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Demographics and Unemployment*

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Abstract

This paper introduces the age structure of the population into the analysis of medium-term unemployment swings. We incorporate age-related features into the Shapiro-Stiglitz shirking model and find that the observed age pattern of unemployment can be explained in terms of the model. Moreover, we find that changes in the age composition of the population – in particular the ageing of the baby-boom generation – has caused OECD wide unemployment to be 50 basis points lower than what it currently is. The magnitude of his effect varies between countries though but it is never larger than 140 basis points (France and Italy). More importantly, the age-effect on the labour participation rate is considerable - the rates would have fallen by almost 5 percent point more than observed in the OECD if the baby-boom generation had not come of age. There is also a statistical relationship between several macroeconomic shocks and demographic factors. In particular, the larger the share of working-age individuals, the higher is the ratio of investment to GDP, and the higher the share of the 25-34 year old cohort, the greater the rise in stock prices in recent years.

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1. Introduction

There is an evolving literature on the long swings of economic activity reflected in medium-term changes in unemployment.[1] Current research aims at explaining the decade-to-decade movements in average unemployment as well as the cross-country variation. A consensus appears to be emerging on the importance of the interaction between shocks and institutions (see e.g. Blanchard and Wolfers, 2000) but there is less agreement on the nature of the shocks.

Potential shocks include changes in the rate of productivity growth, skill-biased technological progress, the world real interest rate, the price of energy, and changes in the share of profits. Movements in any one of these variables have been shown to affect labour demand, hence also the natural rate of unemployment in the presence of real wage rigidity[2]. However, this literature has paid surprisingly little attention to demographic factors, in particular changes in the age structure of the population. It is the objective of this paper to help fill this gap by exploring the potential interaction between age structure and aggregate labour-market outcomes.

A recent paper by Shimer (2000) studies demographic factors in the United States by looking at the effect of compositional changes in the US labour force with respect to age, sex, race, and education. In particular, Shimer finds that changes in the age distribution account for a substantial part of the long-swings in the US unemployment rate. Because the teenage unemployment rate is several times higher than the aggregate unemployment rate, changes in the share of teenagers in the population has had a significant effect on the aggregate unemployment rate. Thus, Shimer finds that the entry of the baby boom into the labour market in the 1960s and 1970s raised the aggregate unemployment rate by about 2 percentage points while the subsequent ageing has reduced it by about 1½ percentage points.

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[1] See the volumes by Lindbeck and Snower (1988), Layard, Nickell and, Jackman (1991), Bean (1994), Phelps (1994), and Pissarides (1990).

[2] A recent paper relates unemployment to the state of the stock market (Fitoussi, Jestaz, Phelps, and Zoega, 2000; Phelps and Zoega, 2001). If hiring can be described as an intertemporal investment decision, changes in the stock market may reflect changes in the shadow price of trained labour, which should cause an increase in hiring and a fall in unemployment. The paper finds empirical support for this hypothesis in a positive association between stock-market indices and employment performance.

In this paper we would like to expand on his work using OECD data but we would also like to analyse other factors of a more macroeconomic nature. While demographic changes affect the composition of the labour force and hence possibly also the aggregate unemployment rate, these may also play a role in the genesis of various macroeconomic shocks. Demographic factors have been shown to be important for private savings, current-account deficits, and housing prices, to take a few examples. To the extent that these affect labour-market participants, unemployment may be affected.

Significant demographic changes have taken place in the OECD countries in the past few decades. Figure 1 shows the share of prime-aged workers (25-54) in the population for the G7 countries. The emergence of the baby-boom generation in the labour market in the late 1960s changes the age structure of the labour force significantly and so will its exit from the labour market. But what are the implications for labour-market outcomes, employment and unemployment?

(Figure 1)

Demographic factors could potentially account for the large difference in unemployment between good and bad-performing countries. A comparison of the high-unemployment countries of Belgium and Spain, on the one hand, and Portugal, on the other hand, is one example. Interestingly, the share of prime-aged workers has fallen in the two bad performers while it is still rising in Portugal.

2. Demographics and Real-wage Rigidity

We are interested in the effect of the age distribution on medium-term movements in unemployment. As a natural starting point, we will derive a model of real-wage rigidity from first principles and show how age effects can arise in this model. We consider both the effect of the average age as well as the effect of the variance of the age distribution at a particular point in time. We then turn to several macroeconomic shocks and relate these to demographic factors.

In our model of the labour market, there are moral-hazard problems that prevent wages from performing their role in equilibrating the labour market. Firms profit by offering employees a fixed salary when workers are sufficiently risk-averse. But such

an insurance scheme – involving workers accepting lower wages in return for a guarantee of a fixed salary – creates a moral-hazard problem: workers are now insured against the consequences of reduced effort and this creates the temptation to slack off and hence cause the very loss that they are insured against. Following convention, we refer to the lack of effort as *shirking*. This is the model of Calvo (1979) and Shapiro and Stiglitz (1984)[3]. In response to the incentive problem, firms use their wage policy to motivate the workforce. By raising wages, the penalty imposed on those who are caught shirking becomes more severe. But when wages are increased, employment contracts and unemployment helps to motivate workers – the penalty of being sacked is increased. Unemployment becomes a disciplinary device!

We are interested in how the age of workers affects their shirking behaviour. We assume that age affects workers in two ways: through the level of non-wage income and through the propensity to quit. As Miles Kimball has put it, a model's state variables capture all that we know about the past while its costate variables capture expectations about the future. Since the older workers have a longer past, we would expect this to be reflected in a state variable such as the level of wealth or non-wage income. Because they have a shorter remaining tenure, they may value future employment less, which is reflected in the expected, present discounted value of future benefits from employment. This may result in a higher propensity to quit. Both non-wage income and the propensity to quit are likely to change over a worker's lifespan for this reason.

The level of non-wage income – defined as the income level the worker enjoys independent of his employment status – is age dependent. Standard life-cycle arguments suggest that the level of wealth and non-wage income is rising in age until the age of retirement is reached. As workers age, the imputed rent from home ownership becomes more important as does an expanding portfolio of shares and bonds. So older workers typically have a higher fallback income from assets. When retirement age approaches, the accrued benefits of rights to pensions set in. Pensions

[3] What follows is an amended version of the efficiency-wage model of Shapiro and Stiglitz (1984). We make shirking be a continuous variable while Shapiro and Stiglitz assume that it can only take two values, 0 and 1. We also allow for wealth accumulation.

and social security wealth not only determine the age of withdrawal from the work force but also behaviour on the job prior to retirement.

Family responsibilities also affect labour-market behaviour and employment attachment. Single men suffer higher unemployment rates than their married counterparts, their job duration is shorter on average and wages lower. This could be explained by a negative income effect on married men, who often support children and a non-working wife. Married women, however, sometimes do not "benefit" in the same sense from marriage if they have lower wages than men. In this case, the presence of a husband creates a positive income effect, which reduces their employment attachment. The same applies to young adults who receive family support. Finally, welfare support may be age-dependent. For example, health care is most needed towards the end of life while education is more important in the beginning.

Second, there are also differences in the expected quit rate across age groups. Both the youngest and the oldest workers have higher quit propensities, although for different reasons. The young are more likely to quit until they discover where their abilities are of greatest use while the older workers have the option of early retirement. Both enjoy a cushion of non-wage income; the family in the case of the young and accumulated savings in the case of the older workers. Finally, workers in their prime might suffer portability losses (with regard to accrued pensions rigths) from quitting which might dicourage them from changing jobs.

We now turn to the economic model. We will first assume that workers are all of the same age and derive how age-related effects may influence their wages and unemployment rate. We will subsequently discuss the implications of the more plausible assumption of heterogeneity when it comes to the age of workers.

