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Abstract

A medium-term relationship exists between share prices, normalised by labour productivity, and the rate of unemployment in the OECD countries. A similar relationship appears to exist between unemployment and house prices. This helps explain decadal changes in mean unemployment, such as the shift to higher mean unemployment in the Continental European countries in the 1970s and 1980s that coincided with a fall in the level of share prices, as well as differences in mean unemployment between countries.

Keywords: Unemployment, share prices, natural rate of unemployment.
JEL classification: E24, J23

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In Keynes's General Theory, investment determines demand, which determines unemployment. The evolution of unemployment was determined by the dynamics of investment, driven by the state of confidence in expected returns on production. Unfortunately, these insights were mostly forgotten by mainstream[1] theory but are now being rediscovered. Thus New Keynesian models assume that labour market institutions determine the natural rate of unemployment and ignore investment as a factor behind the problem of persistently high unemployment. The problem of persistently high unemployment in some OECD member countries is then traced to labour market institutions. However, recent models of the natural rate of unemployment bring back to life the idea that expectations affect investment and have a long-run effect on the labour market. Thus, to take just one example from these models, when the value of trained employees increases compared to the cost of training workers we expect firms to increase their rate of hiring which lowers unemployment in the presence of real wage rigidity. Yet, the long-run relationship between asset prices, investment and unemployment is often ignored in empirical studies of the causes of persistent unemployment. It is the objective of this paper to map this relationship as one of the stylised facts of the economy in the medium to long-run, using data that cover the very recent period of volatile unemployment and asset prices.

An equilibrium relationship between asset prices and unemployment was derived in an attempt to explain the decline in the economic performance of Continental Europe in the 1970s, 1980s and the 1990s, in particular an elevated level of unemployment in many countries on the Continent. Initial attempts at explaining this observation were based on the idea that a transitory recession could leave permanent scars in the labour market – there was hysteresis in the labour market.[2] However, as the period of high unemployment turned from years to decades, this explanation lost credence.[3] Theories that explained changes in the labour-market equilibrium not related to the past

[1] Blanchard (2000) expressed his surprise at discovering a medium-term relationship between investment and unemployment by labelling it as the "Modigliani Puzzle".
[2] See Lindbeck and Snower (1989) and Layard et al. (1991).
[3] See also Karanassou and Snower (1998). These authors deny that cyclical and structural movements in unemployment are independent of one another and focus on the link between the two. They view changes in unemployment as the outcome of interplay between shocks and adjustment processes – the latter reflecting various labour-market institutions – which makes it possible for transitory shocks to have a medium-term impact on unemployment.

performance of the labour market turned out to be more convincing and these could potentially explain infrequent shifts in mean unemployment.[4] There are basically two variants of the theory, one based on flow models and the other on stock models. While Blanchard and Katz (1997), Nickell and Layard (1999) and Phelps (1994) provide good examples of the stock approach, Mortensen and Pissarides (1999) and Pissarides (2001) are good examples of the flow approach.

A distinction can also be made between models where changes in equilibrium unemployment are caused by changes in macroeconomic factors and models where changes in the equilibrium are brought about by changes in labour market institutions. Phelps (1994) presented three basic models where the demand for labour had an investment dimension, which opened the way for expectations about future profits and interest rates to affect current labour demand and the equilibrium in the labour market. Involuntary unemployment is caused by firms paying efficiency wages. He then went on to attribute the elevation of unemployment in Europe and elsewhere in the OECD to a rise in the world real rate of interest. The related idea that productivity growth may affect equilibrium unemployment is initially due to Pissarides (1990) who made firms discount future profits from vacancies by the difference between the real rate of interest and the expected rate of productivity growth.

Another approach attributes changes in equilibrium unemployment to changes in labour-market institutions. An early synthesis of this work is found in Layard et al. (1991) and later contributions include Nickell and Layard (1999) and Nickell, Nunziata and Ochel (2005). For a critical assessment see Baker (2004). In these models, the level of unemployment in equilibrium depends on the level and duration of unemployment benefits, the level of firing restrictions, the coverage of labour unions and the centralisation of bargaining, to mention a few of the variables included in the analysis. Belot and Van Ours (2000) explain changes in unemployment in the OECD countries by changes in these institutions and also allow for an interaction between institutions. See also Coe and Snower (1997).

[4] See Bianchi and Zoega (1998) and Papell et al. (2000) on the importance of infrequent shifts in mean unemployment.

The two approaches are by no means mutually exclusive and Layard et al. (1991), Phelps (1994, chapter 17), Blanchard and Wolfers (2000) and Fitoussi et al.(2000) combined them by letting the effect of shocks depend on institutions.[5] However, the relative importance of macroeconomic variables, on the one hand, and labour market institutions, on the other hand, does matter: In one view, unemployment should be tackled through institutional changes in the labour market without paying too much attention to other parts of the economy. In contrast, a moving equilibrium model of unemployment where the equilibrium depends on expectations about future profits and interest rates is richer in that it implies that the level of unemployment depends on economic performance in a wider sense: productivity, expected productivity growth, innovations, entrepreneurship and global capital markets. See Phelps (2006, 2007).

The current global slump offers an ideal testing ground for these theories because it comes following a prolonged boom in asset markets that appeared to reflect expectations of high and rising future profits. Such an asset-price boom should have coincided with low levels of unemployment and the current global slump in asset markets should similarly bring higher levels of unemployment.

1. Employment and asset prices

Any theory that assumes adjustment costs of labour gives a relationship between employment and the implicit shadow price of labour. Oi (1961) pioneered the idea that labour is a quasi-fixed factor of production. Phelps (1994) built on Salop (1979), Calvo (1979) and his own work in the 1960s (Phelps, 1968) to obtain three models linking unemployment to different asset prices where there is real wage rigidity due to efficiency wage reasons, see also Hoon and Phelps (1992) and Fitoussi and Phelps (1988). There is the customer-market model of Phelps and Winter (1970) extended to a general equilibrium framework where changes in the shadow price of customers lead firms to change their mark-up of price over marginal cost and hence also their demand wage. When the shadow price goes up – because of lower interest rates or higher expected profits – firms respond by lowering prices to invest in a larger market share

[5] An alternative is to let institutions interact with shocks as in Ljungqvist and Sargent (1998). An increase in labour market turbulence will in this case lead to greater skill losses and unemployment in countries where benefits are high with a long duration, such as in many of the European countries.

and acquire more customers, making the demand wage increase and unemployment fall. In Phelps's turnover-training model, an increase in the shadow price of trained workers makes firms decide to train more workers, raise the hiring rate, and this lowers unemployment in steady state. Finally, in a two sector model of a labour-intensive capital goods sector and a capital-intensive consumer good sector, an increase in the shadow price of capital will make firms increase wages which will also lower unemployment as in the Rybzynski effect. A closely related model is that of Pissarides (2001) who adopts the matching framework to show how an increase in the shadow price of a vacancy will make firms offer more vacancies which then creates more matches between employers with vacancies and unemployed workers and equilibrium unemployment falls. There is also the model of Greenwald and Stiglitz (1993) who show how firms' equity can affect equilibrium unemployment through a very different channel. In their model a lower levels of equity raises expected bankruptcy costs which makes firms lower their level of hiring when future output prices are random and raises equilibrium unemployment.

Hatton (2006) explores the relationship between productivity growth and unemployment using long-run historical data for the U.K. and finds that high productivity growth brings low unemployment. Both real interest rates and productivity growth are reflected in share prices. In Fitoussi et al. (2000) and Phelps and Zoega (2001) we document the empirical relationship between unemployment and share prices, normalised by labour productivity. We find that both variables are subject to discrete changes in their mean value and that these changes are related so that when a country experiences an upward shift in mean unemployment, the mean level of share prices drops from one plateau to another. Thus the transition from a regime of low unemployment to the one of high unemployment that took place in many continental European economies in the 1970s and 1980s coincided with a similar transition in the stock market towards lower levels of share prices.

