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The Modigliani "Puzzle"

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Abstract

Medium- to long-term changes in unemployment appear to be closely correlated with medium- to long-term changes in private investment. This becomes a puzzle once we abandon the Keynesian framework as an explanation for medium-term movements in unemployment and replace it with the natural-rate framework of Friedman and Phelps. It also opens up the possibility that factors affecting private saving and investment may impinge directly on the natural rate of unemployment. One such factor is the age structure of the population. We explore these possibilities and find a surprisingly robust medium- to long-run relationship between investment and unemployment both over time and across countries.

JEL classification: J1, E2
Keywords: Modigiani puzzle, investment, unemployment, age-structure

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Medium- to long-term changes in unemployment appear to be closely correlated with medium- to long-term changes in private investment. Olivier Blanchard (2000) has referred to this relationship as the "Modigliani puzzle". In contrast, Franco Modigliani (2000) sees it as a natural manifestation of the Keynesian paradigm where changes in autonomous investment are the driving force behind movements in output and employment. The Modigliani puzzle is hence no puzzle to Modigliani himself! However, it may become a puzzle once we abandon the Keynesian framework as an explanation for medium-term movements in unemployment and replace it with the natural-rate framework of Friedman (1968) and Phelps (1968). The moving natural rate of Phelps (1994) and Blanchard (2000), amongst many others, then turns out to be highly correlated with the rate of investment. The high correlation between unemployment and investment at low frequencies has gone unnoticed to many observers but is important in its own right, apart from having implications for theoretical modelling. It also opens up the possibility that factors affecting private saving and investment may impinge directly on the natural rate of unemployment.

The raw relationship between the decadal averages of investment and unemployment for 19 OECD[1] countries is visible in Figure 1 below.

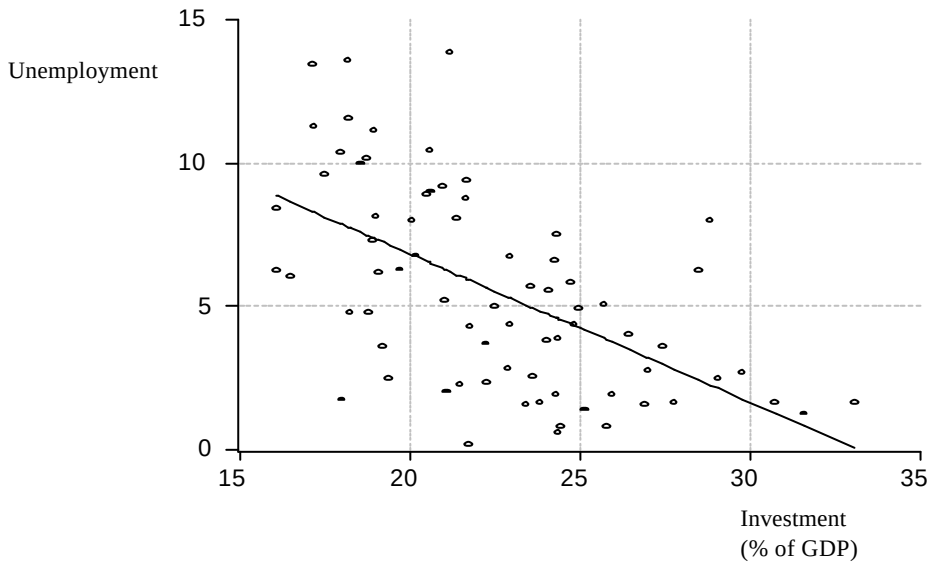

Figure 1. Investment and unemployment in the OECD (decadal averages for the period 1960-97).

[1] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, United States.

The simple correlation between the two series is -0.51, and rises to -0.57 once two outliers have been removed from the data (Spain in the 1980s and 1990s, not shown in figure).

In order to further test for a relationship between unemployment and investment we estimated both panel and cross-section equations. The results are reported in Table 1.

Table 1. Relationship between unemployment, investment, and real price of oil in the OECD, 1960-97

	Annual	Decadal averages	Annual*	Decadal averages*	1960-69+	1970-79+	1980-89+	1990-97+
Constant	0.161	0.150	-	-	0.064	0.071	0.183	0.173
	(21.1)	(6.04)			(2.76)	(2.83)	(4.13)	(4.06)
Investment	-0.526	-0.529	-0.765	-0.886	-0.173	-0.138	-0.481	-0.410
	(16.5)	(5.30)	(21.0)	(6.75)	(1.90)	(1.37)	(2.52)	(1.91)
Real price of oil	0.065	0.126	0.061	0.117	-	-	-	-
	(7.40)	(3.30)	(9.08)	(3.82)				
Observations	708	76	708	76	18	19	19	20
Adj. R^2	0,32	0,35	0,44	0,55	0.10	0.07	0.13	0.07