2.1 Shirking and Ageing

Imagine that all workers are of the same age. We start by looking at the behaviour of firms and then sketch the microfoundations of workers' shirking decision. Current profits are equal to the difference between output and the total wage bill:

$$\Pi = g\left(N(1-l)\right)^{q} - wN \qquad (1)$$

Productivity is denoted by g, N is employment, and w is the real (product) wage. The representative firm sets wages at each moment in time in order to maximize profits. This decision is based on the effect wages have on on-the-job effort or shirking l. The shirking function shows the proportion of the time spent at work that the worker is inactive. It is increasing in wages and strictly concave. Reducing wages may cause profits to fall if workers respond by reducing their effort – increase shirking. We describe the microeconomic foundations of this function below. The representative firm's first-order conditions with respect to wages and employment follow:

$$-gq\left[N(1-l)\right]^{q-1} l_w(w;\ u,\ b) = 1 \tag{2}$$

$$gq\left(N(1-l)\right)^{q-1}(1-l) = w \tag{3}$$

The left-hand side of equation (2) has the marginal of raising wages benefit – in terms of increased output due to less shirking – while the right-hand side has the marginal cost – in terms of higher wage costs. The left-hand side of equation (3) has the marginal benefit of employing one extra worker and the right-hand side the marginal cost. Combining the two equations gives the following condition – called the *Solow elasticity condition* – for the optimal wage:

$$-\frac{w\, l_w}{1-l} = 1 \tag{4}$$

The condition says that wages should be set at a level at which the elasticity of shirking with respect to wages is equal to one.

In a theoretical appendix at the back we find that the optimal incentive wage, w^s, is a positive function of the level of non wage income, n, and the quitting rate, b;

$$w^s = f(n, b), \quad f_n > 0,\ f_b > 0 \tag{5}$$

where the functional form depends on the form of the utility function. By equalising the demand wage – given in equation (3) – and the supply wage – in equation (5) – we get that

$$w^s = W^s(n, b) = W^d(g) = w^d \tag{6}$$

and the reduced-form solution becomes

$$w = W\left(\overset{+}{n}, \overset{+}{b}, \overset{+}{g}\right) \tag{7}$$

Unemployment is a positive function of non-wage income and the quit rate and a negative function of productivity.

The intuition of these results can be summarised as follows: A rise in the level of non-wage income benefits the unemployed more than the employed because they have a higher marginal utility of consumption – because they are poorer and consume less – and hence makes the unemployment state less undesirable in comparison to employment. Employed workers therefore shirk more – since they fear unemployment less – and firms respond by raising their wages. When the cost of labour goes up, employment contracts and unemployment rises. The intuition behind the effect of the propensity to quit is similarly simple. When workers approach retirement age and can afford to quit – or alternatively young workers live with parents with same effect – the higher quit rate makes them discount more the possibility of future job loss due to current shirking: if you are going to quit in the not so distant future, you value your job less, hence shirk more which, again, makes firms raise wages. Unemployment rises when the cost of labour goes up.

We have shown how workers' age – hence non-wage income and the propensity to quit – may affect the rate of involuntary unemployment. We have assumed that the workers are all of the same age. We will now assume that this is not so and that there are workers of different ages in the labour market, all collecting identical wages which are based on the average age for the labour force, hence the average level of non-wage income and the average propensity to quit.

2.2 The Unemployment Distribution

Assuming one market wage, the unemployment rates of the different age sub-groups will differ. We can now calculate the steady-state unemployment rates for the different age groups. In steady state the flow into and out of unemployment are equal for each age group:

$$h(L-N) \;=\; \big(ml(a)+b(a)\big)N \tag{8}$$

where h is the rate of transition from unemployment to employment, L is the labour force in age group i and N is the number employed. This gives

$$u = \frac{ml + b}{h + ml + b} \tag{9}$$

in steady state where $du_i/dn_i > 0$ – since $db_i/dn_i > 0$ and $dl_i/dn_i > 0$ – and $du_i/db_i > 0$. It follows that the higher is the level of non-wage income and the higher is the quit rate, the higher is steady-state unemployment. Figure 2 shows the intuition behind this result.

(Figure 2)

When the level of non-wage income n rises, the difference between the value of being employment and unemployment falls. The reason for this should by now be obvious: the marginal utility of consumption is higher for the unemployed workers, therefore they benefit more from the extra income and an employed worker has less to lose from shirking, as can be seen from equation (A4) in the Appendix. Workers then face a higher risk of dismissal and the outflow into unemployment rises, resulting in a higher rate of unemployment in steady state.

Our maintained hypothesis is that the level of non-wage income is age-dependent. It then follows that the age distribution of the population affects the aggregate unemployment rate because of a compositional effect: When the cohorts suffer different unemployment rates due to different levels of non-wage income or different quit rates, their relative size affects the aggregate unemployment rate.

3. Demographics and Macroeconomic Shocks

The age distribution of the population may have an effect on the nature of macroeconomic shocks. Generations differ in their saving propensities and creativity and innovations may come more frequently at certain stages in life. Thus both investment opportunities and the supply of available savings – in an open economy the current account and perhaps the world real rate of interest – may depend on the age distribution of the population. These factors can be shown to affect the level of labour demand.

We can think of two types of macroeconomic shocks that have been emphasised in the recent literature that may relate to the age distribution of the population. First, according to standard life-cycle arguments, the aggregate saving rate is a function of the age distribution because prime-age workers are the ones who generate the bulk of savings. In a world of perfect capital mobility, the OECD-wide age distribution should thus affect the level of world real interest rates. This has been shown to affect unemployment in a theoretical context by Phelps (1994) and empirically by Blanchard and Wolfers (2000) and Fitoussi *et al.* (2000). At a national level, the Feldstein-Horioka findings suggest that there may be an even more direct relationship between savings and investment – hence hiring and employment. Williamson (1997) describes how demography can influence growth through saving and investment behaviour. He points out that the South-East Asian economies have been fortunate to have a disproportionately large group of prime-aged workers in the past couple of decades.[4] Moreover, an expanding adult population creates investment demand for what has been called population-sensitive investment such as equipment, training and housing investment.

In an open economy with perfect capital mobility, changes in domestic saving should not affect domestic investment directly. Instead, the savings would flow to finance the most profitable investment opportunity in the global economy. Consequently, a high saving rate would show up in a current-account surplus and a lower world real interest rates, in particular if many countries share changes in the age distribution, see Herbertsson and Zoega (1999).

The recent booms in the US, the Netherlands, and the UK can be traced to the recent productivity improvements and the expectations of further improvements in the future as reflected in the state of the stock market. Such productivity gains often find their origin in the innovations and creativity of entrepreneurs. It is here that the age distribution may again come into play. Casual observation suggests that people may be most creative in their thirties and forties. A relatively young population would then have proportionately more entrepreneurs than an older one and hence also a faster rate of expected productivity growth and a higher-valued stock market.

[4] He finds that East Asia's demographic transition can account for 1.5 to 2 percentage points of the 6.1 percent annual per capita income growth since 1970.

Finally, the responsiveness of employment and unemployment to macroeconomic shocks may depend on the age distribution. It is easy to imagine how the age distribution can affect the sensitivity of aggregate employment macroeconomic shocks:

- Job security is rising in tenure and hence, *ceteris paribus*, in age. Since it is more difficult to dismiss an old worker, the sensitivity of employment to shocks could be a decreasing function of the size of the older cohorts. The age structure and the institutional framework may interact in that employment-protection legislation may be more effective the older is the average worker. However, firms may opt for early retirement instead of dismissals, which would cause the effect to show up in labour-force participation instead of unemployment.
- A transitory shock is more likely to lead to the dismissal of an older worker because of his shorter expected post-depression tenure. Thus the level of labour hoarding may be smaller for the older workers due to their shorter remaining work life. This would make the sensitivity to shocks greater.
- Older workers may find it more difficult to find another job as their remaining tenure is shorter. They are therefore more likely to become long-term unemployed. As a result, the higher is the proportion of older workers in the labour force the more likely is a transitory shock to employment to have a persistent effect on employment.
- Older workers may be more resistant to real wage moderation as their accumulated wealth reduces their dependence on employment. This raises the possibility that real-wage cuts are less likely the higher the proportion of older workers.

We can summarise the implication of our discussion so far before taking a look at the data. There are four key implications:

- Changes in the composition of the working-age population matter for the aggregate unemployment rate because of differences in the within-(age)group unemployment rates.
- Demographic changes are related to macroeconomic shocks through savings, real interest rates and investment.

- Demographic changes may affect the rate of innovation in the economy
- Demographic changes may affect the way employment and unemployment respond to macroeconomic shocks.

4. Compositional Effects

When different cohorts suffer different rates of unemployment, changes in the relative size of these cohorts will affect average unemployment across all cohorts, which is the aggregate unemployment rate. The implication of the model above is that a high proportion of prime-age workers is likely to generate low average unemployment rates. These predictions are supported by the data. Figure 3 plots age-specific unemployment rates for 21 of the 29 OECD countries[5] in the period 1965-98.