Phelps and Zoega (2004) find that stock market capitalisation and unemployment are inversely related and that market capitalisation and productivity growth are positively related in a sample of OECD countries. Beaudry and Portier (2006) show that a large proportion of the low-frequency variation in economic activity is explained

by medium-term-future accelerations and decelerations of productivity. In related work, Smith and Zoega (2008) use principal components analysis to compare global changes in employment and investment and find that the two variables are closely related and mirror the movement of the world real rate of interest. Taken together, the results suggest that the long swings of unemployment may reflect changes in the investment outlook – expected profits and interest rates.

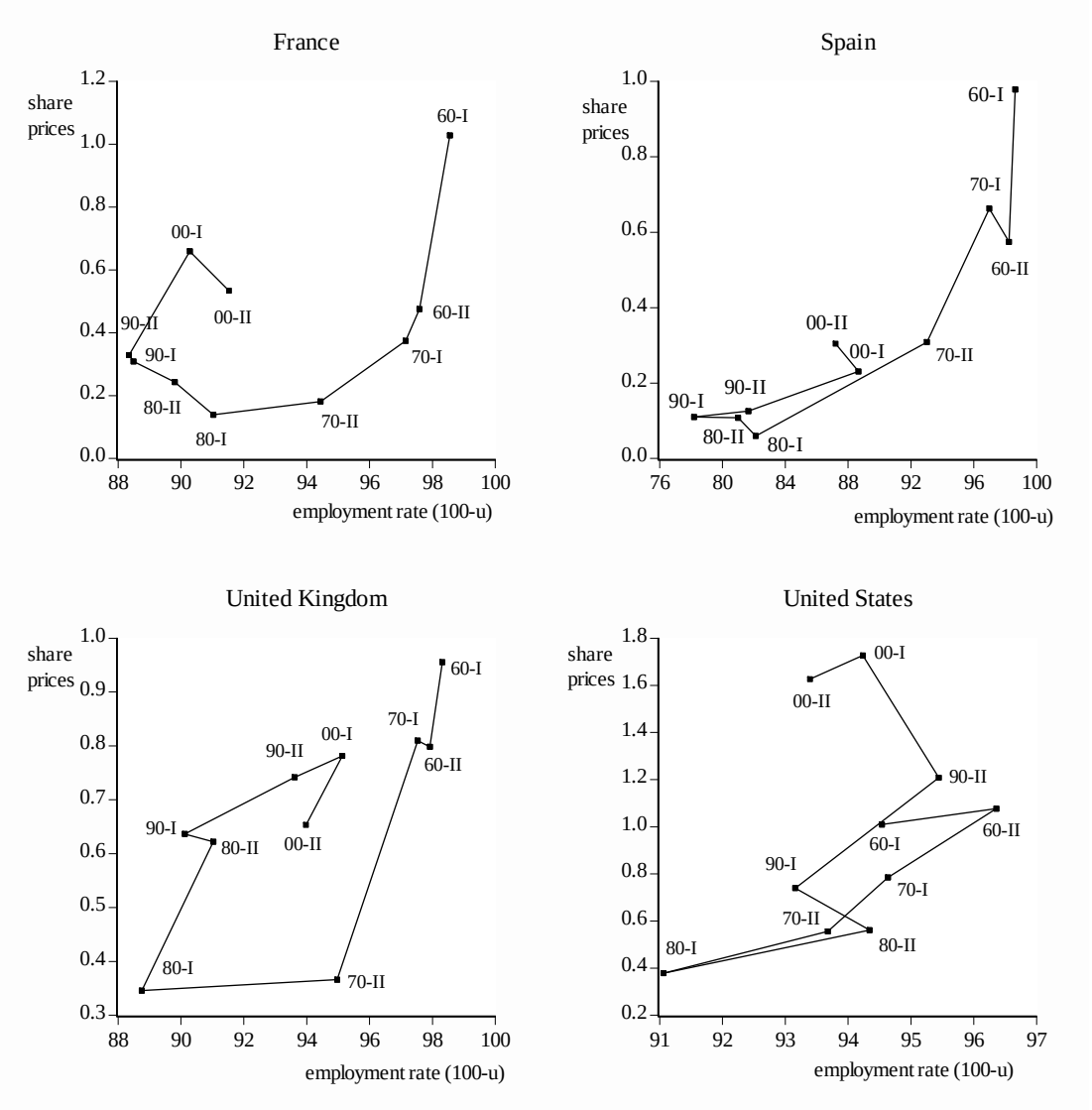
2. The Phelps curve

The positive relationship between share prices, normalised by labour productivity, and the rate of employment (one minus the unemployment rate) is surprisingly robust to changes in the periods used or the choice of a country. This relationship was dubbed the "Phelps curve" by Anthony Scott (2001). The normalisation by productivity is done in the tradition of the Tobin q model of investment – labour productivity is meant to capture the cost of investment which in our case can consist of hiring new workers.[6]

Figure 1 below relates share prices – normalised by labour productivity[7] – to the employment rate (100 minus the rate of unemployment) for four large countries for the period 1960-2009. The share price variable is measured by its average level for the first three years of each half-decade while the unemployment rate is measured by the last three years of each half-decade, the rationale being that hiring decisions do not have an instantaneous effect on the level of employment. A clear upward-sloping relationship is apparent. The top two countries, France and Spain, have suffered high unemployment since the 1970s while the bottom two, the U.K. and the U.S. have had lower levels of unemployment. Note that the movement to a level of lower average employment in the 1970s and 1980s in France and in Spain coincides with a move towards lower share prices. Similarly, the partial recovery in the first years of the new century coincides with rising share prices. In contrast, there is full recovery of both employment and share prices in the U.K. and the U.S.

[6] This is most easily seen in the turnover-training model where the new recruits have to be trained by more experienced workers, which distracts them from their own productive activities.
[7] Labour productivity is measured by gross domestic product (GDP) per employed worker.

Figure 1. The Phelps curve



The relationship can be estimated by a pooled cross-section, time-series regression,

$$u_{it} = \alpha_i + \beta \log(q_{it}) + \varepsilon_{it} \qquad (1)$$

where q denotes normalised share prices and the index i denotes countries and the index t half-decades, starting with 1960-1964 and ending with 2005-2009. The functional form is adopted because theoretical models suggest a convex wage curve in the wage-employment rate space so that changes in labour demand have a smaller effect on unemployment when unemployment is low than when it is high. The results are reported in Table 1 below. In order to check for robustness, the first column uses half-decades starting with 1960-1964 while the following four columns test for the robustness of the results by starting with the half-decades 1961-1966, 1962-1967, 1963-1968 and 1964-1969 respectively.

Table 1. Estimated Phelps curves

Share prices										I (% of GDP)
Levels					First differences					
(1) 1960-	(2) 1961-	(3) 1962-	(4) 1963-	(5) 1964-	(6) 1960-	(7) 1961-	(8) 1962-	(9) 1963-	(10) 1964-	(11) 1960-
-2.05 (6.33)	-1.87 (5.84)	-2.15 (7.17)	-2.27 (7.32)	-2.05 (5.79)	-2.08 (6.10)	-2.08 (6.21)	-2.24 (6.44)	-2.41 (6.96)	-2.35 (6.25)	-37.13 (10.57)

Estimation method: pooled cross-section, time series, weighted least squares. t-ratios in parentheses.