Notes: t-statistics in parentheses. * Estimation method Fixed Effects. +White Heteroskedasticity-Consistent t-statistics

The first two columns report the results of panel estimation without fixed effects for annual and decadal data. Unemployment is explained by investment and real oil prices.[2] Interestingly, the coefficient of investment is highly statistically significant for both annual and decadal data and its numerical value is very similar in the two estimations. An increase in the share of GDP devoted to investment in physical capital by 5% (i.e. from 10% to 15% of GDP) goes together with a fall in unemployment of over 2%. Such a correlation would not come as a surprise at annual frequencies but the results using decadal data suggest that the medium-run level of unemployment is related to average decadal investment. The panel equation using decadal observations explains 35% of the variation in the unemployment data.

In columns 3 and 4 the estimation is repeated using panel data but now including fixed effects. These control for any omitted, country-specific variables. The numerical value of the investment coefficient is now increased. An increase in investment of 5%

[2] Oil prices are measured as the ratio of the price of crude oil in the U.S. to the producer-price index for that country. See Oswald et al. (2000) on the empirical importance of oil prices in the determination of unemployment.

now goes together with a fall in unemployment of over 4%. The fixed-effect estimation using decadal averages explains 55% of the variation in the unemployment data.

Finally, the last four columns of Table 1 report the results of cross sections, one for each of the four decades. The coefficient of investment is negative in all cases and statistically significant in the 1960s, 1980s and 1990s. However, its numerical value is somewhat lower than in the panel estimation and so is the overall explanatory power of the equations as measured by the adjusted coefficient of variation.

The literature on medium-term changes in unemployment has emphasized the role of institutions. Institutions are either deemed to be important in their own right (Nickell and Layard, 1999) or because of their interaction with shocks (Phelps, 1994; Blanchard, 2000). As a practical matter, the institutional measures of Nickell and Layard do explain a large part of the variation in average unemployment across countries. The question then arises whether this leaves any role for investment. In Table 2 we report the results of both panel and cross-section regressions of unemployment on a set of institutional variables and investment. The institutional measures refer to the period 1983-1988, on the one hand, and 1989-1994, on the other hand. We use the former to explain the cross-sectional variation in unemployment in the 1980s and the latter to explain the cross-sectional variation in unemployment in the 1990s. This limits our panel to two periods; the 1980s and the 1990s[3].

Column 1 has the results of panel estimation for the 1980s and the 1990s without fixed effects and with investment excluded. All the coefficients have the expected sign but only some are statistically significant. The unemployment rate depends significantly on the replacement ratio, the coordination of unions and employers and union coverage. When investment is added to the equation it comes shining through with a highly significant, negative coefficient. Interestingly, the size of this coefficient is in the same ballpark as the estimates in Table 1; a 5% rise in investment causes unemployment to fall by over 2%. Column 3 has the panel estimates with fixed effects but without investment and column 4 then includes investment in the fixed-effects estimation. The coefficients of the institutional variables become more significant but the estimate of the coefficient of investment is more or less unaffected.

[3] We now omit oil prices from the equation because of the reduced time-series dimension.

Finally, the last four columns of the table report results from the estimation of pure cross sections for the 1980s and the 1990s, with and without investment. Investment retains its status as one of the most influential variables in these regressions.

Table 2. Unemployment, institutions and investment

	Decadal averages		Decadal averages+		1980-89		1990-97	
Constant	1.72	11.81	-	-	2.20	11.05	1.21	14.38
	(0.71)	(3.88)			(0.54)	(3.60)	(0.26)	(3.02)
Replacement ratio	0.09	0.10	0.10	0.10	0.12	0.12	0.07	0.08
	(3.33)	(4.52)	(4.18)	(5.08)	(3.06)	(4.88)	(0.85)	(1.32)
Duration of benefits	0.16	-0.15	0.39	0.02	0.35	-0.10	0.94	1.10
	(0.46)	(0.52)	(1.20)	(0.08)	(0.83)	(0.30)	(1.23)	(1.48)
Employer coordination	-2.73	-3.23	-3.25	-3.48	-3.85	-4.01	-2.34	-2.68
	(2.96)	(4.37)	(3.92)	(4.98)	(3.60)	(4.86)	(0.88)	(1.13)
Union coordination	-2.44	-1.29	-2.72	-1.62	-2.61	-1.34	-2.68	-2.05
	(2.10)	(1.33)	(2.63)	(1.75)	(2.08)	(1.08)	(1.25)	(1.10)
Union coverage	3.84	3.27	2.84	2.75	2.41	2.49	2.34	0.04
	(2.93)	(3.09)	(2.34)	(2.69)	(1.36)	(2.22)	(0.75)	(0.01)
Union density	0.01	0.02	0.04	0.04	0.04	0.05	0.07	0.10
	(0.19)	(0.71)	(1.23)	(1.39)	(0.87)	(1.32)	(0.76)	(1.15)
Active labour market programmes	-0.04	-0.11	-0.07	-0.12	-0.08	-0.13	-0.06	-0.15
	(0.96)	(2.89)	(1.68)	(3.25)	(1.80)	(4.65)	(0.93)	(2.15)
Employment protection	0.31	0.79	1.01	1.12	1.12	1.07	1.60	3.76
	(0.48)	(1.49)	(1.63)	(2.17)	(1.43)	(1.78)	(0.60)	(1.58)
Investment	**-**	**-0.49**	**-**	**-0.42**	**-**	**-0.43**	**-**	**-0.66**
		(4.30)		**(3.77)**		**(3.77)**		**(2.82)**
Observations	38	38	38	38	19	19	19	19
Adj. R^2	0.13	0.31	0.30	0.39	0.67	0.80	0.12	0.34