(Figure 3)

We note that unemployment is highest for the 15-19 and 20-24 age groups. Surprisingly it is also higher for the 25-34 group than it is for the older groups. The group over 55 has a slightly higher rate than the 35-55 but the difference is only moderate. Figure 4 shows that although the age-group-unemployment profile differs across countries it has remained remarkably stable within the individual countries in recent decades.

(Figure 4)

In the light of the changing demographic structures in the OECD it is intresting to decompose the aggregate unemployment rate into a part that can be traced to a changing age structures of the labour force (for example the age group 15-24 accounted for almost 23 per cent of the labour force in the middle of the sixties but only for 16 per cent in 1998) and a residual part that can be explained by other factors.

Our methodology to assess to what extent these disparate recoveries can be attributed to demographic factors follows Phelps and Zoega (1997). We construct fixed-weight unemployment indices where the weights are the initial labour-force

[5] Countries that are excluded are: Czech Republic, Hungry, Italy, Korea, Mexico, the Netherlands, Poland, and Switzerland. Italy, the Netherlands, and Switzerland are excluded because age-group classification of the data is different there from the rest of the OECD countries and therefore not comparable, the reminder is excluded due to lack of data.

shares of the different age groups and compare these with plots for actual unemployment.[6] Figure 5 plots the average actual (u), the adjusted unemployment (u_h) rates and the difference between the two in 21 OECD countries in the period 1965-1998.[7] The difference is the part of the actual unemployment rate that can be traced to demographic changes in the OECD during the period.

(Figure 5)

Figure 5 shows that unemployment in the OECD would have been almost 50 basis points higher in 1998 if the age-structure had remained the same over the whole period. As the population has grown older, the labour force has shifted from age groups where unemployment rates are high (the 15-24 year olds) to groups were employment is higher (the 25-54 year olds) and consequently the aggregate unemployment rate has gone down.

(Figure 6)

Figure 6 draws similar plots to those of Figure 5, but now for selected individual countries. The figure reveals that different countries have been affected very differently by changing demographic structures. The UK unemployment rate was only 20 basis points lower in 1998 due to the ageing of the population while the difference was 140 basis points in France and Italy. The figure shows that not much happen to the demographic unemployment rate in Italy until the late eighties. In the early nineties the actual and adjusted unemployment rates started to drift apart and in 1998 unemployment would have been 140 basis points higher if the age-structure would have remained the same as in 1977. The demographic unemployment rate in Germany is interesting. Age groups close to retirement have higher unemployment rates than

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[6] For the calculation we define: u_i as the unemployment rate in group i, u as the aggregate unemployment rate, L_i as the number of people in group i, L as the total number of people in the labour force. Furthermore, we define $v_i = L_i/L$, as the share of the labour force belonging to group i. Then by definition: $u_t = \sum_{i=1}^{n} v_{it} u_{it}$, where u_t is the aggregate unemployment rate at time t and n is the number of age groups. Now define an adjusted unemployment rate u_h which is such that labour force group-age-weight, $v_{i,}$ always takes the value that it had in the first year of the analysis and we get the unemployment rate adjusted for demographic changes: ,$u_{ht} = \sum_{i=1}^{n} v_{i1} u_{it}$, where u_i is as before. (One of the most obvious weaknesses of the analysis the choice of the base year.)

[7] Data source: OECD *Employment Outlook* various issues, OECD (1999), and UN (1998).

the younger cohorts and consequently Germany is not prone to demographic shocks in the same way as the other countries.

Unemployment is only one side of the coin. A changing age structures may also be reflected in lower labour-force participation rather than unemployment. Figure 7 shows the development of male non-participation rates in the G7 countries (as before, Japan is excluded).[8] In 13 OECD countries, the average labour force participation of 55-64 year-old males fell by more than 12 percentage points between 1979 and 1998. The participation rate increased by approximately 5 percentage point for females, resulting in an overall average drop in OECD labour force participation of almost 3 percentage points, cf. Herbertsson and Orszag (2001).

(Figure 7)

The figure shows that labour-marked participation is falling in all age groups in the six countries shown. The shape of the non-participation profile seems to have changed over time in the countries. The greatest fall in the youngest age groups is in France and Germany but in the oldest age group in the UK and the US.

The increased withdrawal of the old from the labour force into retirement has gained much attention among researchers, see Herbertsson (2001), but the fall in participation of the young is less well understood. To investigate if the overall fall in participation rates can be explained by changing demographic realities we did a similar exercise as we did for the unemployment rate, i.e. we decomposed the male participation rates into cohort participation rates and then corrected the rate for changing age structures. Figure 8 shows our results.

(Figure 8)

As can be seen from the figure, this exercise overestimates the fall in the participation rates substantially. Participation would have fallen by more if the baby-boom generation had not come of age. In France the participation rate is more than 14 percent higher, 8 percent higher in Germany but only 3.5 per cent in the US. The

[8] The rationale behind only showing the non-participation rates for males is that during the period male labour-force participation fell substantially in the oldest cohorts while female participation increased, which might alter our results.

effect of changing demographics on the participation rate is much stronger than on the unemployment rate.

We conclude that the compositional effect is not a major factor in explaining the disparate development of unemployment within the group of OECD countries. In contrast, demographic factors have been shown to be very important for the evolution of labour-force participation, which would have fallen even more if there had been no demographic changes. The question now arises whether the changes in the age distribution could generate or help in the generation or the propagation of macroeconomic shocks.

5. Demographics and Macroeconomic Shocks

Demographic factors are likely to affect investment demand, the supply of savings, and the generation of new ideas – entrepreneurship – in addition to influencing how employment and unemployment responds to macroeconomic shocks. We start with the macroeconomic shocks and then move on to look at the responsiveness to these shocks.

5.1 Macroeconomic Shocks

Empirically, the rise in the real rate of interest at the beginning of the 1980s coincided with the elevation of unemployment to a higher plateau in a great many OECD countries. The idea that real interest rates and the natural rate of unemployment are linked has recently acquired some following (see papers by Blanchard and Wolfers, 2000; Nickell, 1999, amongst others).[9]

Table 1 reports results of a regression of the annual world real rate of interest on three age groups; 15-34, 35-54, and above 55. The world real rate is calculated as the average of real interest rates in the G7 countries. Note that all coefficients are statistically insignificant apart from the share of the oldest cohort, which is positively related to the interest rate.

[9] There is some empirical evidence to support this contention. Blanchard and Wolfers (2000) use panel data and find that unemployment and real interest rates have moved together in recent decades. So do Phelps and Zoega (1998). Clearly the elevation of unemployment in the early 1980s coincided with a regime shift in real interest rates, which moved to a higher plateau.

(Table 1)

The positive relationship between the share of the oldest group and the real rate of interest is apparent in Figure 9 below.

(Figure 9)

There are two groups in the data, one corresponding to the period of low real interest rates before 1980 and the other corresponding to the high-interest-rate period that followed. The latter has a higher proportion of the older workers. However, note that no relationship is visible within each group.

There may also be a direct link between saving and investment – hence hiring and employment, which does not go through the world real rate of interest. The results of Feldstein and Horioka (1980) show that national saving and investment rates are highly correlated contrary to the implications of perfect capital mobility. If higher savings cause higher investment – and this is a big if since the reasons for the FH results are still hotly disputed – we would also expect higher investment in human capital, including the hiring and training of new workers.

To investigate these hypotheses we calculated the raw correlation between the age-structure in a panel of OECD countries and investment and unemployment, cf. Herbertsson and Zoega (1999). Figure 10 depicts the calculated correlations between share of the population in 12 age groups and unemployment on the left-hand axis and investment on the right-hand axis.[10] Clearly, both investment and unemployment are correlated with the age structure in such a way that a high investment corresponds to low unemployment.

(Figure 10)

Note that the effect of the age structure is somewhat different here in that it is the presence of the young, not the old, that goes with lower investment while it was the share of the oldest cohorts that seemed to matter for the world real rate of interest.

To investigate the relationship between investment and the age structure more formally we ran a panel regression on 152 countries using the investment/GDP ratio

[10] The figure shows a three-point moving average of the raw correlations.

(i) as a dependent variable and (the log of) initial PPP adjusted GDP and the share of population at working age (defined here as people aged 15 to 64) on the right-hand side.

$$i_{it} = \underset{(4.7)}{-0.38} + \underset{(5.0)}{0.06} \times \log\left(GDP_{i0}\right) + \underset{(4.7)}{0.77} \times POP_{it} + e_{it} \qquad (12)$$

We are able to explain about 26 per cent of the variation in investment between countries by the regression, using the random effects panel model, for the period 1960-92. It is apparent the age structure variable (*POP*) comes shining through, the larger the share of people at working age, the greater is investment relative to GDP.