The first five columns show the estimation results for the equation in levels while columns (6) – (10) show the results in first differences. The fixed effects for each of the sixteen countries included in the study[8] are reported in an appendix. The coefficients of the logarithm of q in the first column and the first line of the table indicate that a 10% increase of q will generate a fall in unemployment of around -0.20%. One cannot reject the hypothesis that the five estimates in columns (1) to (5) are statistically equivalent.[9]

[8] Australia, Austria, Belgium, Canada, Finland, France, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, the U.K. and the U.S. Denmark is omitted because it did not have a sufficiently long time series for share prices, Germany because of its unification in 1990.

[9] A Wald test using the estimation results in columns (1) and (6) was used to test whether the estimated coefficient of log(q) could take the values reported in columns (2)-(5) and (7)-(10) respectively. The hypothesis of equality could not be rejected at the 5% level of significance.

Overall, the estimates confirm a robust relationship between share prices and unemployment. The last column of the table shows results when the logarithm of share prices is replaced by investment as a share of GDP. The results indicate that a 10% increase of investment as a share of GDP is associated with a 3.7% fall in unemployment. The results so far appear to suggest that unemployment and investment are related and that changes in the level of share prices precede changes in the level of unemployment. A test of Granger causality can be used to verify this result. Using annual data for the same variables, we ran Granger causality tests and report the results in Table 2 below. The null hypothesis of no Granger causality can be rejected for 14 out of the 16. However, in the case of Austria and Italy, we cannot reject the hypothesis. The alternative hypothesis of changes in unemployment not Granger causing changes in share prices could only be rejected for the United States at the 10% level of significance.

Table 2. Granger causality tests

	Obs.	F	Prob.	Lags		Obs.	F	Prob.	Lags
Australia	45	5.73	0.001**	4	Japan	45	4.66	0.004**	4
Austria	45	0.75	0.561	4	Netherlands	45	3.51	0.016**	4
Belgium	45	5.44	0.002**	4	New Zealand	45	3.66	0.013**	4
Canada	45	2.67	0.048**	4	Norway	45	3.46	0.017**	4
Finland	45	2.79	0.041**	4	Spain	45	2.28	0.080*	4
France	46	2.57	0.068*	3	Sweden	45	4.03	0.008**	4
Ireland	46	2.38	0.085*	3	U.K.	46	2.76	0.055*	2
Italy	45	0.62	0.649	4	U.S.	45	5.19	0.002**	4

The table reports Granger causality tests for changes in the logarithm of normalized share prices *q* not causing changes in unemployment *u*. ** denotes rejection of the null hypothesis of no Granger causality at the 5% level while * denotes a rejection at the 10% level.

In order to explore the relationship between share prices, investment and unemployment further, the first five principal components (PC) of the matrix (16 countries, 10 periods) of share prices, unemployment and investment were then calculated.[10] The eigenvalues are shown in Table 3 below.

[10] See Smith and Zoega (2008).

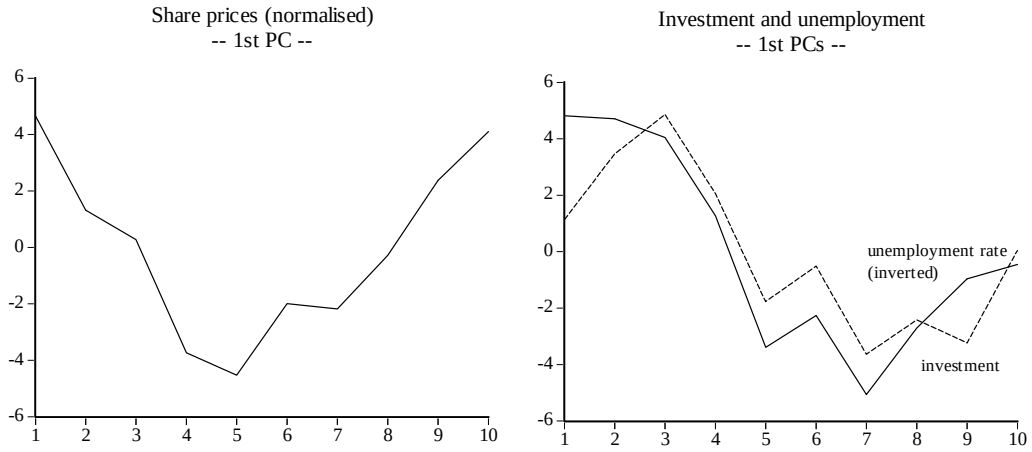
Table 3. Principal components (PC)

	PC 1	PC 2	PC 3	PC 4	PC 5
Share prices:					
Eigenvalues	8.92	4.02	1.37	0.79	0.49
Cumulative Prop.	0.56	0.81	0.89	0.94	0.97
Unemployment:					
Eigenvalues	11.40	2.51	0.92	0.64	0.25
Cumulative Prop.	0.71	0.87	0.93	0.97	0.98
Investment:					
Eigenvalues	7.42	3.76	2.06	1.27	0.59
Cumulative Prop.	0.46	0.70	0.83	0.91	0.94

The 1st principal components explain between 46% and 71% of the variation in the sample. The unemployment matrix is most easily captured by the first principal component (71% of variation explained) while the investment matrix is more difficult to explain (41% explained by 1st principal component). The first principal component for share prices captures movements in average unemployment over the sample; the second principal component has large positive weights on the Continental European economies and a negative weights on the more flexible Scandinavian economies, as well as Canada, New Zealand and the U.S.; and the third a large weight on Japan; the remaining two are more difficult to interpret (see appendix for the eigenvectors). The first three principal components explain almost 90% of the variation in the share price matrix. The first principal component for unemployment similarly captures changes in average unemployment in the sample; the second principal component distinguishes countries that recovered in the 1990s from those that did not – the Scandinavian countries and Japan that did not recover have a negative weight and the U.K., the U.S., Ireland and the Netherlands have a positive weight; the remaining components being more difficult to interpret. The first two principal components explain 87% of the variation in the unemployment matrix. The first principal component for investment again captures changes in average unemployment with countries having broadly equal weights, except for France with a much smaller weight; the remaining principal components being more difficult to interpret. The first principal component explains 46% of the variation in the investment matrix.

The following figure shows the first principal components of share prices, unemployment and investment. Striking similarities appear, especially between unemployment and investment.

Figure 2. The first PCs of share prices, unemployment and investment



The figure clearly shows a medium-term relationship between average share prices, average unemployment and average investment (as a share of GDP) for the 16 countries. The rise in average unemployment in the 1970s and 1980s corresponded to a fall in share prices and investment, and the recovery of employment in the 1990s and 2000s corresponded to a recovery of investment and share prices.

Finally, Figure 3 shows the actual unemployment rate for the United States as well as the one predicted from changes in normalised share prices, column 1 in Table 1. The figure reveals how the long swings of unemployment correspond to the long swings of the stock market.

Figure 3. Actual and predicted unemployment in the U.S.

The unemployment and share price number for 2009 are those for the month of May 2009.

Moreover, using current values for share prices and labour productivity, it can be predicted that the equilibrium unemployment rate in the United States will be around 5.5% if share prices, normalised by labour productivity, return to their 1995 level. This implies that the current actual unemployment rate of 9.4% is well above the equilibrium rate calculated using only one causal variable. The horizontal line shows the 5.5% rate of unemployment. Clearly, the current unemployment rate of 9.4% is much higher than the one predicted by equation (1).

3. Multiple regressions

The strength of the relationship between unemployment and share prices shown in Figure 1 and Table 1 may be surprising to some readers. However, it does not preclude other influences. Equilibrium unemployment has also been shown to depend on the rate of productivity growth, real exchange rates, house prices and oil prices and a host of labour market variables.

