relationship) between *INR* and *OUTR*. In particular, we formally test for the exogeneity of *INR*, whether there is a cointegrating relationship between *INR* and *OUTR* and, should there be a relationship, whether it is such that if *INR* increases then sooner or later *OUTR* will rise by an amount equal to the rise in *INR*.

Using monthly data for *INR* and *OUTR* over the period 1980:01 – 2001:03 we find for both Males and Females (separately considered) that *INR* and *OUTR* are I(1) and that

[9] That *INR*, *OUTR* and *UR* move up and down together is a feature not only of the Australian data but is also to be found in data for France, Germany, Spain and the USA (Burda & Wyplosz, 1994, p 1289f; Balakrishman and Michelacci, 2001, p 145), Canada (Jones & Riddell, 1998, p S106f), the UK (Burgess, 1994, p 811; Balakrishman and Michelacci, 2001, p 145) and New Zealand (Silverstone and Gorbey, 1995).

[10] Note that *UR* is measured at the beginning of the period (month) whilst the flows are measured as occurring over the whole of the period (month). In that sense, there is a one-period lag 'built-in' to the data set.

they are cointegrated with a cointegrating vector of approximately (1, -1).[11] The relevant Error Correction Models are reported below. For both Males and Females, tests for Causality show that *INR* is exogenous and that *OUTR* is endogenous.[12] We cannot stress enough the importance of this finding, which is not only a feature of Australian data - Balakrishnan & Michelacci (2001, p 142 and 143f) find that Inflow and Outflow Rates for the US, UK, Germany, France and Spain also have cointegrating vectors of (1, -1). This is a finding which has enormous implications for our understanding of the behavior not only of *OUTR* over time but also the behavior of *UR* - as we shall explain later – hence our description of it as the 'law of flows'.

The error correction model for Males is[13]

$$D(OUTR)_t = \underset{(0.0204)}{-0.1131}*(OUTR_t - \underset{(0.0035)}{1.0483}*INR_t) + \underset{(0.0492)}{0.1655}* D(OUTR)_{t-3}$$

$$+ \underset{(0.0563)}{0.3795}* D(INR)_{t-1}$$

and for Females is

$$D(OUTR)_t = \underset{(0.0204)}{-0.1131}*(OUTR_t - \underset{(0.0036)}{1.0483}*INR_t) + \underset{(0.0492)}{0.1654}* D(OUTR)_{t-3}$$

$$+ \underset{(0.0563)}{0.3795}* D(INR)_{t-1}$$

where D signifies the first-difference operator. Figures in parentheses are the estimated standard errors of the coefficients.

In this paper we are particularly interested in the fact that the Outflow Rate is 'pro-cyclical' where by that term we mean it goes up and down with the Unemployment

[11] Another way to put this is to say that in the long run $INR_t - OUTR_t = e_t$, where e_t is stationary with mean zero.

[12] In the full VEC Model the error correction coefficient for D(*INR*) is insignificant while the coefficient for D(*OUTR*) is both negative and significant.

[13] In the case of both Males and Females the optimal lag length as determined by the Schwarz and Hannan-Quinn criterion is 3 (months). In fact the coefficient of interest (the long-run coefficient which

Rate.[14] For many, as we have noted in the introduction, this is a surprising and puzzling or paradoxical finding. As we shall see, given that the Unemployment Rate is cyclical, given also the finding that *INR* and *OUTR* are cointegrated and that the cointegrating vector is (1, -1), the result that we refer to as the 'law of flows', it is not surprising that *OUTR* is pro-cyclical and nor is it surprising that to find that *OUTR* rises (with *INR*) in recessions. Indeed, it would be odd if it were not so.

In the next section of the paper we explain why we observe this co-movement (and pro-cyclicality). We then show how our explanation for the observed positive correlation between the Outflow Rate and the Unemployment Rate can be used to improve our understanding of the determinants of the severity of recessions.

4. Why does the Outflow Rate vary with the Unemployment Rate?

It is common to regard any flow measured in terms of numbers of persons per month moving between any two states to be determined by the relevant transition probability in conjunction with the size of the relevant pool at the beginning of the month. Applying this idea, the flow measured in terms of numbers of persons per month moving out of Unemployment (*OUT*) is equal to the product of the transition probability of moving out of Unemployment[15] (*TPO*) and the number unemployed (*U*) at the beginning of the month. So that:[16]

$$OUT_t = TPO_t \times U_t \tag{1}$$

Dividing both sides by the size of the Labour Force gives an expression for the Outflow Rate (*OUTR*) in terms of the transition probability and the Unemployment Rate (*UR*).

$$OUTR_t = TPO_t \times UR_t \tag{2}$$

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relates *OUTR* to *INR*) is quite robust to different lag specifications. The results reported here are for the case where all insignificant lagged difference terms have been restricted to zero.

[14] The term 'counter-cyclical' is often used to describe this when the cycle in *GDP* is being used as the reference point. Our reference point is the cycle in *UR*.

[15] *TPO* will equal the ratio of the number moving from Unemployment to another state over the course of the month divided by the total number unemployed at the beginning of the month.

[16] For the moment we will deal with a highly aggregated approach to the Outflow Rate in that we are not distinguishing between the various destinations of the Outflow. Later in the paper we model outflow in terms of three explicit components: Outflows to Full-time Employment, Outflows to Part-time Employment and Outflows to Not in the labour force.

Figure 2 shows for Males and Females the time paths of *TPO* (LH scale & solid line) and the (inverted) Unemployment Rate (RH scale and dashed line) in Australia over the period 1980:01 – 2001:03.

[FIGURE 2 NEAR HERE]

For Males the range of *TPO* is from a low of 0.250 per month to a high of 0.391 per month, with a mean of 0.312 and the standard deviation is 0.038. For Females the range is from a low of 0.385 per month to a high of 0.495 per month, with a mean of 0.437 and standard deviation 0.027. We note that *TPO* can be very high with 1/3 or even close to 1/2 of the number unemployed at the beginning of the period moving out of Unemployment over the month![17]

The Unemployment Rate has been inverted on the charts to more clearly show the movement of *TPO* in times of recession and recovery. Clearly *TPO* and *UR* are negatively correlated with *TPO* falling in recessions and rising during recoveries.[18]

Given the relationship between *OUTR*, *TPO* and *UR* as presented in equation (2), and given also that *TPO* falls as UR rises, how can *OUTR* rise as *UR* rises? The explanation is that the effect of the fall in *TPO* on *OUTR* does not offset the effect of the rise in *UR* on *OUTR*.

It is useful at this point to look at the behavior of *UR*, *TPO* and *OUTR* over the course of the two major recessions experienced in the past 25 years.

For ease of exposition we will work with the proportionate change in the Outflow Rate which, given (2), can be expressed as:[19]

$$\frac{\Delta(OUTR)}{OUTR} = \frac{\Delta(TPO)}{TPO} + \frac{\Delta(UR)}{UR} \tag{3}$$

[17] This is so high that one has to consider the possibility of measurement error and especially errors associated with mis-classification. This issue has been extensively explored in the USA where re-interview data is available. It would appear that the most common cause of spurious transitions there is the high level of false classification (and non-serially correlated misclassifications) of unemployed persons as not in the labour force. See Poterba & Summers (1995) and the references cited therein.

[18] Contempraneous correlation coefficients between *TPO* and the *UR* (not inverted!) are: Males -0.696 and Females –0.932.

[19] This is really only an approximation to the exact relationship which is given in Appendix A. For this reason the column totals in each case will not sum to the exact figure given for the proportionate change in *OUTR*.

Table 2 below shows the relative size of movements in *OUTR*, *TPO* and *UR* for Males and Females over the course of the two recession episodes.[20]

We have already noted that, over the course of a recession, *TPO* falls while the Unemployment Rate rises. In principle, the two changes could offset each other. However, in practice the relative proportionate changes are such that the net effect is a rise in the Outflow Rate. The proportionate change in *UR* more than offsets the fall in *TPO* and we see this born out in Table 3. Although *TPO* falls over the course of the recession, it falls by an absolute magnitude which is only 1/3 to 1/2 of the rise in the Unemployment Rate. As a result, in each case *OUTR* rises over the course of the recession by an amount which is roughly equal to 1/2 to 2/3 of the rise in the Unemployment Rate.

[TABLE 2 NEAR HERE]

Notice that in each case examined in the Table 2 that the proportionate change in *TPO* is less than that of *UR*. In other words, *TPO* is related to *UR* in such a manner that the elasticity of *TPO* with respect to the Unemployment Rate appears to be in the range –1/3 to –1/2 and definitely it would seem to be not as negative as –1. Because *TPO* is <u>inelastic</u> with respect to the Unemployment Rate, we observe *OUTR* rising in recessions.

Having noted that finding, we are now in a position to turn (inter alia) to the question raised in the title of this paper regarding the severity of recessions.

5. What determines the severity of recessions?

In thinking about the extent to which the Unemployment Rate changes between any two periods, we will work with the approximation:[21]

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[20] We are dealing with discrete and relatively large changes. Proportionate changes for *OUTR*, *UR* and *TPO* are (largest – smallest) divided by ½ (largest + smallest). Where the largest was the earliest observation the resultant figure for proportionate change is given a minus sign. Dates for the beginning and end are dates at which *OUTR* was at its trough and *OUTR* was at its peak (these are pretty much the same as when *UR* was at its trough and peak). For Males the dates are 1981:05 – 1983:09 and 1989:12 – 1993:02. For Females the dates are 1981:07 – 1983:10 and 1989:12 – 1993:05.