Note: The replacement ratio is defined as the average ratio of unemployment benefits to wages; the duration of benefits is the maximum number of months that workers can collect unemployment benefits; union density measures the proportion of the labour force belonging to labour unions; union coverage shows the proportion of the labour force covered by union wage settlements; union- and employer coordination are indices for coordination among different unions and employers during wage bargaining, active labour market programmes are measured by expenditure on active labour market programmes per unemployed person as a percentage of output per person and, finally; employment protection is measured by the number of months salary that goes into mandatory redundancy payments. All variables refer to the period 1983-88 for the 1980s and 1989-1994 for the 1990s. Source: Nickell and Layard (1999). t-statistics in parentheses. +Estimation method Fixed Effects. Cross sectional estimates have been corrected for heteroscedasticity.

We have reported a very strong and robust correlation between unemployment and investment at medium-term (that is decadal) frequencies. This opens the door for the possibility that the determinants of investment may also affect the average (or natural) unemployment rate. To investigate this hypothesis we calculated the raw correlation between the age-structure and investment and unemployment for a cross-section of

OECD countries, cf. Herbertsson and Zoega (2000). Figure 2 below depicts the correlations between the share of the population in 12 age groups, on the one hand, and unemployment (left-hand axis) and investment (right-hand axis), on the other hand. Interestingly, the two relationships appear to be mirror images. Clearly, both investment and unemployment are correlated with the age structure, and high investment and low unemployment go together. A high proportion of middle-aged workers then corresponds to high investment and low rates of unemployment, while a high proportion of the young corresponds to low investment and high unemployment.[4] This brings us to an important contribution of Professor Modigliani, namely the life-cycle hypothesis of consumption (Modigliani and Brumberg, 1954; Modigliani, 2000). Combining the two Modigliani insights we find that when the population is saving due to life-cycle reasons we have both high investment and low unemployment but when it is dissaving we get low investment and high unemployment.

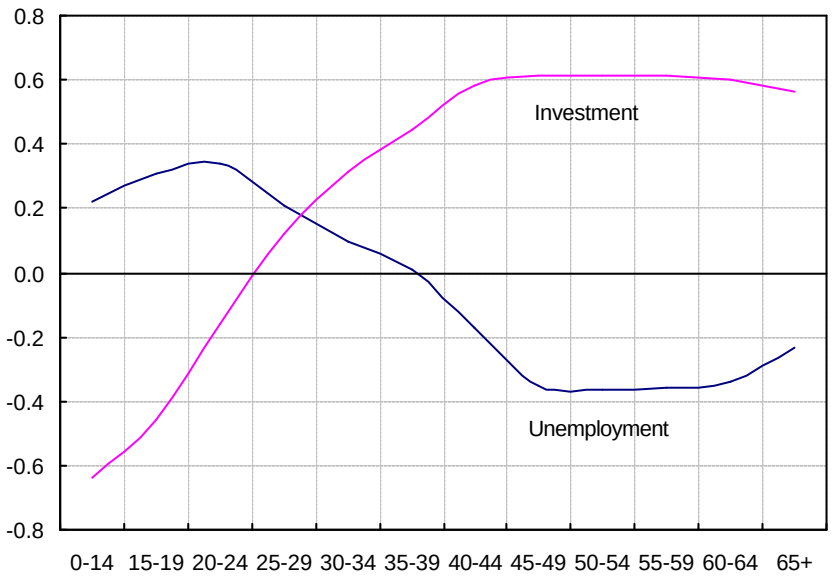

Figure 2. The correlation between the age structure, investment, and unemployment across OECD countries (averages for the period 1965-95).