The importance of the rate of productivity growth for unemployment has been emphasised by, amongst others, Manning (1992), Hoon and Phelps (1997), Pissarides

(2001) and Ball and Moffitt (2001). In Manning (1992), a higher expected rate of productivity growth makes workers expect a higher rate of wage growth which makes them value their current jobs more, hence have a lower propensity to shirk their duties which then makes it possible for firms to pay lower wages relative to current productivity without reducing workers' effort. In Hoon and Phelps, higher current productivity growth makes productivity rise relative to wealth which then makes the demand wage rise by more than the supply wage until wealth has caught up with rising productivity. In Pissarides (2001), higher expected productivity growth raises the shadow price of vacancies which makes firms create more vacancies which gradually raises the level of employment. In Ball and Moffitt (2001), higher current productivity growth raises the marginal product of labour while it takes time for workers to realise that their productivity has increased, hence wage aspirations initially grow at a slower pace than the demand wage and employment increases until workers' expectations have adjusted.

There may also be a relationship between real exchange rates and equilibrium unemployment, as described by Hoon, Phelps and Zoega (2005). Lower real exchange rates have the effect of shielding domestic producers from import competition which allows them to raise markups, that is to lower the real demand wage measured in domestic produce, which increases unemployment. Thus, a real exchange rate depreciation has a contractionary effect on the supply side in the medium term while possibly having a short-term expansionary effect on the demand side.

House prices may impact equilibrium unemployment since construction is labour intensive. In one of three models presented in Phelps's *Structural Slumps*, there are two sectors: a labour-intensive capital producing sector and a capital-intensive consumer good sector. Clearly, house construction can be viewed as a labour-intensive capital producing sector. In the model a rise in the real rate of interest would make the price of capital fall which makes the factor used intensively in producing capital fall, that is wages fall and so does employment.

Oil prices have shown a surprisingly robust association with the unemployment rate in recent decades.[11] The elevation of oil prices in the 1970s and early 1980s coincided

[11] See Carruth, Hooker and Oswald (1998).

with the elevation of unemployment and the fall of oil prices in the middle of the 1980s coincided with falling unemployment, the sudden rise in the early 1990s with an elevation of unemployment. Bruno and Sachs (1985) were among the first to highlight the possible link between the two variables. When oil prices go up, firms have to lower their real demand wage but in the presence of real wage rigidity unemployment rises. Another way of phrasing this effect is to say that higher oil prices imply higher fixed costs which call for higher markups of price over marginal costs which then translates into a lower real demand wage. With an upward-sloping wage curve, one gets a higher natural rate of unemployment.

Several labour market variables (see appendix for sources and definitions) have been shown to have a robust medium-term relationship with unemployment. The variables include the coordination of bargaining; union density; benefit replacement rates; the duration of benefits; and, finally, employment protection. These variables have shown a fairly robust association with unemployment in many studies.[12] There is some evidence that suggests that unions raise unemployment while the coordination of employers and unions in wage negotiations lowers it.[13] Moreover, the level and duration of unemployment benefits has a positive correlation with the rate of unemployment.[14] The evidence on employment protection is ambiguous, except that there seems to be a clear positive relationship between employment protection and long-term unemployment.[15,16,17]

Table 4 has the results of a regression where the unemployment rate (in percent of the labour force) is regressed on a host of macroeconomic variables in vector $\boldsymbol{M}$ in

[12] See, amongst others, Layard, Nickell and Jackman (1991), Baker et al. (2004) and Nickell, Nunziata and Ochel (2005).
[13] See Nickell and Layard (1999) and Booth et al. (2000).
[14] See Layard et al. (1991) and Nickell and Layard (1999).
[15] See, amongst other, Lazear (1990), Bentolila and Bertola (1990), Elmeskov et al. (1998) and Nickell and Layard (1999) on the effect of employment protection.
[16] In a recent paper, Lafontaine and Sivadasan (2009) show that labour regulation lowers the frequency of employment adjustment at the firm level which creates misallocation costs that offset some of the benefits for incumbent workers of longer tenure and protection against job loss during downturns.
[17] There is the possible problem that institutions are likely to be endogenous, responding to the evolution of unemployment. Smith and Zoega (2008) investigate this by running a random effects panel estimator for each institutional measure on its lagged value, lagged unemployment and the lagged value of a principal component of the unemployment matrix that captures changes in OECD-wide unemployment. They found that national unemployment was never significant which suggests that endogeneity is unlikely to be a problem.

equation (2) below and a group of labour market variables found in vector Λ in the equation where the vectors A and B have the coefficients of the relevant macroeconomic variables and labour market variables,

$$u_{it} = \alpha_i + \mathrm{AM} + \mathrm{B}\Lambda + \varepsilon_{it} \qquad (2)$$

The vector M has macroeconomic variables; an index of share prices (normalised by productivity), an index of house prices (normalised by productivity), real exchange rates (calculated using the consumer price index), the world real rate of interest and productivity growth and oil prices (deflated by the consumer price index), while the vector Λ has the battery of labour market variables; a measure of coordination, the density of labour unions, the replacement ratio, the duration of benefits and employment protection (see appendix for sources and definitions). The results follow in the table for a pooled cross section – time series regression when fixed effects for each of the 16 countries have been added.

The logarithm of share prices has a statistically significant negative coefficient that is robust to the inclusion of the other variables. The numerical value of the coefficient implies that a 10% increase in share prices makes unemployment fall by about 0.2 percentage points, the doubling of share prices, normalized by productivity, then makes unemployment fall by 2%. When house prices are added in column (2), we lose a lot of observations and are left with only 65 which cover the most recent periods.

Table 4. Multiple regressions – fixed effects

	(1)	(2)*	(4)*	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Constant	4.71	6.2	-18.79	3.09	5.42	2.21	5.99	3.17	2.19	2.92	2.91
	(6.95)	(17.87)	(13.01)	(4.56)	(9.04)	(2.31)	(4.98)	(4.23)	(2.57)	(2.73)	(1.83)
Stock prices (norm., logs)	-2.05	-1.91	-1.55	-2.48	-2.53	-2.21	-2.44	-2.12	-2.22	-2.19	-2.16
	(3.16)	(7.76)	(4.31)	(6.33)	(5.10)	(4.48)	(6.09)	(4.86)	(5.83)	(5.50)	(5.13)
House prices (norm, logs)		-1.69	-1.82								
		(1.62)	(2.22)								
Real exchange rate (logs)			5.51								
			(14.65)								
World real rate of interest (%, logs)				1.59	1.32	1.41	1.35	1.35	1.31	1.30	1.30
				(3.77)	(4.37)	(4.62)	(5.20)	(5.47)	(5.71)	(5.70)	(5.67)
Prod. Growth (%, logs)					-0.90	-0.41	-0.48	-0.65	-0.57	-0.58	-0.57
					(11.59)	(3.59)	(4.07)	(4.66)	(3.94)	(3.72)	(3.65)
Real oil prices (logs)						1.56	1.24	1.12	1.05	1.09	1.11
						(5.22)	(4.01)	(3.99)	(3.50)	(3.64)	(3.73)
Coordination							-1.51	-1.95	-1.85	-1.91	-1.91
							(4.89)	(6.06)	(5.25)	(5.84)	(5.84)
Unions density								0.11	0.10	0.09	0.09
								(8.20)	(8.26)	(6.57)	(6.33)
Replacement ratio									3.11	3.47	3.68
									(1.79)	(2.02)	(2.14)
Duration of benefits										-1.17	-1.25
										(1.48)	(1.63)
Employment protection											0.09
											(0.10)
R-squared	0.61	0.50	0.53	0.68	0.72	0.76	0.79	0.80	0.81	0.81	0.81
Observations	160	65	55	160	156	156	156	156	156	156	156

Linear estimation after one-step weighting matrix. White cross-section standard errors and covariance. t-ratios in parentheses.