Figure 11 shows the cumulative rise in share prices normalised by labour productivity from 1990 to 1997 in 18 OECD countries plotted against the size of the 25-34 cohort (in 1990). We take the year 1997 as a reference point because it may mark the advent of the "new economy". We measure cohort size both relative to its own size in 1960 (left-hand panel), as well as by the share of the total population (right-hand side panel).

(Figure 11)

A clear positive relationship is visible. The larger is the relative size of the young, the larger is the cumulative rise in the stock market. We should note that the relationship is much stronger when we normalise by the number of young people in 1960 rather than by the current total population. This suggests that what is important is to have a large number of young workers today rather than a low number of older workers.[11] The relationship appears again in the period 1970-79, but interestingly not in the period 1980-1989

5.2 Interaction Between Shocks and Institutions

We follow Fitoussi *et al.* in estimating the sensitivity of unemployment to macroeconomic shocks. The following panel estimation is performed;

[11] This goes against the predictions of Sala-i-Martin (1996). He models the old as reducing overall output due to a negative external effect on the younger, more agile workers.

$$u_{it} = a_i + b_i u_{it-1} + q_i X_i + e_{it} \quad (13)$$

where X_i is a vector of country-specific and global shocks. These are the world real rate of interest, the real price of oil and the rate of growth of labour productivity. The country-specific estimate of θ can then be used as a measure of the sensitivity of unemployment to country-specific and global shocks which makes $\theta/(1-\beta)$ a measure of the steady-state sensitivity. The following table tests for the determinants of the steady-state sensitivity of unemployment to macroeconomic forces in a cross section of 19 OECD countries.

(Table 2)

Interestingly, the population between the ages of 15 and 34 comes shining through! In particular, the higher is this proportion, the smaller is the sensitivity to macroeconomic shocks. This suggests that an ageing population may face a more rigid labour market, i.e. employment fluctuations become more severe.

The relationship between sensitivity and the share of the 15-34 years olds can be seen in the Figure 12 below where the share is the average value taken in 1960-1999.

(Figure 12)

We conclude that the age distribution of the population may belong alongside the institutional variables when explaining cross-country differences in the sensitivity to macroeconomic shocks.

6. Conclusions

We have found that the compositional effect of demographic changes do not account for the big swings in unemployment observed in many of the OECD countries. Looking at the OECD as a whole, current unemployment is 50 basis points lower than it would be if the age distribution of the labour force were the same as in 1960. However, the effect varies somewhat between countries with France and Italy showing the biggest effect of approximately 140 basis points.

While the compositional effect on unemployment is not very large, this does not apply to labour force participation. If it had not been for the ageing of the baby-boom

generation, participation would have fallen much more in the OECD. In France the participation rate is more than 14 percent higher, 8 percent higher in Germany but only 3.5 per cent in the US. The effect of changing demographics on labour force participation in much stronger than on the unemployment rate We also looked for an effect of the age distribution on the generation of and response to macroeconomic shocks. We found a surprising correlation between real interest rates and the share of workers over 55 years of age. We also found a strong correlation between the share of workers between 25 and 34 and the rise in the stock market between 1990 and 1997. On both counts we would expect a relationship between the age distribution – either locally or globally – and national unemployment rates.

Finally, we found that the sensitivity of unemployment to macroeconomic shocks depends negatively on the share of the young in the population when we also take into account various labour market institutions.

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Appendix A

We are interested in how age effects may enter the shirking decision and by extension the representative firm's wage- and employment decision. Imagine an employed worker who gets utility from both consumption C^1 and shirking, l. These are his two control variables that he adjusts to maximise expected discounted utility[12] subject to the dynamic budget constraints below

$$\frac{dA^1}{dt} = w + n + rA^1 - C^1 \qquad \text{(A1)}$$

[12] Note that he has to take into account the transition probabilities from employment to unemployment and back to employment and so on.

where A^1 denotes real wealth – in the form of public bonds – of an employed worker, n is the level of non-wage income and r is the real rate of interest. By raising his level of current consumption, the worker accumulates less wealth and hence consumes less in the future. By increasing the level of shirking, the worker gains instantaneous utility but increases the risk that he will be dismissed. The probability of dismissal is equal to $m \cdot l$ where m is the employer's monitoring intensity, which is decided by firms.

The instantaneous utility function – or felicity function – is the following:

$$U\left(C^1,\ l\right), \quad U_{C^1} > 0,\ U_l > 0,\ U_{C^1C^1} < 0,\ U_{ll} < 0 \tag{A2}$$

Letting V denote discounted lifetime utility, the first-order conditions from the maximisation of this lifetime utility level by an employed worker are the following:

$$U_{C^1}\left(C^1,\ l\right) = V_A^1 \tag{A3}$$

$$U_l\left(C^1,\ l\right) = m\left(V^1 - V^0\right) \tag{A4}$$

The worker equates the marginal utility of private consumption to his marginal utility of wealth. The worker, similarly, equates the marginal benefit and the marginal cost of shirking. The marginal benefit is equal to the instantaneous marginal utility from shirking. The marginal cost is equal to the expected fall in lifetime utility due to a rise in the probability of detection and dismissal.

Using the solution values for C^1 and l and the underlying Bellman equation gives the familiar equation (A5) where b denotes the quit rate, m is the rate of pure time preference, and $ml+b$ is the probability of moving from the employed to the unemployed state:

$$rV^1 = U\left(C^1,\ l\right) + V_A^1 \frac{dA^1}{dt} + \left(ml + b\right)\left[V^0 - V^1\right] \tag{A5}$$

This is an asset-pricing equation, which describes the value of being employed V^1 as a function of the instantaneous utility of being employed, the value of being unemployed and the transition probability between the two states. The left-hand side has the required return and the right-hand side the sum of instantaneous utility

(dividend) and the expected gain from both wealth accumulation and a change in employment status (expected capital gain).

The maximisation problem to be solved by an unemployed worker is slightly simpler. The worker now only gets utility from consumption, C^0 being his only control variable,

$$U\left(C^0\right), \quad U_{C^0} > 0, \; U_{C^0C^0} < 0 \tag{A6}$$

and faces the dynamic budget constraint

$$\frac{dA^0}{dt} = rA^0 - C^0 \tag{A7}$$

where A^0 is denotes the holdings of public bonds by an unemployed worker. The first-order condition is given in equation (A8):

$$U_{C^0} = V_A^0 \tag{A8}$$

As in the case of the employed worker, optimal consumption is at the level where the marginal utility of private consumption is set equal to his marginal utility of wealth. Using the solution value for C^0 and the underlying Bellman equation gives the asset-pricing equation

$$mV^0 = U\left(C^0\right) + V_A^0 \frac{dA^0}{dt} + a\left[V^1 - V^0\right] \tag{A9}$$

where a is the transition probability out of unemployment. The left-hand side is again the required return and the right-hand side the sum of the instantaneous utility and the expected gain from both wealth accumulation and a change in employment status.

Since the only form of nonhuman wealth is public bonds and all public bonds must be held by someone, equations (A1) and (A7) are related in the following way,

$$u\left[rA^0 - C^0\right] + (1-u)\left[w + rA^1 - C^1\right] = 0 \tag{A10}$$

where u is the rate of unemployment and the first term denotes wealth decumulation by the unemployed – the selling of bonds – while the second term denotes the wealth accumulation by the employed – the buying of bonds.