[21] A quick way to see how (4) is derived is to assume that the size of the labour force (*LF*) is constant and to define $X = U \times (1/LF)$, where U is the number unemployed. It must then be the case that $dX/dt = (1/LF) \times (dU/dt)$. Now we know that $dU = IN - OUT$, and so $dX/dt = d(U/LF) = (1/LF) \times (IN - OUT)$.

$$d(UR) = \left(\frac{IN - OUT}{LF}\right) = \frac{IN}{LF} - \frac{OUT}{LF} = INR - OUTR \tag{4}$$

Where *IN* and *OUT* are the absolute number of persons flowing in to and out of Unemployment over the period respectively and *LF* is the absolute size of the Labour Force at the beginning of the period.

Clearly, if *INR* exceeds *OUTR* the Unemployment Rate will rise; if *OUTR* exceeds *INR* the Unemployment Rate will fall, and; if *OUTR* equals *INR* the Unemployment Rate will remain constant.

Let us now envisage a world in which we have a classical business cycle in which *UR* moves up and down with a recurrent wave-like motion. Over the course of a recession the Unemployment Rate begins at its 'trough level' (where it is momentarily constant), it then rises (which must be because *INR* exceeds *OUTR* and the rise in *UR* will persist only so long as this is true) by a large or small amount until it reaches its peak (where, again, *UR* is momentarily constant). Another way to put this is to say that over the course of a recession we move from a situation where *INR* and *OUTR* are both equal and momentarily constant, to a number of successive periods where *INR* exceeds *OUTR* and then to a situation where *INR* and *OUTR* are again both equal and (momentarily, at least) constant.

It may be useful at this point to (re-) state some 'stylised facts' about the Unemployment Rate and the Inflow and Outflow Rates over the course of the business cycle. They are: (1) The Unemployment Rate is cyclical as are the Inflow Rate and the Outflow Rate. (2) Both the Inflow Rate and the Outflow Rate are 'procyclical' whereby we mean they both go up and down with the Unemployment Rate and, inter alia, this means that <u>both</u> *INR* and *OUTR* rise in recessions. (3) During a recession *INR* (which is rising) exceeds *OUTR* (which is also rising) and as a result *UR* rises.

Figure 3 is a stylized diagram of the evolution of *UR*, *INR* and *OUTR* over the course of the recession phase of the business cycle. The two dates where *INR* and *OUTR* are equal correspond to the trough and the peak in the *UR* series and that in between those two dates *INR* exceeds *OUTR* and the Unemployment Rate, as a consequence, is rising.

This expression is an approximation as we have assumed that Labour Force is constant. See Dixon (2002), for an explanation of the way in which a growing Labour Force can be incorporated into the expression for the change in the Unemployment Rate.

[FIGURE 3 NEAR HERE]

In what follows we will take the Inflow Rate (*INR*) to be pre-determined and to be itself behaving in a wave-like manner. When the Unemployment Rate has troughed or 'bottomed out' the Inflow and Outflow Rates must be equal. As the recession begins the Inflow Rate will rise relative to the Outflow Rate (of course the recession begins because the Inflow Rate rises) and indeed will keep rising until (at least) the peak is reached. The statement, that over the course of the recession *INR* rises is important as it is the key to what follows. For the Unemployment Rate to peak, the Outflow Rate must rise over the course of the recession, and it has to keep rising until it has caught up with the Inflow Rate. Once it has caught up, the Unemployment Rate will stop rising and it (*UR*) will have peaked (i.e. the recession will be at an end).

Treating the Inflow Rate as pre-determined, we can approach the determination of the severity of recessions by posing the - by now familiar - question: what determines the Outflow Rate in any period?

For ease of exposition we will continue to work with proportionate changes. The proportionate change in the Outflow Rate over any period can be expressed as:

$$\frac{\Delta(OUTR)}{OUTR} = \frac{\Delta(TPO)}{TPO} + \frac{\Delta(UR)}{UR} \tag{3}$$

Now we know that over the full course of the recession (that is for the whole of the period from the bottoming out of the Unemployment Rate, which will occur immediately prior to the beginning of the recession, to the peaking of the Unemployment Rate, which will occur immediately prior to the beginning of the recovery) the proportionate change in the Outflow Rate will have to equal the proportionate change in the Inflow Rate[22] (which we are taking as exogenous) and so we may substitute *(Δ(INR)/INR)* for *(Δ(OUTR)/OUTR)* in the above and solve for the proportionate change in the Unemployment Rate. In proportionate change terms:[23]

[22] Again, the evidence and common sense is that Inflow and Outflow Rates are cointegrated with a cointegrating vector equal to (1, -1).

[23] This expression is really only an approximation to the exact relationship which is given in Appendix B. For this reason in the table which follows the column totals will not sum to the exact figure given for the proportionate change in *UR*. Note also the minus sign on the RHS of (5). This means that the larger the fall in *TPO*, the larger the rise in the Unemployment Rate will have to be.

$$\frac{\Delta(UR)}{UR} = \frac{\Delta(INR)}{INR} - \frac{\Delta(TPO)}{TPO} \tag{5}$$

Both expressions (3) and (5) make intuitive sense and are capable of straight-forward explanation.[24] Over the course of the recession phase of the business cycle, the Outflow Rate must rise to (eventually) exactly match the rise in the Inflow Rate - which we are taking to be exogenous. Given that *TPO* does not rise during a recession (we have already seen that it falls) an increase in the Outflow Rate can only be brought about by an increase in the Unemployment Rate. The rise in the Unemployment Rate required to raise the Outflow Rate to equal the (now higher) Inflow Rate will depend upon two things: (a) how far the Inflow Rate has risen and (b) how far *TPO* falls over the course of the recession. To the extent that *TPO* falls, there will be less outflow from the pool of unemployed given any level of inflow and so for any level of inflow the Unemployment Rate will be higher than it otherwise would be.[25] Another way to put this is to say that, because *TPO* falls, the Unemployment Rate has to work harder and thus rise further in order to get the Outflow Rate to rise by the same amount as the Inflow Rate. (Again, it is important that the reader note the minus sign in front of the $(\Delta TPO/TPO)$ term in equation (5).)

To summarize (remember our stylized facts as captured in Figure 3): The deepness or the severity of a recession[26] depends upon two things. First, how far the Inflow Rate rises, and; Second, how far/fast *TPO* falls. The greater (smaller) the rise in the Inflow Rate, the greater (smaller) the Unemployment Rate will rise. The greater (smaller) the fall in *TPO*, the greater (smaller) the Unemployment Rate will rise. For given Inflow behavior, the severity of the recession, the extent to which *UR* rises from its trough to its peak, depends on the behavior of *TPO* and, given that it falls, how far it falls. The faster and the further *TPO* falls, the more severe will the recession be.

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[24] There is another way to arrive at (5). We know that $d(UR) = INR - OUTR$ and that *OUTR* is equal to $TPO \times UR$. If we insert this into our expression for $d(UR)$ and solve for the *UR* which would make *dUR* equal to zero (that is solve for the equilibrium Unemployment Rate) we would find that it is: $UR = (1/TPO) \times UR$. Writing this expression for the equilibrium Unemployment Rate in proportionate change terms gives equation (5).

[25] And equation (5) confirms this.

[26] By which we mean the extent of the rise in the Unemployment Rate over the course of a recession.

Table 3 shows the relative size of the components of equation (5) (i.e. *INR*, *TPO* and *UR*) over the course of the two major recessions experienced in the past 25 years.[27] Again, we work in terms of proportionate changes. For Males the severity (as indicated by the size of the proportionate change in *UR*) of the second recession was much the same as the first. From the table it is clear that this was simply because the higher proportionate change in *INR* (which would otherwise have meant that the second recession was far more severe than the first) was offset by a smaller (a less negative) proportionate change in *TPO*. For Females the severity (as indicated by the size of the proportionate change in *UR*) of the second recession was noticeable higher than the first. This was because of a higher proportionate change in *INR* (which by itself would have meant that the second recession was far more severe than the first) coupled with a greater proportionate change in (i.e. by a more negative change in) *TPO* (which by itself would also have meant that the second recession was far more severe than the first).

[TABLE 3 NEAR HERE]

Thus far we have treated *TPO* as if it is an exogenous variable on a par with *INR*. In practice it is common for researchers to hypothesize that transition probabilities such as *TPO* are, in part at least, endogenous. Consistent with this approach, we define the elasticity of *TPO* with respect to the Unemployment Rate (which we will denote by the symbol β) to be:

$$\beta = (\Delta TPO/TPO)/(\Delta UR/UR)$$

Rearranging the above to give an expression for $\Delta TPO/TPO$ and then substituting that expression into equation (5), gives

$$\frac{\Delta(UR)}{UR} = \frac{\Delta(INR)}{INR} - \beta\frac{\Delta(UR)}{UR}$$

which may be rearranged to give an expression for the proportionate change in the Unemployment Rate:

[27] Proportionate changes for *INR*, *UR* and *TPO* are (largest – smallest) divided by ½ (largest + smallest). Where the largest was the earliest observation the resultant figure for proportionate change is given a minus sign. Dates are the same as for earlier tables. Again we are dealing with discrete and relatively large changes and for this reason column sums may not be exactly equal to the figures for the recorded proportionate change in *UR*.

$$\frac{\Delta(UR)}{UR} = \left[\frac{\Delta(INR)}{INR}\right] \times \left[\frac{1}{1+\beta}\right] \tag{6}$$

Note that if $0 \geq \beta \geq -1$, the 'Inflow Multiplier' (i.e. 1/(1 + β)) on the RHS of (6) will be greater than 1. The data in Table 3 is consistent with the notiion that *TPO* is related to *UR* in such a manner that the elasticity of *TPO* with respect to the Unemployment Rate (β) is in the range $0 \geq \beta \geq -1$. As a result, $\Delta UR/UR$ will exceed $\Delta INR/INR$. Notice also that if $0 \geq \beta \geq -1$, and β were to (say) rise (i.e. it were to move nearer to zero), the proportionate increase in *UR* would be lower than it would otherwise be for a given proportionate increase in *INR*.[28] It would appear that this is what has happened in Australia. Table 4 shows for the two recessions the values of the proportionate changes in *INR* and *UR* together with values of β arrived at using information provided in Table 3[29] and the value of the Inflow Multipliers implied by those figures for β.