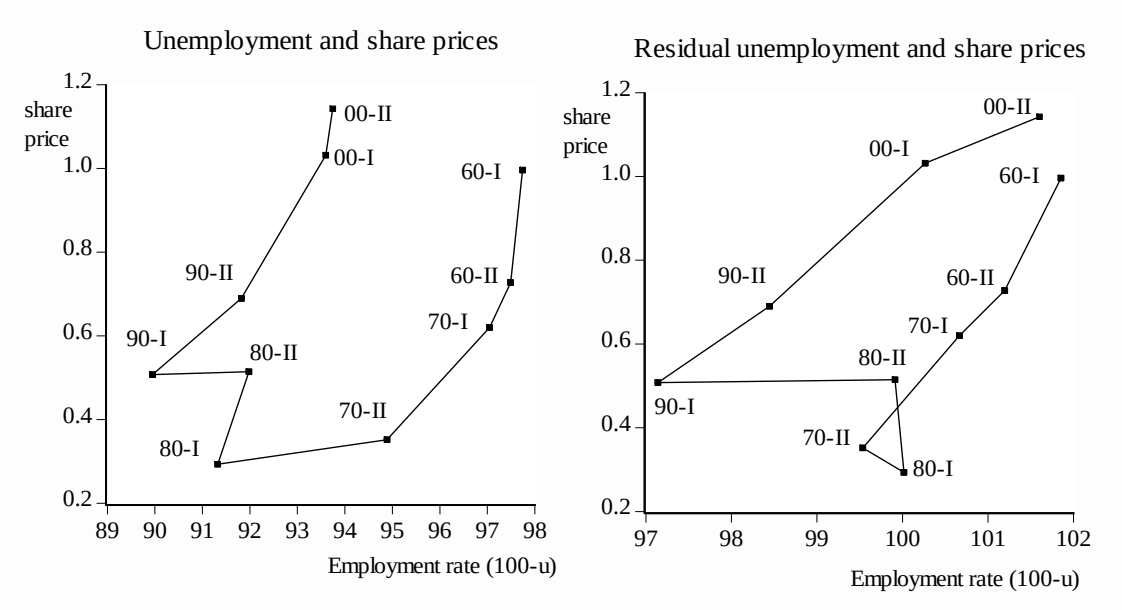
* fixed effects omitted.

A doubling of house prices will lower unemployment by about 1.7 percent. Taken together, a doubling of both share prices and house prices (relative to labour productivity will lower unemployment by over 3.5%. The coefficient of real exchange rates is positive and significant, implying that the exchange rate is positively correlated with unemployment, which is inconsistent with the models described above but consistent with the effects of a monetary shock in a Keynesian model. The logarithm of the world real rate of interest has a positive and significant coefficient; the rate of productivity growth turns out to have a robust and significantly negative coefficient and the one remaining macroeconomic variable, the logarithm of the real price of oil, has the predicted positive coefficient, which is statistically significant and robust to the inclusion of all other variables. The numerical values of the estimated coefficients imply that a doubling of real interest raise unemployment by up to 1.5 percentage points; that a doubling of oil prices would raise unemployment by a similar magnitude; and that each percentage increase in the rate of productivity growth would lower unemployment by about 0.6 percentage points.

Turning to the labour-market variables, more coordination in wage bargaining lowers unemployment; increased density of unions raises it; and a higher unemployment benefit replacement ratio raises unemployment. However, both the duration of benefits as well as employment protection have statistically insignificant coefficients.

Figure 4 shows the average of the rate of employment and normalised share prices for the 16 countries – the left-hand side panel – and the partial correlation between employment and share prices where the former is calculated as the residual from regressing the employment rate on all macroeconomic variables in Table 4 except share prices – the right-hand side panel. In the left-hand side panel there is a shift in the relationship between the 1960s-1970 and the 1990s-2000s, which is much reduced in the right-hand side panel when the effect of other macroeconomic variables has been removed, making the observations for the first half of the 1960s and the second half of the 2000s very similar.

Figure 4. Employment and share prices, total and partial relationship



The figure shows clearly that the medium- to long-term fluctuations in OECD employment are associated with fluctuations in share prices normalised by productivity.

4. Conclusions

There is a medium-term relationship between share prices and unemployment. This relationship is quite robust to the inclusion of other explanatory variables. The relationship is consistent with models of the equilibrium unemployment rate that explain changes in the equilibrium by changes in an economy's performance, such as the current and expected rate of productivity growth, as well as current and future real interest rates. The level of share prices captures the influence of these variables and should hence be negatively correlated with unemployment.

While the models described in this paper assume that stock prices have an information advantage, the question arises what would change if we allowed for the effect of animal spirits, described by Keynes.[18] In the equilibrium models discussed above, it is clear that when managers share the optimism of the market they may decide to hire new workers and it does not matter if their expectations are incorrect as long as

[18] See e.g. Robert J. Shiller (2003) and Hyman Minski (1992).

the mistaken expectations are attributable to the uncertainty they face about the future.[19] In a Keynesian model, in contrast, optimism creates investment demand for output that lowers unemployment. Thus, the stylised relationship between share prices, investment and unemployment also sits comfortably within the disequilibrium tradition of old-style Keynesian models.

The current literature on the causes of persistent unemployment, European unemployment in particular, has neglected the medium-term relationship between employment, investment and share prices. The empirical relationship between investment and employment that was one of the few things that Hayek and Keynes did agree on in an earlier age has gone missing in the search for an explanation for the stubbornly high unemployment found in some of the European countries. The renewed emphasis on the labour market and its institutions, which is a return to an almost classical approach, has deprived us of a larger view where product and capital markets are important pieces of the story. Yet the stylised relationship between institutions and unemployment are no stronger than the share price-investment-employment relationships described in this paper. The latter tend to be ignored in the current literature on persistent unemployment to the detriment of our understanding of the long swings in economic activity.

[19] See Hoon and Phelps (2007) on the effect of higher share prices on employment when these are based on an incorrect expectation of higher productivity in the future.