When age structure variables are added to Table 2, these do not have any statistically significant coefficients when investment is also included. However, in the absence of

[4] The absence of a downward-sloping portion on the investment relationship for the older cohorts (and a corresponding upward-sloping segment on the unemployment relationship) is consistent with our own results (Herbertsson and Zoega (2000)) and those of other authors who find that older workers do not dissave as much as the life-cycle model predicts, cf. Ando and Kennickell (1986) and Hurd (1990).

investment, the coefficients of these variables do have the predicted signs. Moreover, investment turns out to depend on the age structure variables in a panel with decadal averages.

We have found that differences in the rate of investment across countries, as well as over time for a given country, can help explain the variation in unemployment measured as decadal averages. Differences in average unemployment over a decade across countries suggest differences in the level of the natural rate of unemployment, sometimes termed "the structural rate of unemployment" because of its apparent shifts.[5] The same applies to differences in average (decadal) unemployment for a given country. It follows that any theory of the natural rate should have to take into account the close relationship between investment and unemployment.

While the low-frequency relationship between investment and unemployment may come as a surprise to many macroeconomists, we would like to point out a strand of literature that fits quite comfortably with the data. This dates back to Oi's (1962) seminal contribution, which first treated labour as a (quasi) fixed asset. When labour takes the form of an asset due to the cost of hiring and training new workers, it becomes natural to expect changes in employment to coincide with changes in investment at lower frequencies. Decades of low investment are also decades of low rates of hiring and high unemployment. Some recent work attempting to explain the medium- to low frequency movements of unemployment has adopted this approach quite successfully. Phelps (1994) and Pissarides (2000) are two examples. Both model the hiring decision as an inter-temporal investment decision in the presence of real-wage rigidity and the steady-state unemployment (that is the natural rate of unemployment) becomes a function of the fundamentals of investment demand.[6] When the expected future profit stream from investing in the hiring and training of new workers goes up – hence also a kind of Tobin's q variable for labour – the rate of hiring rises and the steady-state level of unemployment falls.

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[5] See Phelps (1994).

[6] A recent paper by Phelps and Zoega (2001) relates average unemployment (for half-decades) to the level of share prices normalised by labour productivity. A surprisingly strong relationship arises at low frequencies between the two variables for all OECD countries. When a decade of high (low) unemployment follows a decade of low (high) unemployment, share prices tend to move in the opposite direction: high unemployment and low share prices go hand in hand. This provides empirical support for models that treat labour as a quasi-fixed asset if we take the share prices to be a proxy for (average) q that measures the shadow price of workers.

References

Ando, A. and A. Kennickell (1986), "How much (or little) Life-cycle Saving is there in Micro Data," in Dornbusch, R., S. Fischer and J. Bossons (Eds.*), Macroeconomics and Finance: Essays in Honor of Franco Modigliani*. Cambridge, MA: MIT Press.

Blanchard, O. (2000), *The Economics of Unemployment: Shocks, Institutions, and Interactions*, Lionel Robbins Lectures, October 2000.

Friedman, M. (1968), "The Role of Monetary Policy," *American Economic Review*, 58, p.1-17.

Herbertsson, T. and G. Zoega (2000), "Trade Surpluses and Life-cycle Saving Behaviour," *Economics Letters*, 65, p. 227-237.

Hurd, M. (1990), "Research on the Elderly: Economic Status, Retirement, and Consumption and Saving," *Journal of Economic Literature*, 28, p. 565-589.

Modigliani, F. (2000), "Europe's Economic Problems." Prepared for Testimony before the Monetary Committee of the European Central Bank.

Modigliani, F. and R. Brumberg (1954), "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data." In Kenneth K. Kurihara, ed., *Post-Keynesian Economics*, p. 388-436. New Brunswick, N.J.: Rutgers University Press.

Modigliani, F. (1986), "Life Cycle, Individual Thrift and the Wealth of Nations," *American Economic Review*, 76, 3 (June), p. 297-313.

Nickell, S. and Layard, R. A., (1999), "Labour Market Institutions and Economic Performance." *Handbook of Labour Economics*.

Oi, Walter (1962), "Labor as a Quasi-fixed Factor," *Journal of Political Economy*, 70, p. 538-555.

Oswald, A., A. Carruth and M. Hooker (2000), "Updated Real Oil Price and US Unemployment Figure and Data," mimeo, Warwick University.

Phelps, E.S. (1968), "Money-Wage Dynamics and Labor Market Equilibrium," *Journal of Political Economy*, 76, p. 678-711.

Phelps, E.S. (1994), *Structural Slumps: The Modern Equilibrium Theory of Unemployment, Interest and Assets*, Harvard University Press, Cambridge, MA.

Phelps, E.S. and G. Zoega (2001), "Stocks and Jobs: the Valuation of Firms and Business Assets as a Factor in Structural Slumps and Booms," *Economic Policy*, April, p. 85-126.

Pissarides, C. (2000), *Equilibrium Unemployment Theory*, 2nd edition, Blackwell,

Oxford.

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