Equations (A4), (A5) and (A10) can be simplified and written together as equation (A11):

$$U_l\left(C^1,\ l\right)m^{-1}\left[m+ml+a+b\right] = U\left(C^1,\ l\right)+V_A^1\left[w+n+rA^1-\ C^1\right]-U\left(C^0\right)-V_A^0\left[rA^0+n-C^0\right] \tag{A11}$$

We are interested in the effect of non-wage income and quits on wages. To learn about the level of wages, we need to go back to equation (4) in the main text that describes the firm's wage-setting decision. From that equation it follows that an increase in shirking will raise wages; $dw/dn>0$, iff

$$\Sigma_{l_{wn}} = \left|\frac{l_{wn}n}{l_w}\right| < \left|\frac{l_n n}{1-l}\right| = \Sigma_{ln} \tag{A12}$$

that is the elasticity of shirking Σ_{ln} with respect to non-wage income $\Sigma_{l_w n}$ is larger than the corresponding elasticity of the marginal effect of wages on shirking l_w. The total differential of equation (A11) can be used to find the effect of changes in quitting and non-wage income on shirking which then translates into wages assuming inequality (A12) holds. The partial derivatives found in equation (11) follow:

$$l_b = \frac{\partial l}{\partial b} = -\frac{U_l m^{-1}}{U_{ll}m^{-1}(m+ml+a+b)} > 0 \tag{A13}$$

$$l_n = \frac{\partial l}{\partial n} = \frac{V_A^1 - V_A^0}{U_{ll}m^{-1}\left[m+ml+a+b\right]} > 0 \tag{A14}$$

$$l_w = \frac{\partial l}{\partial w} = \frac{V_A^1}{U_{ll}m^{-1}\left[m+ml+a+b\right]} < 0 \tag{A15}$$

$$l_{wb} = \frac{\partial l_W}{\partial b} = -\frac{V_A^1}{U_{ll}m^{-1}(m+ml+a+b)^2} > 0 \tag{A16}$$

$$l_{wn} = \frac{\partial l_W}{\partial n} = -\frac{V_A^1}{U_{ll}m^{-1}(m+ml+a+b)^2} > 0 \tag{A17}$$

$$l_{ww} = \frac{\partial l_w}{\partial w} = 0 \tag{A18}$$

From equations (A13)-(A18) we conclude that wages are an increasing function of non-wage income – dw/dn > 0 – but that this effect is diminishing in the size of l_w. However, the effect of quitting on wages – dw/db – is ambiguous. There are two effects. First, a higher quit rate gives more shirking, hence lower output and hence a higher marginal product of labour, which raises the marginal benefit of higher wages in terms of increased output. On this count the wage should be a positive function of shirking. Second, the wage turns out to be more potent in reducing shirking the higher is the quit rate – $l_{wb} > 0$ – and this acts to make the optimal wage be falling in the quit rate.

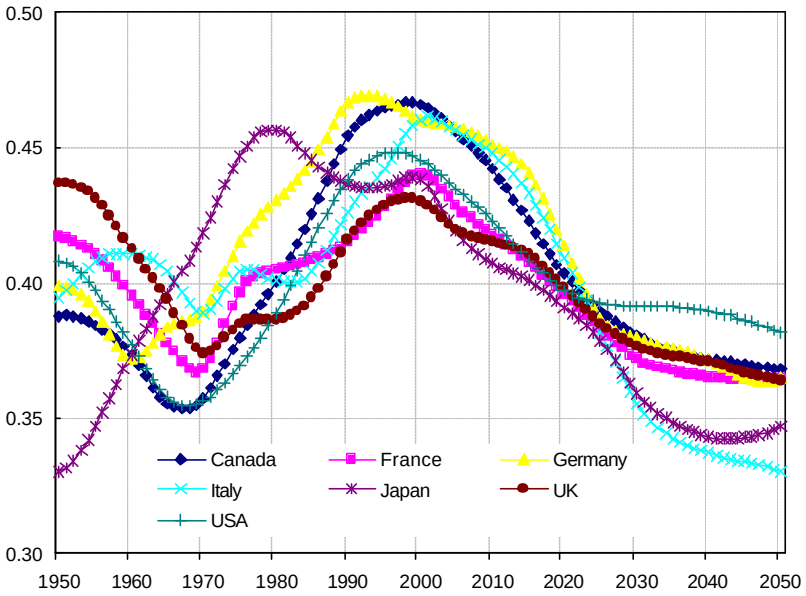

Figure 1. The share of prime-aged workers in the total population (defined as the 25-54 year old/total population ratio) in the G7