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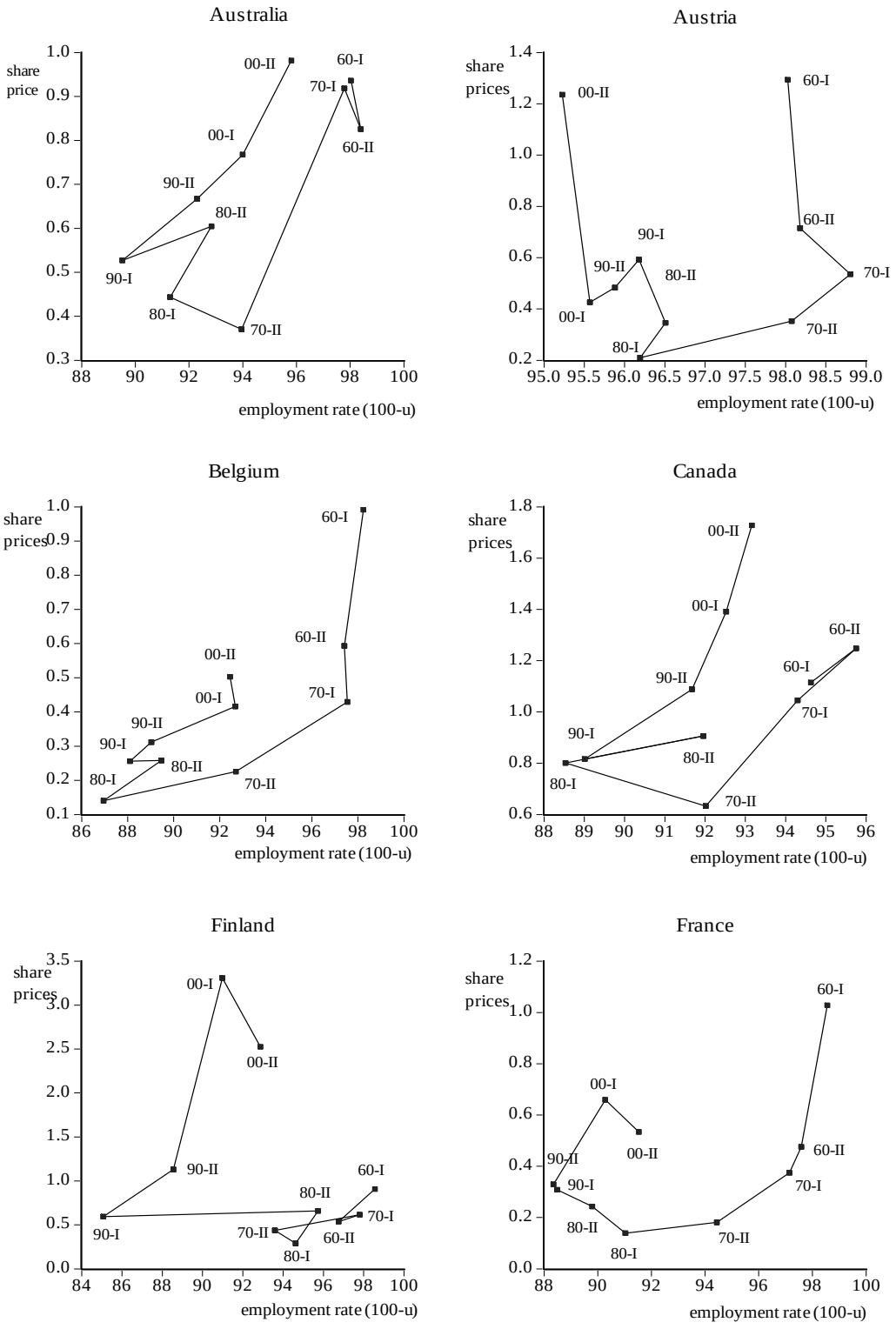
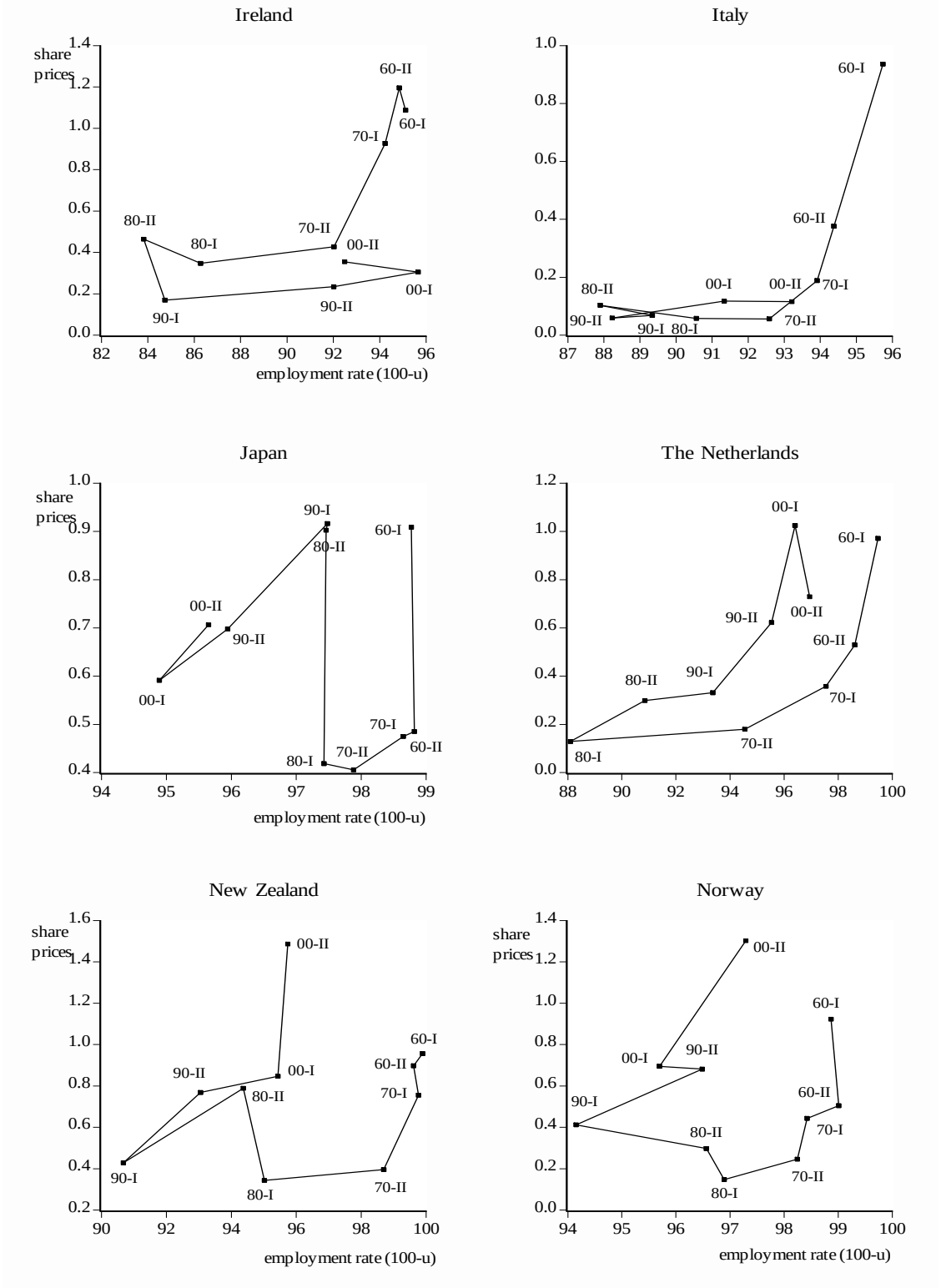
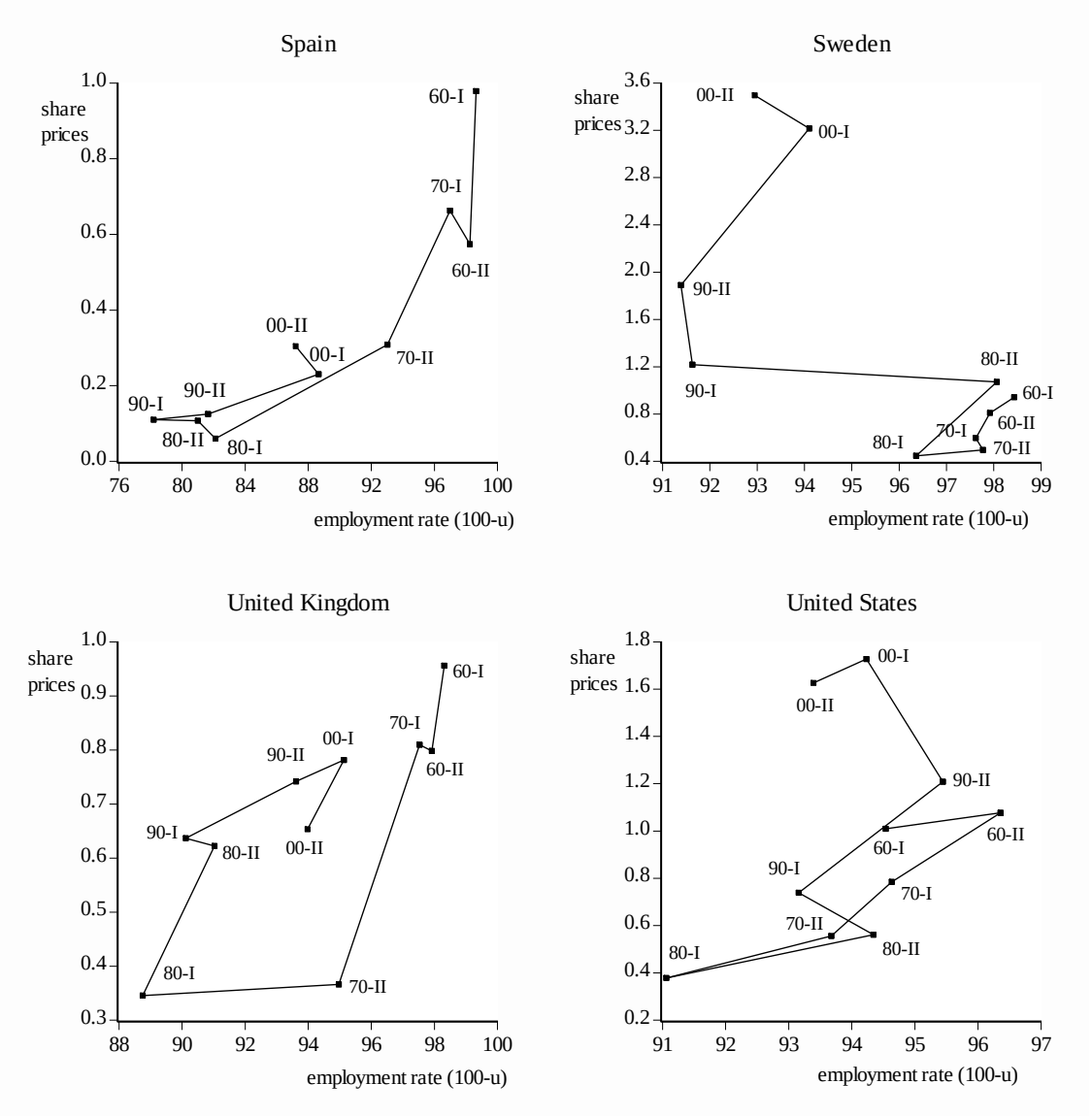
Appendix A