[TABLE 4 NEAR HERE]

Table 4 yields four pieces of information of importance. First, for both Males and Females the value of β lies between zero and minus one and, as a result, the value of the 'Multiplier' will be greater than unity. Second, the value of β for Males seems to be lower (i.e. nearer to minus one) than the value for Females. Third, the values of β and thus 'recession multiplier' for Males and Females may have been converging over time. Fourth, for both Males and Females the value of β, and thus the value of the 'Multiplier', was lower in the second recession than the first and, as a result, the second recession was less severe for both Males and Females than it would otherwise have been.[30] However, it would be unwise to put too much weight on these figures for the *TPO* elasticities (the β's) and Inflow Multipliers as they have both been computed in a very simplistic fashion. The aim of the discussion thus far has simply been to alert the

[28] If $TPO = UR^{\beta}$, and both *UR* and β are varying over time then $(\Delta TPO/TPO) = \beta(\Delta UR/UR) + \ln(UR)\Delta\beta$. Substitution of this expression for $\Delta TPO/TPO$ in (5) gives an expression for $\Delta UR/UR$ as: $(\Delta UR/UR) = (\Delta INR/INR) \times (1/1+\beta) - (\ln UR) \times (\Delta\beta/1+\beta)$.

[29] The values for β used here are arrived at by taking the figures presented in Table 3 and dividing the values of $\Delta TPO/TPO$ by the corresponding values of $\Delta UR/UR$. In the next section of the paper we will estimate β econometrically.

[30] Had β not fallen, the proportionate change in *INR* in the second recession would have been associated with a 15% higher rise in *UR* for Males and a 10% higher rise in *UR* for Females.

reader to the importance of β and to the existence and character of the Inflow Multiplier. We proceed now to more appropriate methods for estimating the size of both.

6. The Elasticity of *TPO* with Respect to *UR*

The transition probability out of unemployment (*TPO*) is an important variable and, because of this, the elasticity of *TPO* with respect to *UR* (i.e. β) is a very important variable. Its magnitude determines, at least in part, the magnitude of the rise in *OUTR* in recession (and the fall of *OUTR* in booms) and it also determines (together with *INR*) the severity of recessions as measured by the extent of the rise in the Unemployment Rate. It is important then to establish the value of the elasticity of *TPO* with respect to *UR* and to test for its stability over time We are also interested in whether there has been any systematic tendency for the β's and Inflow Multipliers for Males and Females to rise or fall and/or to converge over time. This can only be achieved by an econometric study of β and its evolution over time. However, we need to recognize that flows out of Unemployment may be to one of three destinations: Not in the labour force (with its associated transition probability *TPUTN*), Full-time employment (with its associated transition probability *TPUTFTE*), and Part-time employment (with its associated transition probability *TPUTPTE*). This means that the elasticity of *TPO* with respect to the Unemployment Rate will be a weighted sum of the elasticities associated with the Transition Probabilities of flows from Unemployment to each of these three states.

In Appendix C we show that the elasticity of *TPO* with respect to *UR* is equal to:

$$\beta = \omega_N \beta_N + \omega_{FTE} \beta_{FTE} + \omega_{PTE} \beta_{PTE} \tag{7}$$

where:

β is the elasticity of *TPO* with respect to *UR*, β_N is the is the elasticity of *TPUTN* with respect to *UR*, β_{FTE} is the elasticity of *TPUTFTE* with respect to *UR* and β_{PTE} is the elasticity of *TPUTPTE* with respect to *UR*, and

ω_N is the weight associated with the elasticity of *TPUTN* with respect to *UR*, ω_{FTE} is the weight associated with the elasticity of *TPUTFTE* with respect to

UR and ω_{PTE} is the weight associated with elasticity of *TPUTPTE* with respect to *UR*.[31]

Equation (7) indicates that whether β increases or decreases over time depends upon the behavior of the individual β_i's and the weights (ie the ω_i's). To estimate the individual β_i's we need data on the transition probabilities. Figures 4 and 5 show the time series for each of these (i.e. *TPO*, *TPUTN*, *TPUTFTE* and *TPUTPTE*) for both Males and Females.

[FIGURES 4 & 5 NEAR HERE]

The behavior of the transition probabilities over the period 1980:01- 2001:03

Figure 4 shows the behavior of *TPO* – this is the probability that someone who is unemployed in one month will not be unemployed in the following month - and *TPUTN* – this is the probability that someone who is unemployed in one month will have moved to Not in the labour force in the following month - for both Males (series with the prefix *M*) and Females (series with the prefix *F*). For Males *TPUTN* has risen over the whole period while for Females it was roughly constant until after the recession of the early 90's since when it has been rising. Currently (which in this context and in the remainder of this section means the average of monthly values over the period 2000:04 – 2001:03) the value of *TPUTN* for Males is 0.174 while it is much higher for Females, at 0.276.

Figure 5 shows the behavior of *TPUTFTE* – this is the probability that someone who is unemployed in one month will have moved to Full-time employment in the following month - and *TPUTPTE* – this is the probability that someone who is unemployed in one month will have moved to Part-time employment in the following month - for both Males and Females. For Males *TPUTPTE* has risen fairly steadily over the whole period while for Females also there has been a trend increase over the whole period although the cyclical component is more pronounced than for Males. Currently the value of *TPUTPTE* for Males is 0.102 while it is higher for Females, being 0.150. For both Males and Females the cyclical component in *TPUTFTE* is quite pronounced and it

[31] The exact definition of each of the weights and the data required for their computation is given in Appendix C.

is clear that for both Males and Females *TPUTFTE* has been trending downwards over the whole of the period, its current value being around half its value in the early 80's. Currently the value of *TPUTFTE* for Males is 0.110 while it is much lower for Females at 0.061.

Perhaps the most dramatic changes in the transition probabilities over the whole period we are interested in (1980:01 – 2001:03) involve the relative size of *TPUTFTE* and *TPUTPTE*. For both Males and Females *TPUTFTE* has been trending downwards and *TPUTPTE* has been trending upwards. Paradoxically, these similar movements in the transition probabilities have brought about an incredible difference in outcomes for unemployed Males compared with unemployed Females. Whilst *TPUTFTE* and *TPUTPTE* have been converging in the case of Males they have been diverging in the case of Females. The probability that an unemployed Male or Female will become employed in any one month[32] is roughly the same now as it was in the early 80's, the probability of moving to a Full-time job has halved whilst the probability of moving to a Part-time job has doubled. But there the similarities end. In the case of Males, in the early 80's *TPUTFTE* was more than three times the size of *TPUTPTE* but they are now almost identical. For Females *TPUTFTE* and *TPUTPTE* have been diverging. In the early 80's *FTPUTFTE* and *FTPUTPTE* were very similar, but now *FTPUTPTE* is two to three times as large as *FTPUTFTE*. Clearly, for both Males and Females there have been quite astounding changes in their probabilities of exiting unemployment to a full-time rather than a part-time job over the past two decades.[33]

Estimates of the elasticities appropriate to each destination

We turn now to the estimation of β_N, β_{FTE} and β_{PTE} for Males and Females using information on *TPUTN*, *TPUTFTE*, *TPUTPTE* and *UR* obtained from the matched records data over the period 1980:01 – 2001:03 and depicted in the various Figures given above. For each transition probability we wish to estimate the value of the elasticity and test for its stability over time.[34]

[32] This is the sum of *TPUTFTE* and *TPUTPTE*.
[33] The reasons for this will be examined in a later paper by the authors.
[34] We have not attempted here a comprehensive econometric study of all aspects of the transition probabilities as that would entail (i) the development of a comprehensive theory encompassing all of the

The only author who has previously looked at transition probability elasticities in relation to the Unemployment Rate using Australian data is Leeves (1997). He estimated the elasticities using a log-linear specification[35] in the levels using OLS (with an AR1 scheme where appropriate). In some cases[36] his estimates and ours are quite different. It is possible to think of two reasons for this. First, there is the difference in the sample periods - Leeves' data set ends in September 1992 while ours continues up until March 2001. A second reason is that Leeves has not taken into account the non-stationarity of the data he is using and so, even putting the difference in the sample period to one side, it is possible (indeed likely) that he has obtained spurious results.

Upon testing for unit roots in the data we find that all six Transition Probabilities and the two Unemployment Rates are I(1) both in the levels and the logarithms of the levels, but are (all) stationary in the levels and in the logarithms of the levels when first differenced.[37] Since none of the transition probability-unemployment rate pairs were cointegrated we have estimated the elasticities by regressing the first difference in the logs of the Transition Probabilities on a constant and the first difference in the logs of the Unemployment Rate. The results are reported in Table 5 by gender and by the destination of the outflow. In all cases diagnostic tests showed that serial correlation[38] and ARCH effects were absent.

[TABLE 5 NEAR HERE]

For the probability that an unemployed Male will move to full-time employment during the month (*MTPUTFTE*), we find an elasticity with respect to the Unemployment Rate (β_{FTE}) of –0.611 with an estimated standard error of 0.075 and so the estimate of β_N is

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elasticities and not merely the (outflow from the state of being unemployed) elasticities dealt with here, and (b) a full scale econometric study looking at the probabilities as a system (involving SUR at least) and subject to aggregation restrictions. That is well beyond the scope of this paper but it is a project we have commenced.