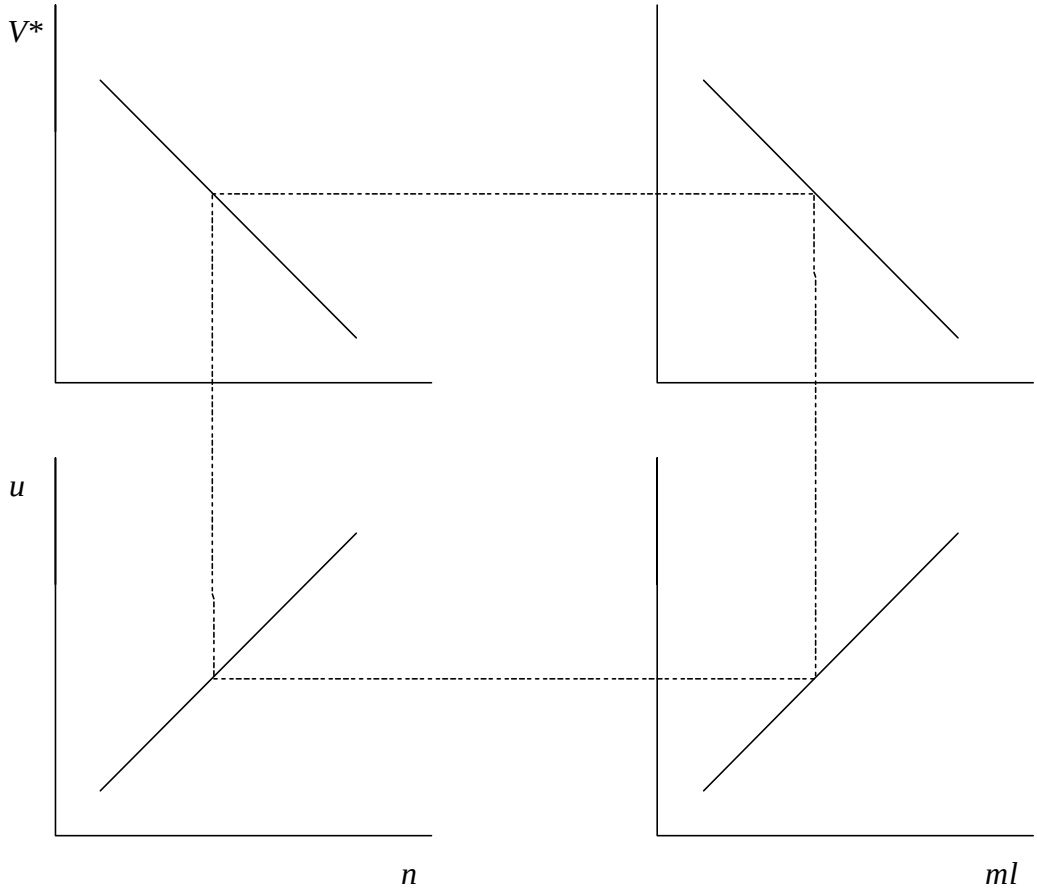

Figure 2. Non-wage income and steady-state unemployment

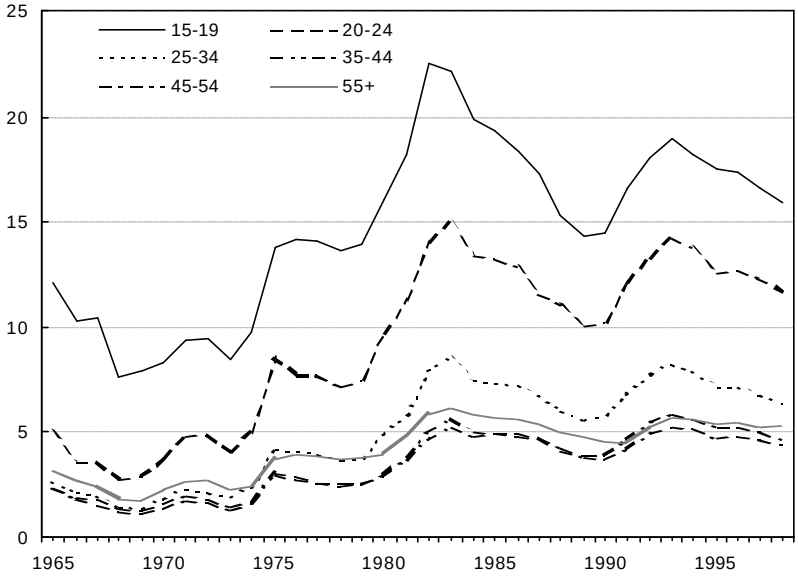

Figure 3. Cohort unemployment in the OECD, 1965-98

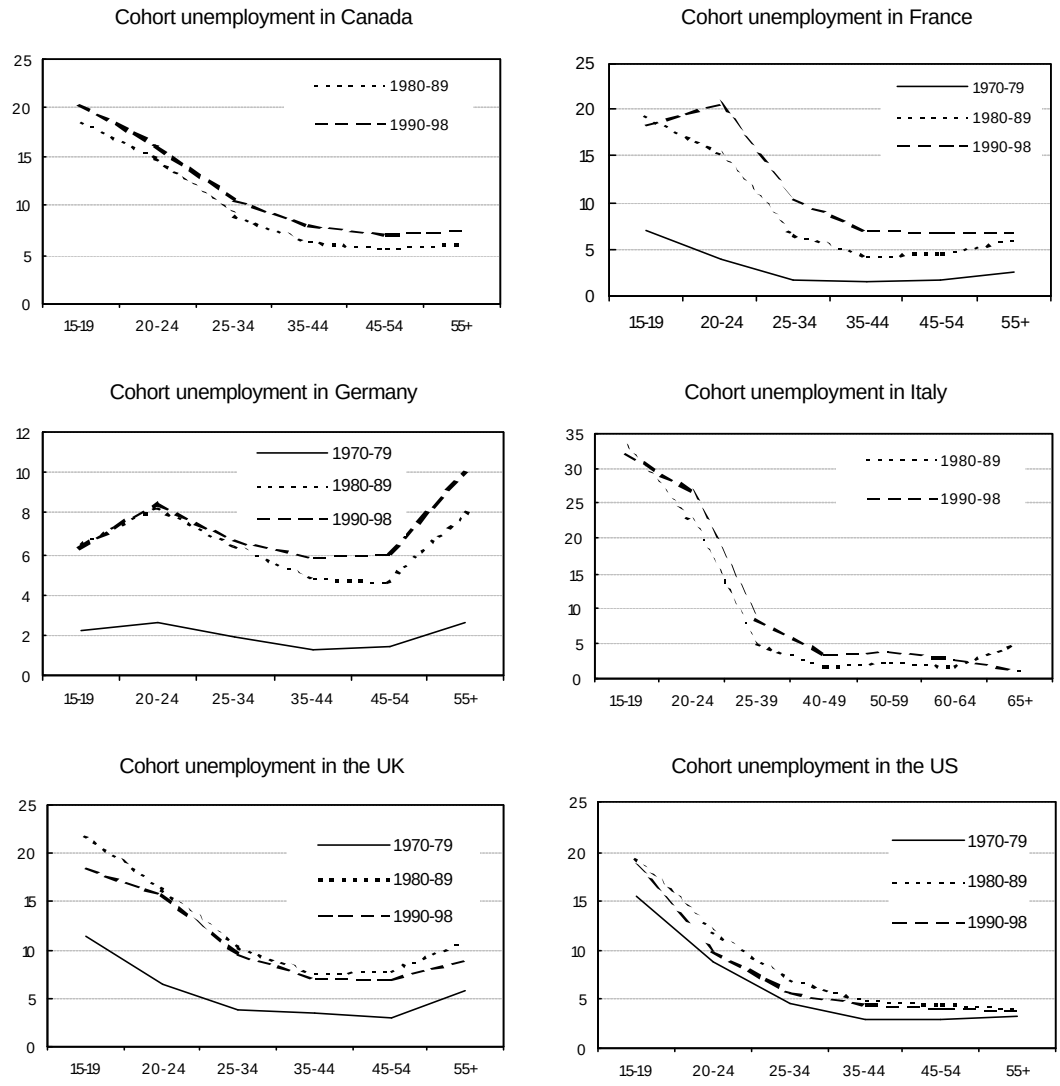

Figure 4. Age-group unemployment in the G7 (Japan excluded)

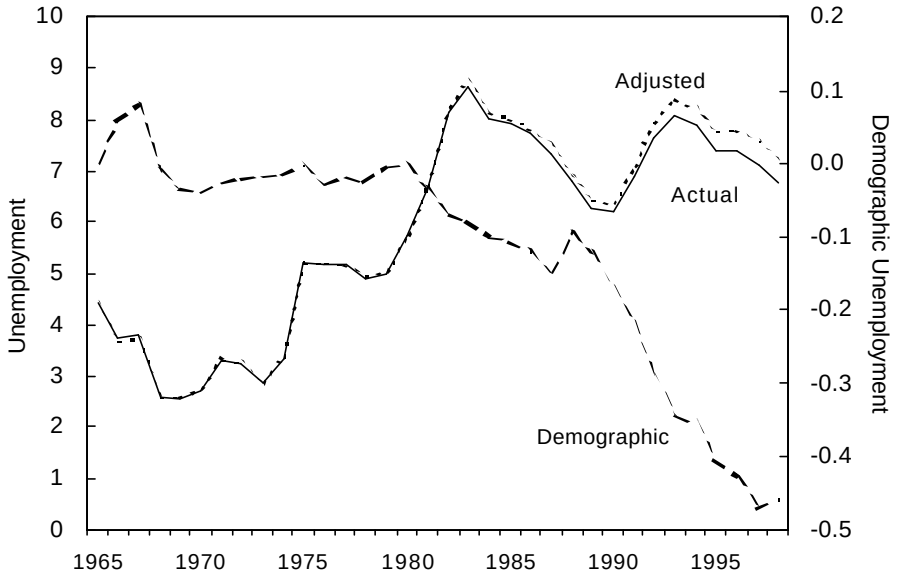

Figure 5. Actual, adjusted, and demographic unemployment in the OECD, 1965-98

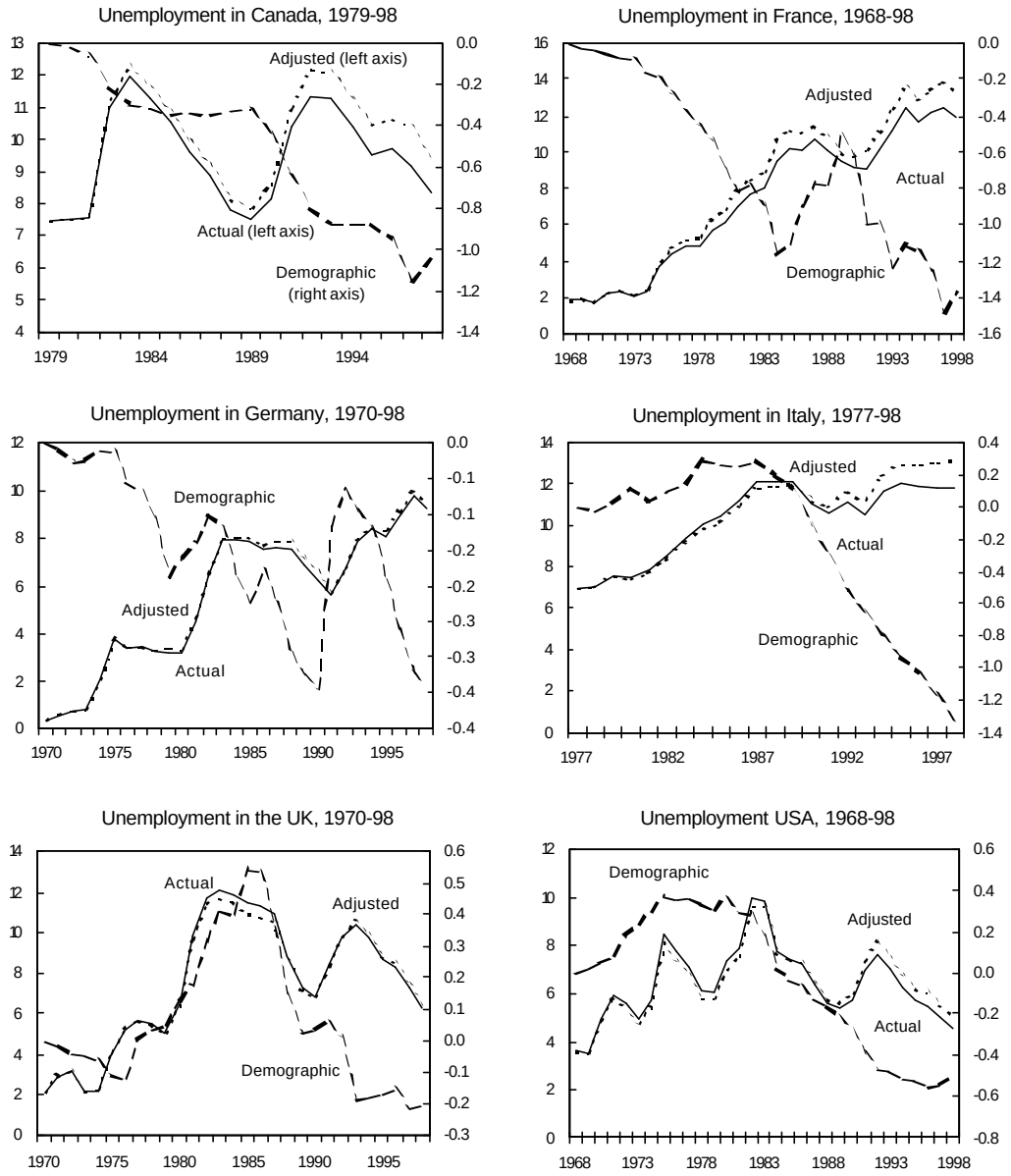

Figure 6. Actual and adjusted unemployment in the G7 (Japan excluded)