Normalised share prices and employment rate in several OECD countries




Ireland
share prices
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
82 84 86 88 90 92 94 96
employment rate (100-u)
60-II
60-I
70-I
80-II
80-I
70-II
00-II
00-I
90-I
90-II
Italy
1.0
0.8
0.6
0.4
0.2
0.0
87 88 89 90 91 92 93 94 95 96
60-I
60-II
80-II
00-I
00-II
70-I
90-II
70-II
90-I
80-I
Japan
share prices
1.0
0.9
0.8
0.7
0.6
0.5
0.4
94 95 96 97 98 99
employment rate (100-u)
90-I
60-I
80-II
00-II
90-II
00-I
70-I
60-II
80-I
70-II
The Netherlands
1.2
1.0
0.8
0.6
0.4
0.2
0.0
88 90 92 94 96 98 100
00-I
60-I
00-II
90-II
60-II
80-II
90-I
70-I
80-I
70-II
New Zealand
share prices
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
90 92 94 96 98 100
employment rate (100-u)
00-II
60-I
90-II
00-I
60-II
80-II
70-I
90-I
80-I
70-II
Norway
share prices
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
94 95 96 97 98 99 100
employment rate (100-u)
00-II
60-I
00-I
90-II
90-I
60-II
80-II
70-I
70-II
80-I


Spain
share prices
1.0
0.8
0.6
0.4
0.2
0.0
76
80
84
88
92
96
100
employment rate (100-u)
60-I
70-I
60-II
00-II
00-I
70-II
90-II
90-I
80-II
80-I
Sweden
share prices
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
91
92
93
94
95
96
97
98
99
employment rate (100-u)
00-II
00-I
90-II
80-II
90-I
60-I
60-II
70-I
80-I
70-II
United Kingdom
share prices
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
88
90
92
94
96
98
100
employment rate (100-u)
60-I
70-I
00-I
90-II
60-II
90-I
80-II
00-II
80-I
70-II
United States
share prices
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
91
92
93
94
95
96
97
employment rate (100-u)
00-I
00-II
90-II
60-I
60-II
90-I
70-I
70-II
80-II
80-I

Appendix B

Fixed effects from the estimation of equation (1)

	Levels					First differences					Inv.
	(1) 1960-	(2) 1961-	(3) 1962-	(4) 1963-	(5) 1964-	(7) 1960-	(8) 1961-	(9) 1962-	(10) 1963-	(11) 1964-	(6) 1960-
Fixed effects – α											
Australia	4.79	4.67	4.55	4.75	5.11	0.26	0.32	0.41	0.36	0.34	15.46
	(6.27)	(6.55)	(6.46)	(6.69)	(6.39)	(0.67)	(0.59)	(0.90)	(0.78)	(0.56)	(13.28)
Austria	1.85	1.89	1.22	1.29	1.65	0.30	0.30	0.16	0.28	0.39	11.83
	(3.16)	(3.13)	(2.21)	(2.41)	(2.93)	(0.55)	(0.60)	(0.34)	(0.57)	(0.77)	(14.13)
Belgium	5.43	5.54	5.12	5.22	5.76	0.49	0.51	0.51	0.51	0.50	15.07
	(5.58)	(5.71)	(5.19)	(5.35)	(5.60)	(0.49)	(0.71)	(0.61)	(0.62)	(0.64)	(11.15)
Canada	7.72	7.51	7.34	7.64	7.87	0.26	0.34	0.36	0.35	0.34	15.37
	(12.83)	(13.60)	(13.61)	(14.49)	(13.19)	(0.70)	(0.52)	(0.71)	(1.00)	(0.56)	(16.10)
Finland	6.14	6.01	5.56	5.93	6.50	0.87	0.89	1.11	1.00	0.88	14.56
	(4.02)	(3.92)	(3.32)	(3.73)	(4.30)	(0.49)	(0.67)	(0.82)	(0.87)	(0.75)	(11.36)
France	5.20	5.42	4.94	4.99	5.43	0.62	0.66	0.86	0.80	0.75	16.24
	(4.64)	(4.91)	(4.31)	(4.50)	(4.69)	(0.22)	(1.28)	(1.56)	(1.59)	(1.43)	(10.92)
Ireland	7.25	7.23	7.29	7.33	7.55	0.03	0.00	-0.56	-0.60	-0.47	17.08
	(6.09)	(5.95)	(5.47)	(5.51)	(5.66)	(0.98)	(0.00)	(0.44)	(0.51)	(0.41)	(9.66)
Italy	4.07	4.31	3.74	3.49	4.08	-0.20	-0.21	-0.24	-0.31	-0.28	16.12
	(4.75)	(4.81)	(4.05)	(3.87)	(4.26)	(0.78)	(0.26)	(0.27)	(0.38)	(0.37)	(16.42)
Japan	1.73	1.82	1.49	1.49	1.70	0.29	0.31	0.30	0.32	0.40	10.68
	(3.22)	(3.61)	(2.82)	(2.75)	(2.95)	(0.37)	(0.85)	(0.63)	(0.73)	(1.17)	(12.70)
Neth.	3.11	3.25	3.16	3.18	3.40	0.21	0.22	0.42	0.32	0.28	12.79
	(3.95)	(4.19)	(4.04)	(4.33)	(4.20)	(0.76)	(0.32)	(0.61)	(0.56)	(0.44)	(11.58)
New Z.	3.05	3.10	2.73	2.71	3.19	0.56	0.56	0.47	0.49	0.53	12.36
	(3.28)	(3.40)	(2.77)	(2.79)	(3.26)	(0.34)	(0.87)	(0.57)	(0.60)	(0.71)	(11.38)
Norway	1.30	1.47	0.98	0.92	1.22	0.25	0.31	0.38	0.41	0.41	11.50
	(1.89)	(2.13)	(1.24)	(1.20)	(1.64)	(0.63)	(0.55)	(0.50)	(0.56)	(0.64)	(12.26)
Spain	8.52	8.90	8.17	8.00	8.65	1.00	1.00	0.59	0.51	0.69	19.14
	(4.86)	(4.92)	(4.43)	(4.44)	(4.73)	(0.37)	(0.74)	(0.38)	(0.36)	(0.58)	(8.13)
Sweden	4.59	4.56	4.04	4.29	4.66	0.91	0.93	0.98	0.96	0.91	14.7
	(3.57)	(3.58)	(3.10)	(3.35)	(3.73)	(0.22)	(1.15)	(1.11)	(1.17)	(1.18)	(11.80)
U.K.	4.95	4.85	4.77	5.00	5.31	0.39	0.41	0.32	0.32	0.36	14.74
	(4.68)	(5.74)	(5.56)	(5.99)	(5.97)	(0.61)	(0.47)	(0.39)	(0.46)	(0.49)	(10.31)
U.S.	5.63	5.56	5.32	5.53	5.62	0.24	0.27	0.18	0.18	0.26	13.84
	(14.34)	(16.79)	(23.90)	(22.37)	(16.77)	(0.63)	(0.69)	(0.59)	(0.49)	(0.48)	(16.30)
Obs.	160	160	144	144	144	144	144	128	128	128	160