[35] Leeves included a time trend and so his regressions were all of the form *Log(TPxx) = c(1) + c(2)*Log(UR) + c(3)*Time*.

[36] Most conspicuously in the case of the *TPUTPTE* elasticities.

[37] For the variables we are considering here, the stochastic processes generating the series will be bounded within finite intervals, which lie somewhere between zero and 100. However, while it may be true that all the series must be stationary in the probability limit, we are dealing with not only a finite realisation of the process, but also with a sample period that is 'short'. In these circumstances, it is quite possible that the series may wander significantly within the interval, exhibiting characteristics that are for all practical purpose indistinguishable from an unrestricted random walk.

[38] A possible exception is the elasticity involving transitions from Unemployment to Not in the labour force by Females where the LM test statistic for AR(1) is significant at the 5% level but not at the 1% level.

significantly different from both 0 and –1 at the 1% level.[39] For the probability that an unemployed Male will move to part-time employment during the month (*MTPUTPTE*), we find an elasticity with respect to the Unemployment Rate (β_{PTE}) of –0.390, with an estimated standard error of 0.061 and so the estimate of β_N is significantly different from 0 and from –1 at the 1% level.[40] For the probability that an unemployed Male will move to Not in the labour force during the month (*MTPUTN*), we find an elasticity with respect to the Unemployment Rate (β_N) of –0.410, with an estimated standard error of 0.056 and so the estimate of β_N is significantly different from 0 and from –1 at the 1% level.[41]

For the probability that an unemployed Female will move to full-time employment during the month (*FTPUTFTE*), we find an elasticity with respect to the Unemployment Rate of (β_{FTE}) of –0.812, with an estimated standard error of 0.115 and so the estimate of β_{FTE} is significantly different from 0 at the 1% level but is not significantly different from –1 at the 5% level.[42] For the probability that an unemployed Female will move to part-time employment during the month (*FTPUTPTE*), we find an elasticity with respect to the Unemployment Rate (β_{PTE}) of –0.558, with an estimated standard error of 0.070 and so the estimate of β_{PTE} also is significantly different from both 0 and –1 at the 1% level.[43] For the probability that an unemployed Female will move to Not in the labour force during the month (*FTPUTN*), we find an elasticity with respect to the Unemployment Rate (β_N) of –0.145, with an estimated standard error of 0.056 and so the estimate of β_N is significantly different from 0 at the 5% level and from –1 at the 1% level.[44]

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[39] For the period 1980-1992 Leeves (1997, p 118) estimates the elasticity of *MTPUTFTE* with respect to *UR* to be –0.64.

[40] For the period 1980-1992 Leeves (1997, p 118) estimates the elasticity of *MTPUTPTE* with respect to *UR* to be +0.50 while for the sub-period 1985-1992 he estimates it to be –0.60 (ibid, p 124).

[41] Leeves (1997, p 118) estimates the elasticity of *MTPUTN* with respect to *UR* to be –0.59 for the period 1980-1992.

[42] For the period 1980-1992 Leeves (1997, p 118) estimates the elasticity of *FTPUTFTE* with respect to *UR* to be –1.20.

[43] For the period 1980-1992 Leeves (1997, p 118) estimates the elasticity of *FTPUTPTE* with respect to *UR* to be –0.06 while for the sub-period 1985-1992 he estimates it to be –1.39 (ibid, p 124).

[44] Leeves (1997, p 118) estimates the elasticity of *FTPUTN* with respect to *UR* to be –0.15 for the period 1980-1992.

Recursive estimates of each of the (six) elasticities are depicted in Figure 6. The elasticities have been remarkably stable over the whole or the greater part[45] of the sample period.

[FIGURE 6 NEAR HERE]

The weights appropriate to each destination

The actual definitions of the weights (the ω_i's in equation (7)) are such that each one records the importance of that 'state' as a destination for the outflow from unemployment. As reported in Appendix C, ω_N is the weight associated with the elasticity of *TPUTN* with respect to *UR* and is equal to (UTN/OUT), ω_{FTE} is the weight associated with the elasticity of *TPUTFTE* with respect to *UR* and is equal to $(UTFTE/OUT)$ and, ω_{PTE} is the weight associated with elasticity of *TPUTPTE* with respect to *UR* and is equal to $(UTPTE/OUT)$. Figure 7 shows the evolution of the weights for Males and Females over the period 1980:01 – 2001:03.

[FIGURE 7 NEAR HERE]

Clearly, the weights (and thus destinations of outflow from Unemployment) have not been constant over the period we are interested in (1980:01 – 2001:03), but their movement can be easily summarized. For both Males and Females the share of Part-time employment as a destination (ω_{PTE}) has risen although for both groups there seems to have been little increase after 1993/94. Currently ω_{PTE} for Males is 0.265 while for Females it is 0.308. For both Males and Females the share of moves to Full-time employment from unemployment (i.e. ω_{FTE}) has fallen as a share of all moves out of unemployment. For Females the bulk of the fall occurred before 1991/92 after which ω_{FTE} has remained fairly constant, perhaps falling a little. For Males the bulk of the fall also occurred before 1991/92 but ω_{FTE} has continued to fall after the recession, albeit at a slightly slower rate than before. Currently the value of ω_{FTE} for Males is 0.286 while for Females it is 0.125. With respect to flows from Unemployment to Not in the labour force: the weight (ω_N) for Males has been increasing over the whole of the period

[45] For the elasticities associated with *MTPUTPTE* and *FTPUTFTE* stability can only be assumed for the period since the mid 80's.

although it was increasing at a faster rate prior to 1992/93 than it has since then. For Females the weight (ω_N) was falling (very slightly) until 1989/90 when it increased but it has been fairly constant since then. Mean values of ω_N at present (the average monthly figure over the period 2000:04 – 2001:03) are 0.449 for Males and 0.568 for Females.[46]

The evolution of β and the Multiplier over time

Combining our estimates of β_N, β_{FTE} and β_{PTE} with historical values of the weights in accordance with equation (7) we can generate a series for β itself. These are set out in Figure 8 for Males (*MBETA*) and Females (*FBETA*).

[FIGURE 8 NEAR HERE]

Both series have been trending upwards primarily because the weights associated with the lowest elasticity category (which for both Males and Females is the elasticity of *TPUTFTE* with respect to *UR*) have been falling whilst the weights associated with the higher elasticity categories have been rising or remaining (roughly) constant.

The current value (the average monthly value over the period 2000:04-2001:03) of *MBETA* is -0.46 and of *FBETA* is -0.36.

Earlier (in equation (6) and the related text) we saw that the (Inflow) Multipliers could be computed as:

$$\text{Multiplier} = \left[\frac{1}{1+\beta}\right]$$

The values of the multiplier over time for both Males and Females are given in Figure 9.

[FIGURE 9 NEAR HERE]

Both series are trending downwards (this is most clearly the case for Males) over the whole of the sample period although they both have been fairly constant over the past 2 or 3 years. The current value (the average monthly value over the period 2000:04-

[46] So it continues to be the case that "women appear to be (much) more likely than men to exit from

2001:03) of *MMULT* is 1.86 and of *FMULT* is 1.55. The fact that the Male Multiplier is larger than the Female Multiplier indicates that recessions would have a more severe impact on the Male Unemployment Rate than on the Female Unemployment Rate, conditional on the proportionate rise in the Inflow Rate being the same. Essentially this is because Females have a greater propensity to exit unemployment (and in particular to move from unemployment to Not in the labour force) than Males.

7. Summary and Conclusions

ABS data on monthly gross flows of labour into and out of unemployment from February 1980 to March 2001 have been used to highlight the importance of the outflow from unemployment, and its determination, in understanding the course of recessions as measured by the unemployment rate.

Both the inflow rate and the outflow rate were found to be procyclical. Given that the inflow rate is procyclical and causally independent of the outflow rate, the outflow rate has to rise and ultimately equal the inflow rate to conclude a recession. In fact, the inflow and outflow rates are found to be cointegrated with long run parameters for the cointegrating relationship of (1, -1). Such is its significance, that we refer to this as 'the law of flows'.

The outflow from unemployment depends on the product of the transition probability from unemployment and the unemployment rate. The transition probability was found to be anticyclical. Then, recessions are longer and more severe[47] the greater is the increase in the unemployment inflow rate and the greater is the fall in the transition probability.

A key parameter in understanding the path of recessions is the elasticity of the transition probability out of unemployment with respect to the unemployment rate. Here it is important to disaggregate outflows to full-time jobs, part-time jobs and to not in the labour force, and by gender. For all categories the elasticity is estimated to be inelastic falling between -1 and 0 and to have been stable over the sample period, but to vary across categories. For example, in absolute values the elasticities are higher for full-

unemployment by leaving the labour force" (Fahrer and Heath, 1992, p 22).

[47] In terms of higher unemployment.

time employment than for part-time employment for both genders and they are lower for females exiting to not in the labour force than for males.

Significant changes over the 1980 - 2001 sample period in the weights for movement from unemployment to full-time employment, part-time employment and not in the labour force have altered the weighted sum elasticities. For males the (aggregate) elasticity of the transition probability out of unemployment with respect to the unemployment rate has trended steadily up to a current value of around -0.46, and for females it has been more cyclically sensitive and has a current value of around -0.36.

The shifts in the mix or composition of the workforce from full-time to part-time jobs, and from males to females, each with lower values for the elasticities of transition out of unemployment with respect to the unemployment rate has resulted in a tendency for there to be both a rise in the outflow rate and a reduction in the severity of recessions.

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APPENDIX A: The exact relationship between *OUTR* on the one hand and both *TPO* and *UR*, on the other.