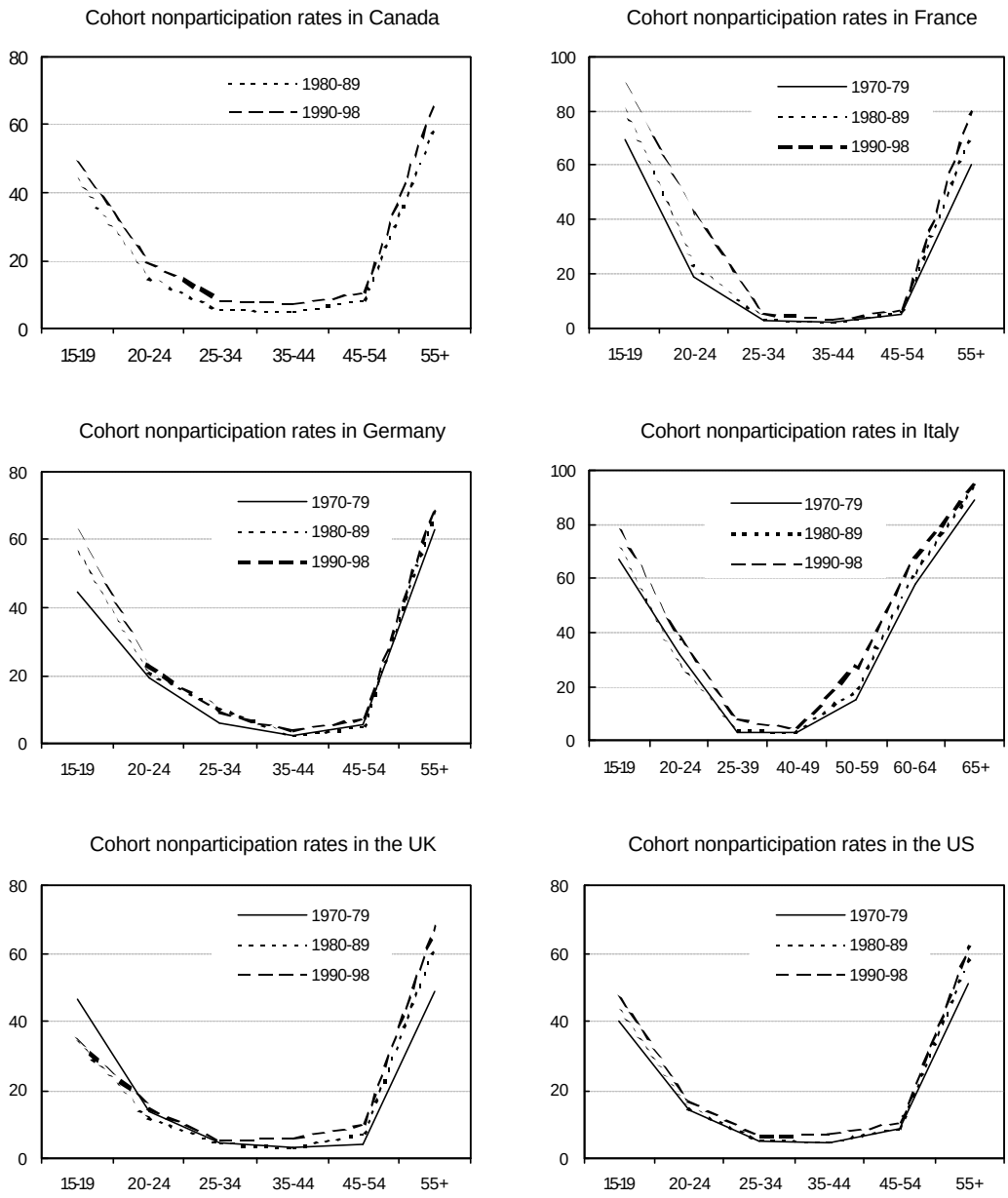

Figure 7. Male cohort non-participation rates in the G7 (Japan excluded)

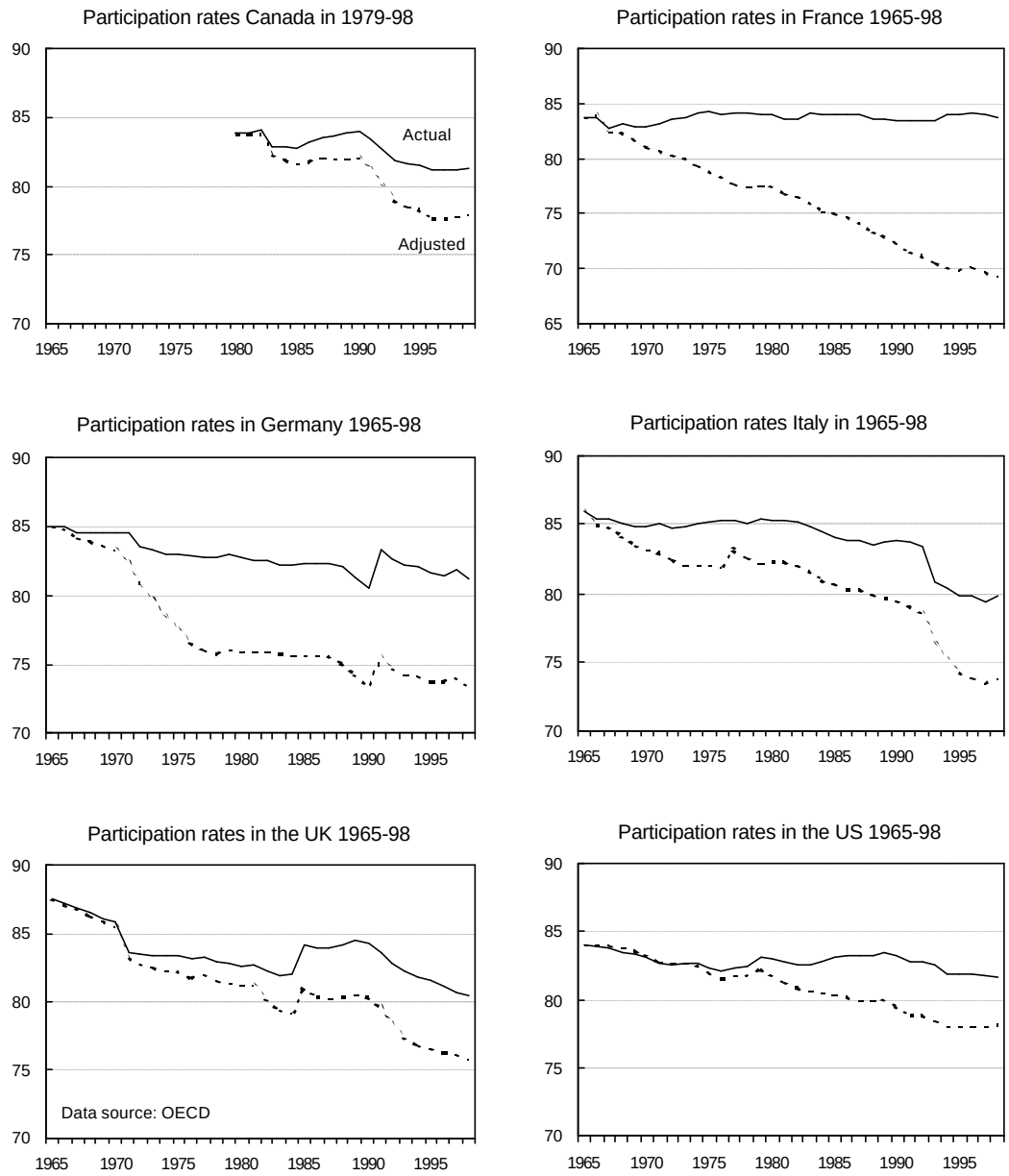

Figure 8. Actual and demographic-adjusted male labour-force participation in the G7 (Japan excluded)