Appendix C
Eigenvectors

Share prices

Countries	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5
Australia	-0.30	0.04	0.20	-0.19	0.35
Austria	-0.28	0.09	-0.14	-0.41	-0.36
Belgium	-0.28	0.25	-0.04	0.06	-0.16
Canada	-0.27	-0.22	0.23	-0.19	0.10
Finland	-0.20	-0.36	0.07	0.31	-0.10
France	-0.30	0.12	-0.14	0.30	-0.21
Ireland	-0.14	0.40	0.34	-0.04	0.20
Italy	-0.21	0.36	-0.15	0.13	-0.25
Japan	-0.12	0.00	-0.81	-0.17	0.30
Netherlands	-0.30	-0.09	-0.09	0.42	-0.06
New Zealand	-0.28	-0.13	0.12	-0.43	0.11
Norway	-0.29	-0.15	-0.05	-0.27	-0.24
Spain	-0.21	0.37	0.17	0.04	-0.11
Sweden	-0.19	-0.41	-0.03	0.03	-0.05
U.K.	-0.27	0.13	-0.08	0.23	0.62
U.S.	-0.26	-0.28	0.13	0.20	0.03

Unemployment:

Countries	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5
Australia	-0.28	0.08	0.09	-0.17	0.31
Austria	-0.23	-0.26	-0.34	0.29	-0.38
Belgium	-0.29	0.10	-0.02	0.10	0.19
Canada	-0.27	0.19	-0.13	-0.29	0.27
Finland	-0.23	-0.29	0.17	-0.44	0.20
France	-0.28	-0.14	0.05	0.20	0.08
Ireland	-0.22	0.34	0.26	0.05	-0.49
Italy	-0.26	0.01	0.36	0.35	0.28
Japan	-0.17	-0.40	-0.40	0.37	0.23
Netherlands	-0.22	0.39	-0.08	0.22	0.23
New Zealand	-0.28	-0.11	0.17	-0.07	-0.27
Norway	-0.27	-0.14	0.10	-0.21	-0.16
Spain	-0.29	0.01	0.10	0.12	-0.18
Sweden	-0.20	-0.41	-0.03	-0.30	-0.13
U.K.	-0.27	0.22	-0.07	0.05	-0.15
U.S.	-0.17	0.31	-0.64	-0.29	-0.07

Investment:

Countries	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5
Australia	-0.29	0.14	0.01	-0.02	0.69
Austria	-0.31	0.00	-0.30	0.09	-0.35
Belgium	-0.25	0.23	-0.00	0.39	-0.19
Canada	-0.32	0.04	0.24	-0.11	0.23
Finland	-0.32	0.23	-0.05	-0.01	0.12
France	-0.03	0.21	0.61	0.05	-0.22
Ireland	-0.24	-0.34	0.11	-0.23	0.11
Italy	-0.35	0.05	-0.08	-0.09	-0.06
Japan	-0.11	0.27	-0.54	-0.01	-0.03
Netherlands	-0.12	0.43	0.20	0.17	-0.13
New Zealand	-0.30	0.05	0.26	0.04	-0.10
Norway	-0.14	0.32	-0.17	-0.53	-0.06
Spain	-0.27	-0.20	0.09	-0.37	-0.37
Sweden	-0.22	-0.36	-0.12	0.25	-0.18
U.K.	-0.22	-0.38	0.06	-0.13	0.03
U.S.	-0.25	-0.21	-0.06	0.49	0.16

Appendix D

The Data and their Sources

Variable	Definition	Units	Source
World real rate of interest	Weighted average of real rates of interest in the G7 countries where their relative GDP, taken from the Summers-Heston data set is used as weights.	Percentages.	IMF: International Financial Statistics and the Penn-World Tables.
Real oil prices	Average crude price, dollars per barrel, constant prices.	Index; base=1 in 1960	IMF: International Financial Statistics.
Productivity growth	The rate of growth of labour productivity, measured as real GDP per man hour.	Percentages.	OECD.
Share prices.	An index of share prices, normalised by GDP per employed worker.	Index; base=1 in 1960.	IMF: International Financial Statistics.
House prices.	House prices, normalised by GDP per employed worker.	Index; base=1 in 2000.	See following page.
Real exchange rate	The effective real exchange rate, calculated using the consumer prices index.	Index; base=100 in 2000.	IMF: International Financial Statistics.
Coordination.	An index of the coordination of unions and employers in wage negotiations.	Index: 1-3	Database of Nickell, Nunziata and Ochel (2005).
Density	The share of the labour force that belongs to a labour union.	Percentages.	Database of Nickell, Nunziata and Ochel (2005).
Replacement ratio	The ratio of unemployment benefits and average wages.	Decimals.	Database of Nickell, Nunziata and Ochel (2005).

Duration of benefits	The maximum duration of unemployment benefits.	Index.	Database of Nickell, Nunziata and Ochel (2005).
Employment protection.	An index of employment protection.	Index: 0-2	Database of Nickell, Nunziata and Ochel (2005).

House prices: National sources

Australia: Australian Bureau of Statistics

Austria: Oesterreichische (Austria) National Bank

Belgium: OECD-IMF WORKSHOP Real Estate Price Indexes.

Canada: Mortgage and Housing Corporation

Finland: StatFin - Online Service

France: National Institute for Statistics and Economic Studies (INSEE)

Ireland: Environment, Heritage and Local Government of Ireland

Italy: Housing Prices and Housing Wealth in Italy by Luigi Cannnari and Ivan Faiella

Japan: Japan Real Estate Institute.

Netherlands: OECD-IMF WORKSHOP Real Estate Price Indexes.

New Zealand: Reserve Bank of New Zealand

Norway: Statistics Norway

Spain: OECD-IMF WORKSHOP Real Estate Price Indexes.

Sweden: http://www.scb.se/

United Kingdom: Nationwide

United States: S&P online