Let $OUTR = TPO*UR$ (A1)

Then it must be true that

$$OUTR + \Delta OUTR = (TPO + \Delta TPO)(UR + \Delta UR)$$

The above may be written as:

$$OUTR\left(1+\frac{\Delta OUTR}{OUTR}\right)=\left(TPO\left(1+\frac{\Delta TPO}{TPO}\right)\right)\left(UR\left(1+\frac{\Delta UR}{UR}\right)\right) \quad \text{(A2)}$$

Given (A1), we may divide both sides of (A2) by *OUTR* (= *TPO*UR*) to yield:

$$\left(1+\frac{\Delta OUTR}{OUTR}\right)=\left(1+\frac{\Delta TPO}{TPO}\right)\left(1+\frac{\Delta UR}{UR}\right)$$

which may be expanded to give:

$$\left(1+\frac{\Delta OUTR}{OUTR}\right)=1+\frac{\Delta TPO}{TPO}+\frac{\Delta UR}{UR}+\left(\frac{\Delta TPO}{TPO}\right)\left(\frac{\Delta UR}{UR}\right)$$

Subtracting 1 from each side gives an expression for the growth Rate of *OUTR* as:

$$\frac{\Delta OUTR}{OUTR}=\frac{\Delta TPO}{TPO}+\frac{\Delta UR}{UR}+\left(\frac{\Delta TPO}{TPO}\right)\left(\frac{\Delta UR}{UR}\right)$$

Which is to say that the proportionate change in *OUTR* is the sum of the proportionate changes in *TPO* and *UR* plus an interaction term

APPENDIX B: The exact relationship between the proportionate change in *UR* and the proportionate changes in *TPO* and *INR*.

The equilibrium value of the Unemployment Rate will be:

$$UR = \frac{INR}{TPO} \tag{B1}$$

It must be true that

$$UR + \Delta UR = \frac{INR + \Delta INR}{TPO + \Delta TPO}$$

The above may be written as:

$$UR\left(1+\frac{\Delta UR}{UR}\right) = \frac{INR\left(1+\frac{\Delta INR}{INR}\right)}{TPO\left(1+\frac{\Delta TPO}{TPO}\right)} \tag{B2}$$

Given (B1), we may divide both sides of (B2) by *UR* (= *INR/TPO*) to yield:

$$1 + \frac{\Delta UR}{UR} = \frac{1+\frac{\Delta INR}{INR}}{1+\frac{\Delta TPO}{TPO}}$$

Subtracting 1 from each side gives:

$$\frac{\Delta UR}{UR} = \frac{1+\frac{\Delta INR}{INR}}{1+\frac{\Delta TPO}{TPO}} - 1 = \frac{1+\frac{\Delta INR}{INR}}{1+\frac{\Delta TPO}{TPO}} - \frac{1+\frac{\Delta TPO}{TPO}}{1+\frac{\Delta TPO}{TPO}} = \frac{1+\frac{\Delta INR}{INR}-1-\frac{\Delta TPO}{TPO}}{1+\frac{\Delta TPO}{TPO}}$$

$$= \left(\frac{\Delta INR}{INR} - \frac{\Delta TPO}{TPO}\right) - \left(\left(\frac{\Delta INR}{INR} \Big/ \frac{\Delta TPO}{TPO}\right) - 1\right)$$

Which is to say that the proportionate change in *UR* is the difference between the proportionate changes in *INR* and *TPO*, less an interaction term.

APPENDIX C: Derivation of the expression for the elasticity of *TPO* with respect to *UR*

By definition *TPO* can be seen as the sum of three transition probabilities:

$$\begin{aligned} TPO &= \frac{OUT}{U} \\ &= \frac{UTN + UTFTE + UTPTE}{U} \\ &= \frac{UTN}{U} + \frac{UTFTE}{U} + \frac{UTPTE}{U} \\ &= TPUTN + TPUTFTE + TPUTPTE \end{aligned} \tag{C1}$$

where

UTN is the number moving from Unemployment to Not in the labour force, *UTFTE* is the number moving from Unemployment to Full-time employment and *UTPTE* is the number moving from Unemployment to Part-time employment, and

TPUTN is the transitional probability that someone Unemployed in the first month will move to Not in the labour force by the next month, *TPUTFTE* is the transitional probability that someone Unemployed in the first month will move to Full-time employment by the next month and *TPUTPTE* is the transitional probability that someone Unemployed in the first month will move to Part-time employment by the next month.

Given (C1), we may write:

$$\frac{dTPO}{dUR} = \frac{dTPUTN}{dUR} + \frac{dTPUTFTE}{dUR} + \frac{dTPUTPTE}{dUR}$$

Multiplying both sides by UR/TPO gives

$$\frac{dTPO}{dUR} \times \frac{UR}{TPO} = \frac{dTPUTN}{dUR} \times \frac{UR}{TPO} + \frac{dTPUTFTE}{dUR} \times \frac{UR}{TPO} + \frac{dTPUTPTE}{dUR} \times \frac{UR}{TPO}$$

which can be written as

$$\frac{dTPO}{dUR}\frac{UR}{TPO} = \frac{dTPUTN}{dUR}\frac{UR}{TPUTN}\frac{TPUTN}{TPO} + \frac{dTPUTFTE}{dUR}\frac{UR}{TPUTFTE}\frac{TPUTFTE}{TPO} + \frac{dTPUTPTE}{dUR}\frac{UR}{TPUTPTE}\frac{TPUTPTE}{TPO}$$

Given the definitions of *TPO*, *TPUTN*, *TPUTFTE* and *TPUTPTE* we may write the above as

$$\frac{dTPO}{TPO}\Big/\frac{dUR}{UR} = \frac{dTPUTN}{dUR}\frac{UR}{TPUTN}\frac{UTN}{OUT} + \frac{dTPUTFTE}{dUR}\frac{UR}{TPUTFTE}\frac{UTFTE}{OUT} + \frac{dTPUTPTE}{dUR}\frac{UR}{TPUTPTE}\frac{UTPTE}{OUT}$$

which may be written as:

$$\beta = \omega_N \beta_N + \omega_{FTE}\beta_{FTE} + \omega_{PTE}\beta_{PTE} \qquad \text{(C2)}$$

where:

β is $\left[(dTPO/TPO)/(dUR/UR)\right]$ which is the elasticity of *TPO* with respect to UR, β_N is $\left[(dTPUTN/TPUTN)/(dUR/UR)\right]$ which is the elasticity of *TPUTN* with respect to *UR*, β_{FTE} is $\left[(dTPUTFTE/TPUTFTE)/(dUR/UR)\right]$ which is the elasticity of *TPUTFTE* with respect to *UR* and, β_{PTE} is $\left[(dTPUTPTE/TPUTPTE)/(dUR/UR)\right]$ which is the elasticity of *TPUTPTE* with respect to *UR*, and;

ω_N is the weight associated with the elasticity of *TPUTN* with respect to *UR* and is equal to (UTN/OUT), ω_{FTE} is the weight associated with the elasticity of *TPUTFTE* with respect to *UR* and is equal to $(UTFTE/OUT)$ and, ω_{PTE} is the weight associated with elasticity of *TPUTPTE* with respect to *UR* and is equal to $(UTPTE/OUT)$.

Equation (C2) is the expression for β which is given in the text.

TABLE 1

Contemporaneous correlation coefficients for the Outflow and Inflow Rates and the Unemployment Rates

Males

	OUTR	*UR*	*INR*
OUTR	1.000		
UR	0.856	1.000	
INR	0.963	0.852	1.000

Females

	OUTR	*UR*	*INR*
OUTR	1.000		
UR	0.955	1.000	
INR	0.954	0.971	1.000

TABLE 2

Proportionate Changes in *OUTR*, *TPO* and *UR* over the course of the two recession episodes

Males

	First recession	Second recession
UR	0.692	0.700
TPO	-0.321	-0.268
OUTR	0.393	0.454

Females

	First recession	Second recession
UR	0.315	0.411
TPO	-0.139	-0.156
OUTR	0.178	0.259

TABLE 3

The size of the components of equation (5) over the course of the two recessions

Males

	First recession	Second recession
INR	0.338	0.420
TPO	-0.321	-0.268
UR	0.692	0.700

Females

	First recession	Second recession
INR	0.175	0.256
TPO	-0.139	-0.156
UR	0.315	0.411

TABLE 4

Proportionate changes in *INR* and *UR* together with the values of β and the Inflow Multiplier for the two recession episodes

Males

	First recession	Second recession
INR	0.338	0.420
β	-0.464	-0.383
$1/(1 + \beta)$	1.866	1.621
UR	0.692	0.700

Females

	First recession	Second recession
INR	0.175	0.256
β	-0.441	-0.380
$1/(1 + \beta)$	1.789	1.613
UR	0.315	0.411

TABLE 5

Estimates of the Elasticity of the Transition Probabilities with respect to the Unemployment Rate (1980:02 – 2001:03)