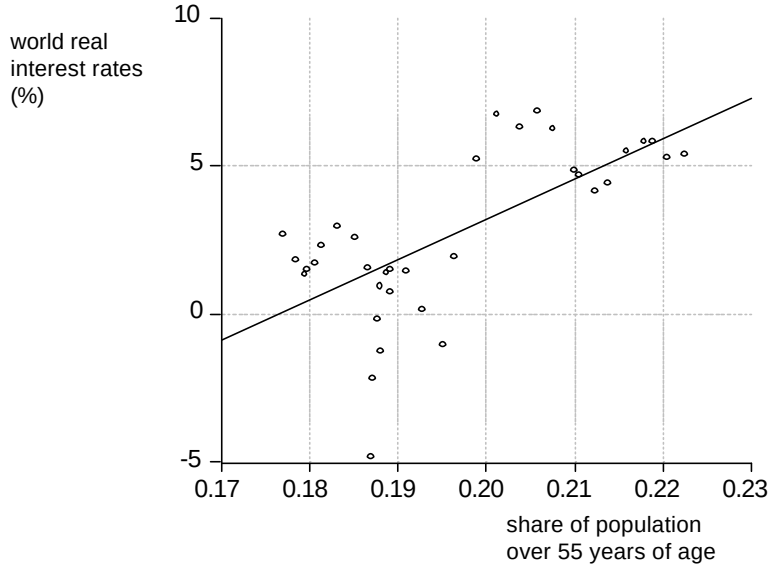

Figure 9. Proportion of population over 55 and the world real rate of interest

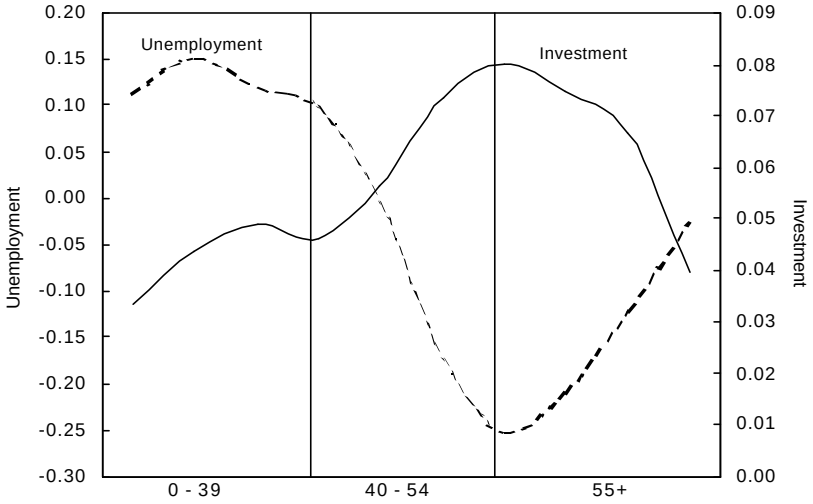

Figure 10. Correlation between the age structure, investment, and unemployment in the OECD, 1965-95

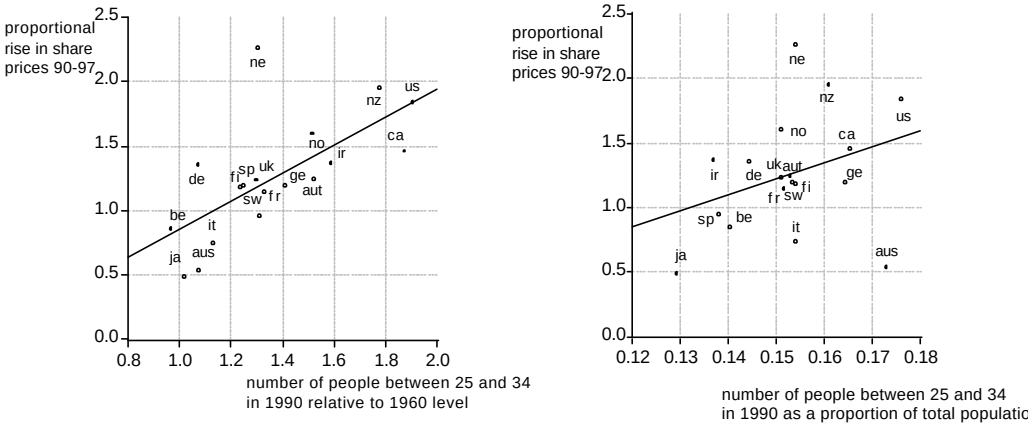

Figure 11. The relationship between the rise in the stock market 1990-97 and the number of people between the ages of 25 and 34 in 1990

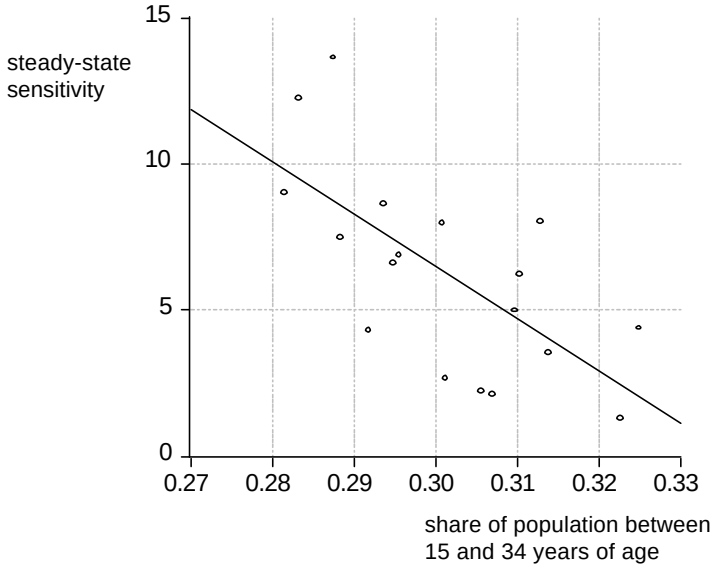

Figure 12. The sensitivity to macroeconomic shocks and the proportion of labour force between the age of 24-34 years

Table 1. The age distribution and world real interest rates

Variable	Coefficient	t-Statistic
Constant	-0.06	(0.1)
15-34	-0.27	(0.21)
35-54	-2.19	(1.13)
55+	3.63	(2.14)
Adj. R^2	0.78	
S.E.	0.01	
D.W.	1.37	

Table 2. Institutions and the sensitivity of unemployment to shocks

	(1)	(2)	(3)	(4)
Constant	4.86	47.69	53.16	63.45
	(2.10)	(2.92)	(3.12)	(3.39)
Duration of benefits	1.10	0.70	0.66	0.69
	(2.65)	(1.81)	(1.65)	(1.63)
Union density	0.11	0.09	0.08	0.08
	(2.20)	(1.73)	(1.50)	(1.41)
Union coordination	-2.62	-2.41	-2.18	-2.3
	(2.34)	(2.92)	(2.26)	(2.22)
Active labour market programmes	-0.13	-0.18	-0.18	-0.18
	(1.86)	(4.30)	(4.09)	(3.92)
Pop. 15-33	…	-135.5	-133.7	-172.1
		(2.74)	(2.69)	(2.67)
Pop. 35-54	…	…	-24.7	14.3
			(0.52)	(0.20)
Pop 55-64	…	…	…	-84.6
				(0.84)
Adj. R^2	0.57	0.74	0.74	0.75
S.E.	2.72	2.20	2.27	2.33

Note: The table shows regressions of the form:

$$q_i/(1-b_i) = a_0 + a_1 Y_i + e$$

where *Y* is a vector of the explanatory variables; replacement ratio, duration of benefits–the number of months at which benefits continue at a reasonable level–union coverage, union density, coordination of unions and employers (indices where "3" refers to maximum coordination) employment protection, active labour market spending and the age structure of the population. We use the average value for the variables 1983-88.

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