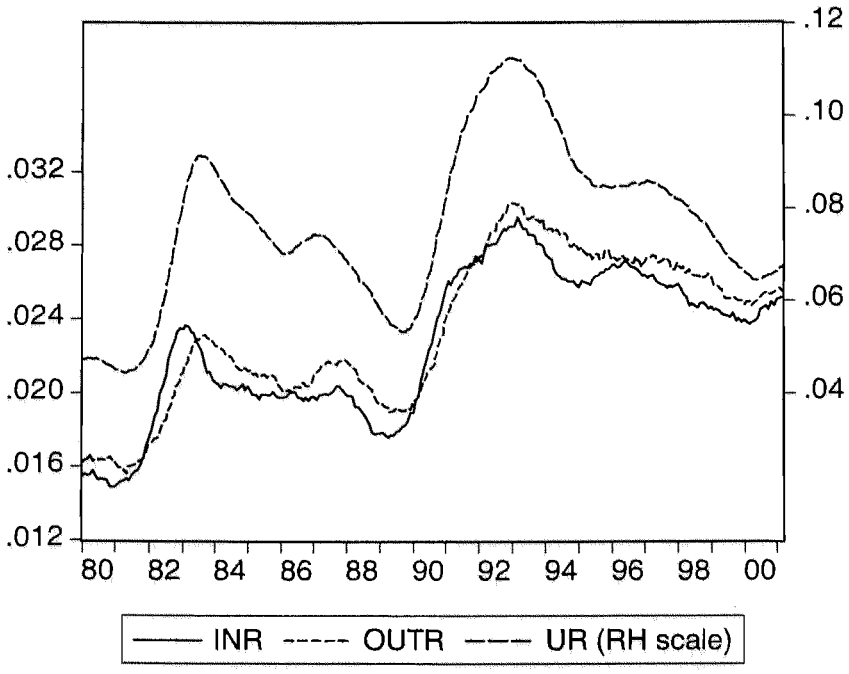
	Elasticity (β_i)	Diagnostics		
		R^2	AR(1)*	ARCH(1)*
Males				
To Full-time Employment	-0.611	0.347	1.598	0.418
	(0.000)		(0.206)	(0.518)
To Part-time Employment	-0.390	0.145	2.360	0.078
	(0.000)		(0.124)	(0.780)
To Not in the Labour Force	-0.410	0.212	0.002	0.052
	(0.000)		(0.963)	(0.819)
Femaies				
To Full-time Employment	-0.812	0.206	1.263	0.047
	(0.000)		(0.261)	(0.827)
To Part-time Employment	-0.558	0.202	1.691	0.646
	(0.000)		(0.193)	(0.422)
To Not in the Labour Force	-0.145	0.040	6.198	0.016
	(0.011)		(0.013)	(0.899)

All figures in brackets are p-values. The p-values for the estimated coefficients are based on Newey-West HAC standard errors.

* LM Test for first-order autocorrelation and ARCH.

FIGURE 1

Males



Females

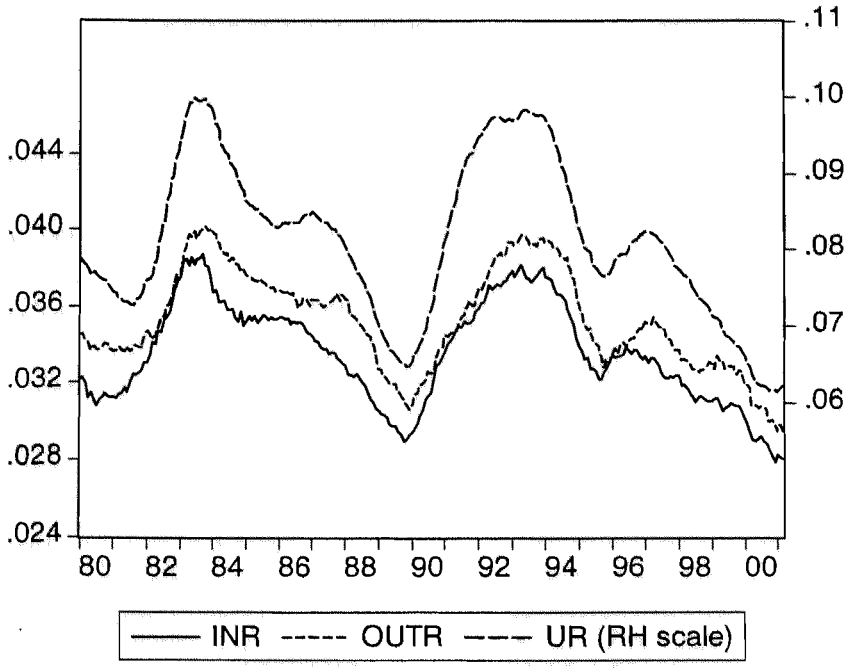
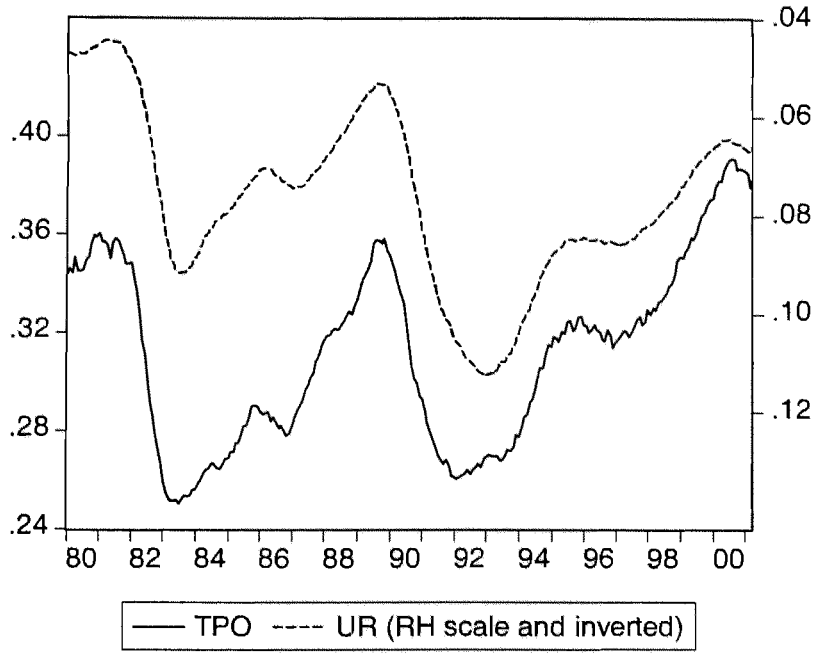


FIGURE 2

Males



Females

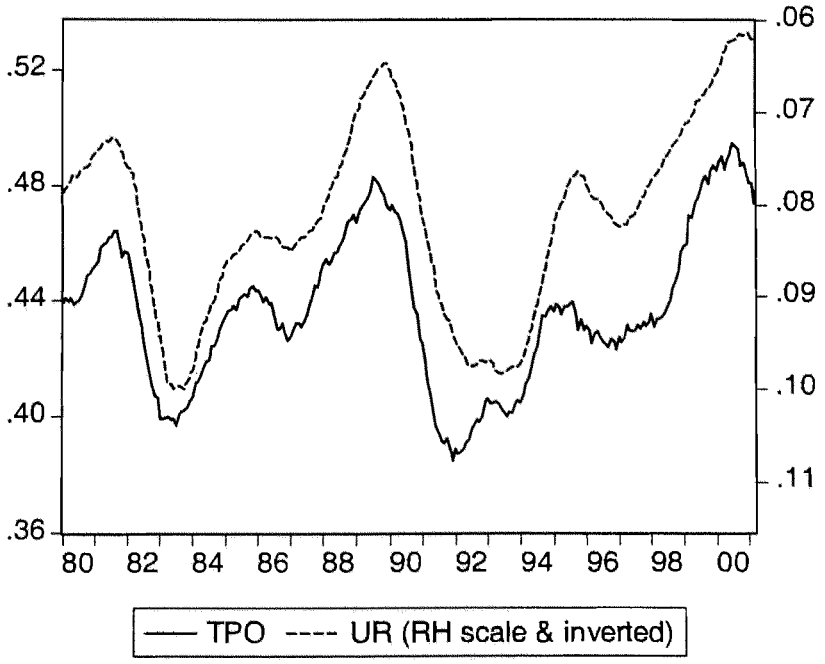


FIGURE 3

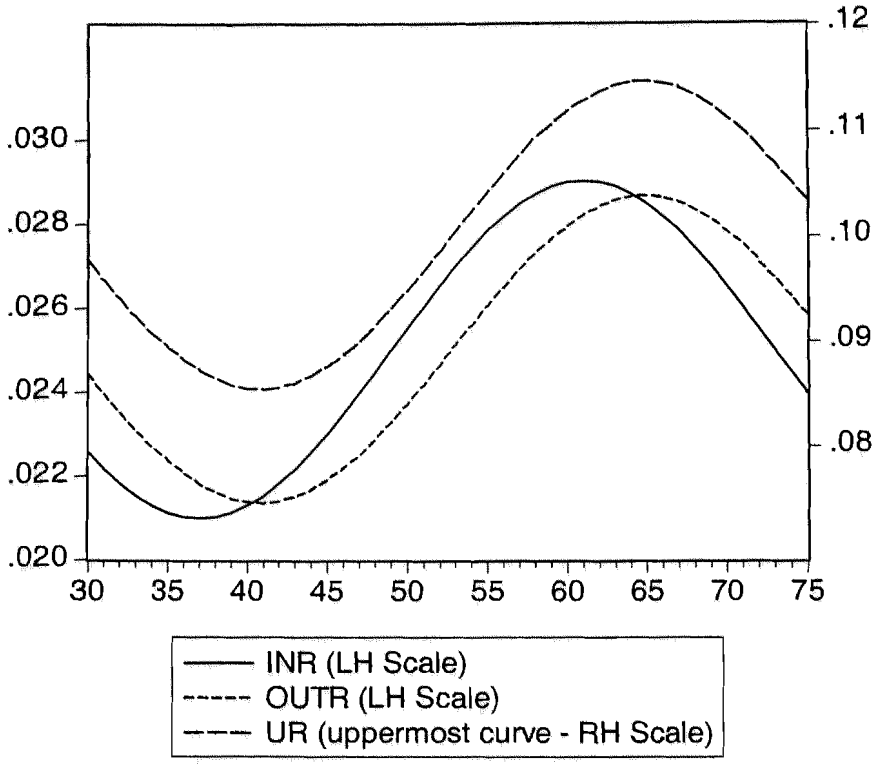
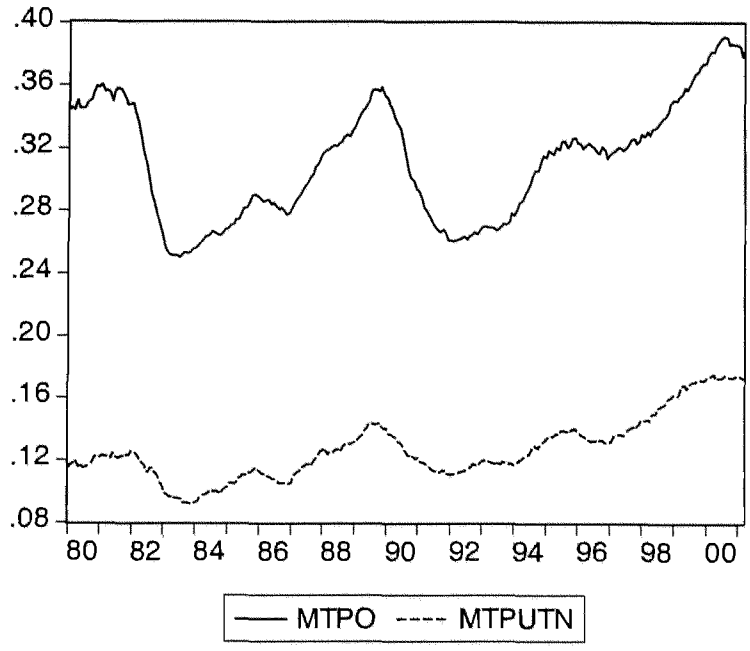

.030
.028
.026
.024
.022
.020
.12
.11
.10
.09
.08
30
35
40
45
50
55
60
65
70
75
INR (LH Scale)
OUTR (LH Scale)
UR (uppermost curve - RH Scale)

FIGURE 4

Males



Females

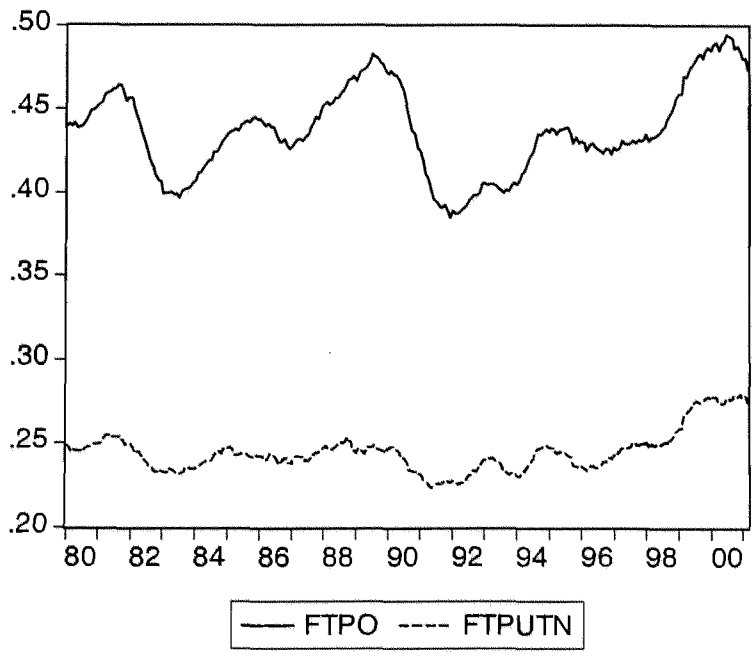
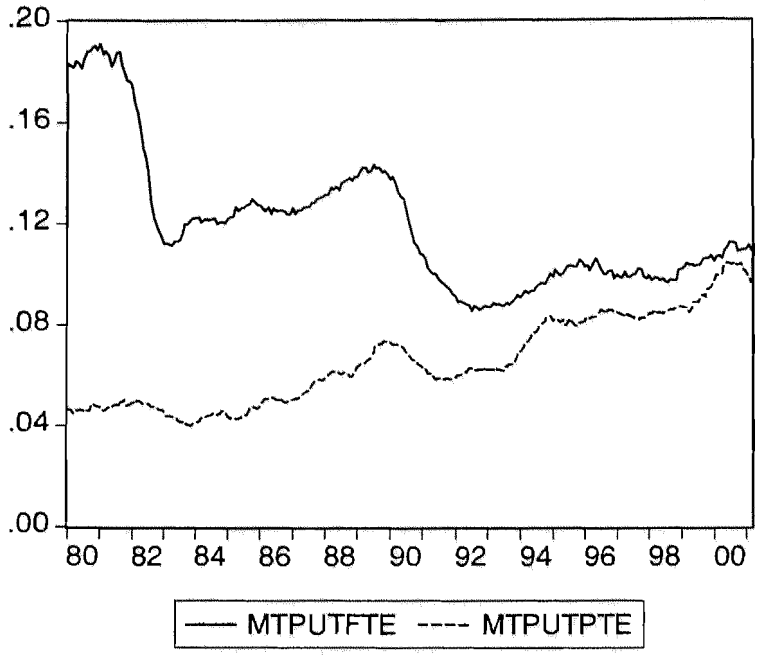


FIGURE 5

Males



Females

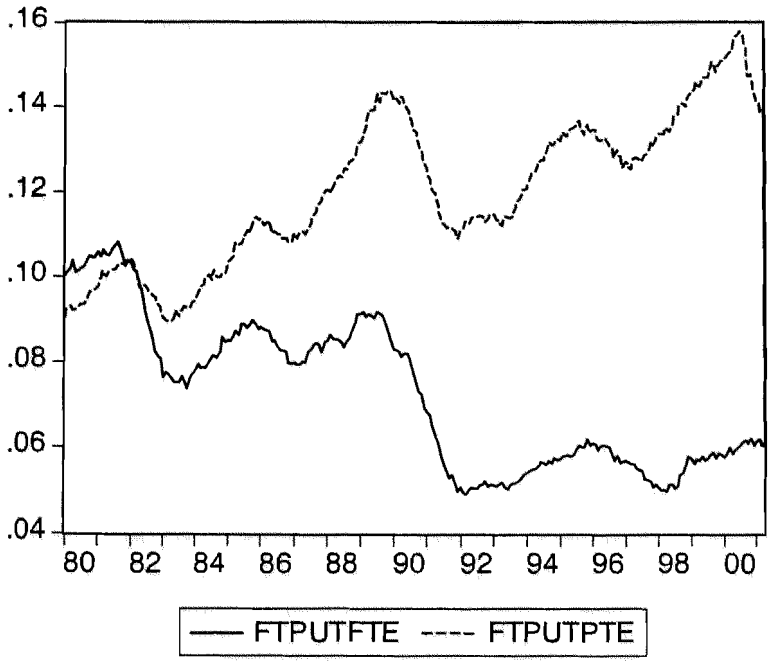
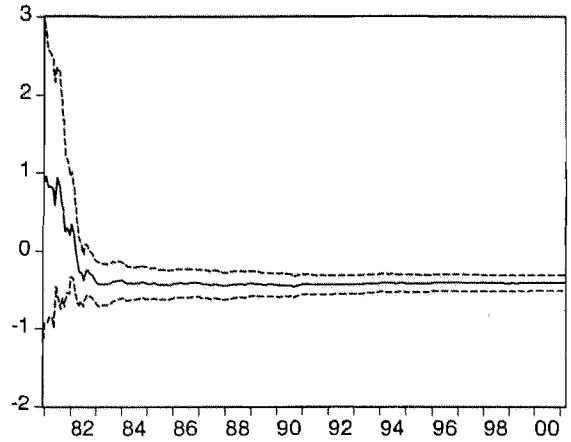


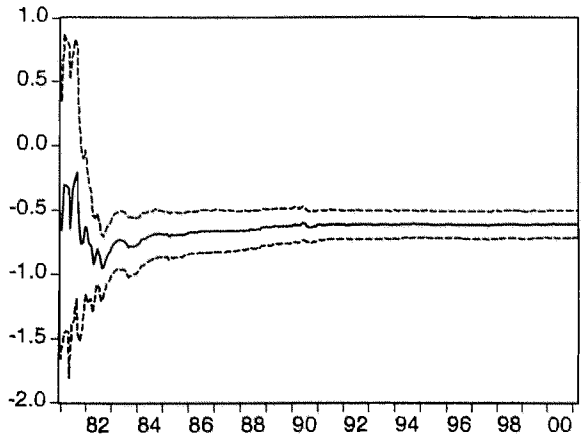
FIGURE 6

Recursive estimates of the elasticities[1]

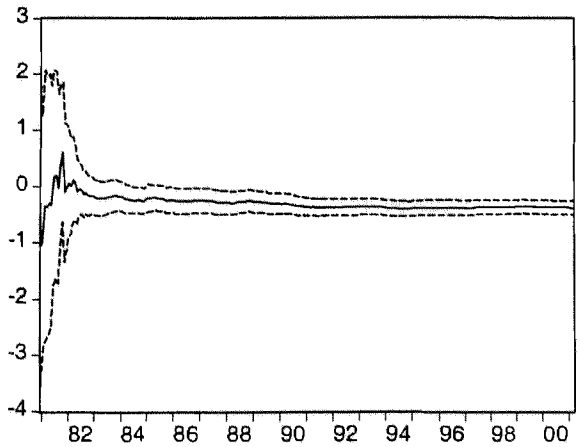
Males: β_N



Males: β_{FTE}



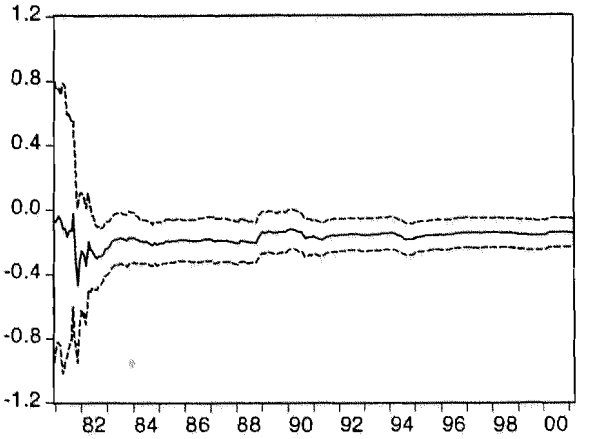
Males: β_{PTE}



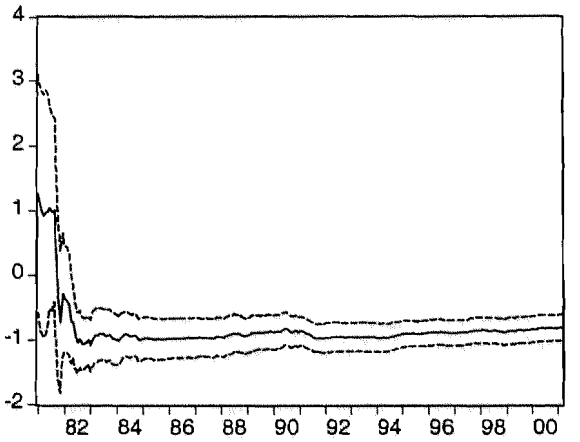
[1] Recursive estimate is the solid line and +/- Two Standard Error bounds are the dashed lines.

Recursive estimates of the elasticities (cont)

Females: β_N



Females: β_{FTE}



Females: β_{PTE}

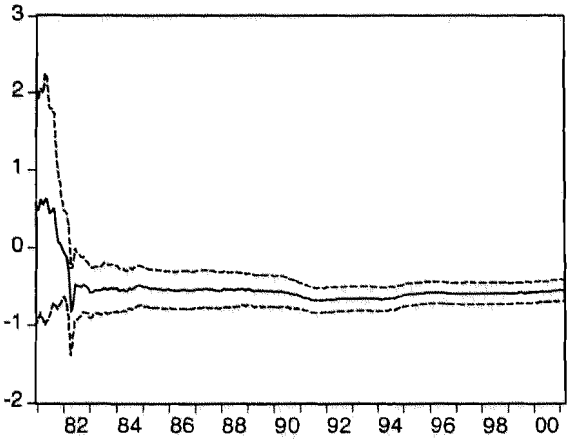
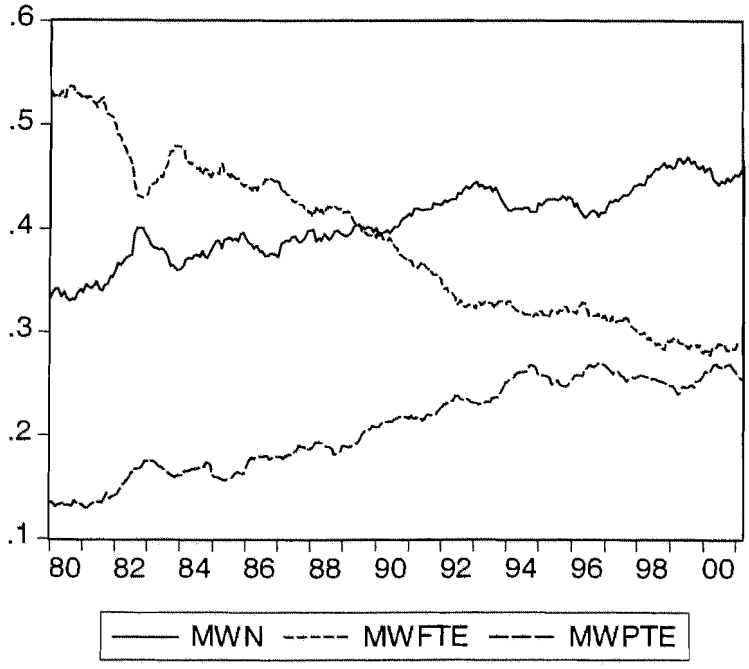


FIGURE 7

Weights for Males



Weights for Females

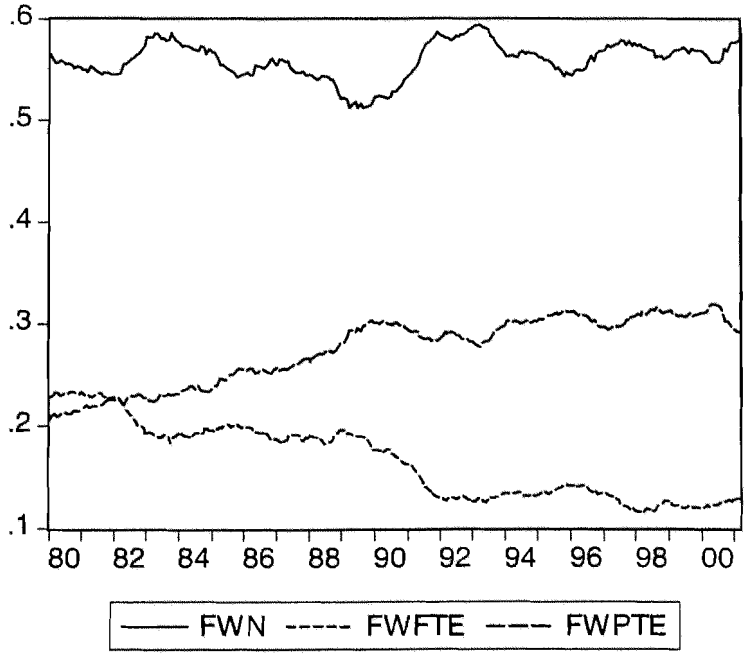


FIGURE 8

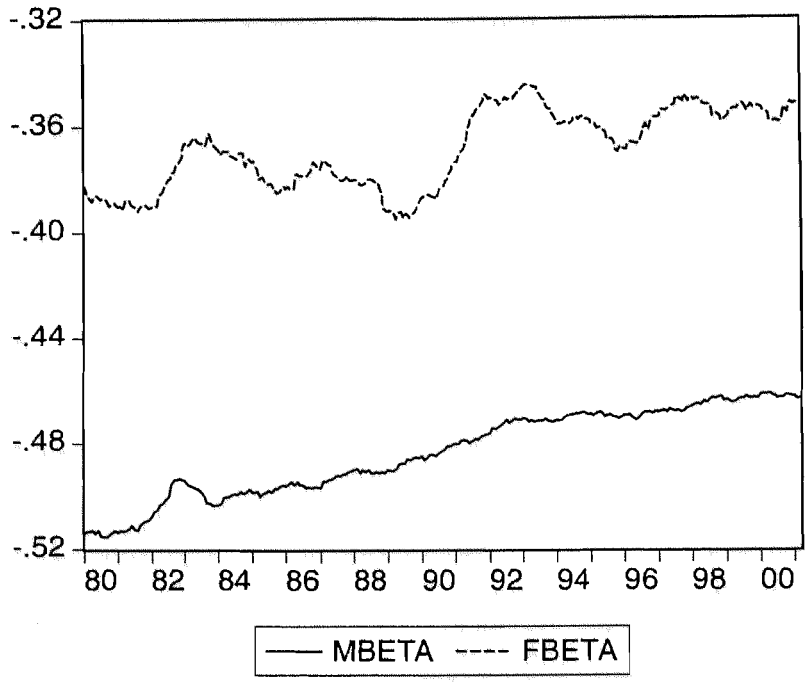
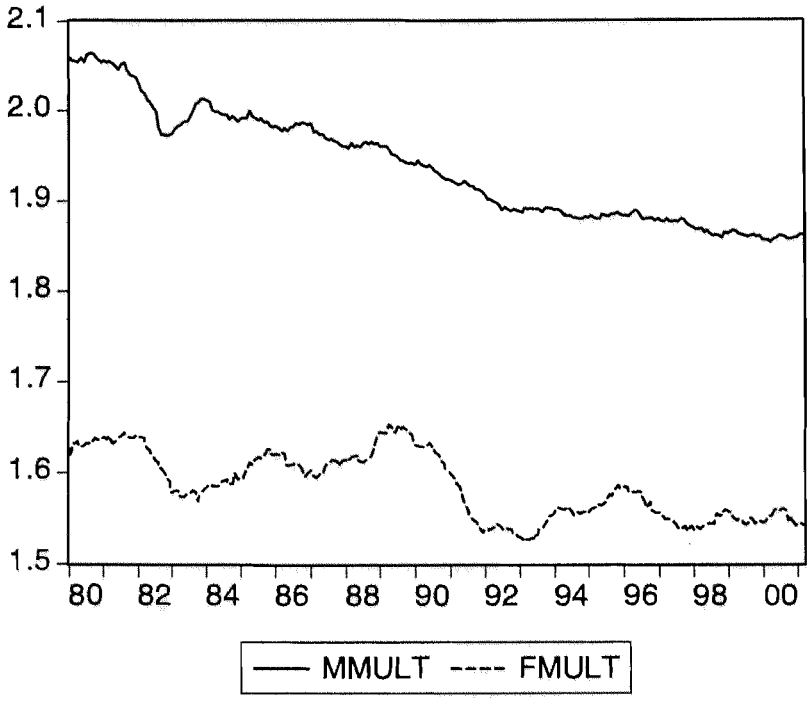


FIGURE 9



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