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The Modigliani Puzzle Revisited: A Note

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Abstract

We estimate the relationship between investment and unemployment in order to explore whether the medium-term relationship emphasized by Franco Modigliani survived the recent Great Recession. Our results indicate that the relationship held up, both employment and investment fell although the estimated coefficient of investment is slightly smaller when the period 2000-2015 is added to the 1960-2000 period.

Keywords: Modigliani puzzle, investment, unemployment, Great Recession.
JEL Classification: J1, E2.

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One of the stylized patterns in macroeconomics is the medium-term relationship between investment and unemployment noted by Franco Modigliani (2000) and estimated by Herbertsson and Zoega (2002). When investment is rising (falling), unemployment tends to fall (rise) not only in the short run but also in the medium run. The medium-run relationship was dubbed the 'Modigliani Puzzle' by Blanchard (2000). To an orthodox Keynesian, it was no surprise that the relationship could also be found in the medium run but to many others this relationship seemed to be a puzzle. The objective of this paper is to assess whether this relationship held over the last decade of a financial crisis and the Great Recession and to test whether it accounts for the relationship between current account deficits and employment found in a recent paper by Bertola (2016).

1. A brief overview of the literature

When observing unemployment over long periods of time it becomes apparent that its long swings dominate shorter business cycles. In many countries, the periods of the fifties and sixties were a period of low unemployment and the seventies and eighties a period of rising unemployment, while the unemployment patterns in the 1990s were more diverse. The first decade of this century then saw unemployment initially falling in many countries and then rising rapidly in the Great Recession.

There is a large literature that explains differences across countries and over time in unemployment by differences in institutions and changes in institutions across countries. The paper by Nickell et al. (2005) is a good example of this approach. Here unemployment is related to labour market institutions such as the level and duration of unemployment benefits, the size and centralisation of labour unions and taxes on labour in addition to several macroeconomic shocks such as oil prices and the real rate of interest. There are also papers that model the relationship between various macroeconomic variables and unemployment. The employment decision has an investment dimension in many of these models. Thus changes in the rate of productivity growth affect firms' investment in vacancies (Pissarides, 2001) as well as the training of workers (Phelps, 1994; Hoon and Phelps, 1997); higher stock prices imply expectations of increased future profits and a higher value of trained workers making firms decide to increase training (Phelps and Zoega, 2001); and higher start-up costs reduce firm creation and employment (Pissarides, 2002), while higher oil prices may increase markups and hence lower the real demand wage causing increased unemployment (Carruth et al., 1998). In some papers the two approaches are combined so that the effect of the macroeconomic shocks depends on the labour market institutions, Blanchard and Wolfers (2000).

There is a more recent literature that explores the experience of the Great Recession of 2008-2009. Hoffman and Lemieux (2013) find that the larger employment swings in the United States than in Canada and Germany can be attributed to the larger employment swings in the construction sector linked to the housing bubble in the United States. Bertola (2016) describes the role of international capital mobility in generating labour market shocks that can account for differences in the evolution of unemployment within Europe. He finds that labour market reforms cannot account for the variation in unemployment when recent years are added. Moreover, the same applies to the interaction of time-varying institutions and macroeconomic shocks and finds that many of the significant coefficients in the Blanchard-Wolfers equation drop out. The author proposes a model where production is affected by the investment of foreigners in the domestic capital stock. Thus capital inflows increase labour demand through increased investment in the capital stock and lower the rate of unemployment. The capital inflow countries – such as Ireland and Spain – before the onset of the crisis experienced falling unemployment for this reason. When the ratio of current account to GDP is inserted into the empirical equation of Blanchard-Wolfers it turns out to be very statistically significant with a negative coefficient so that the current-account deficit countries have lower unemployment. Below we explore whether this is due to the medium-term relationship between investment and unemployment.

2. Shocks identified

We start by measuring the long swings of unemployment and investment using principal component analysis. In an earlier paper by one of us (Smith and Zoega, 2007), we showed how the first principal component (PC) of an unemployment matrix with 21 countries and 42 years of observations could explain 69% of the variation in the matrix and capture the global changes in unemployment.

We have unemployment data for 20 countries from 1960-2015 and investment data (gross capital formation) for sample countries from 1970-2015. We take the standardised 56*20 matrix of unemployment rates (U) and the 46*20 matrix of investment (I) and construct their variance-covariance matrices, $U'U$ and $I'I$, and diagonalize the matrices in the following way

$$A'U'UA = \Phi_1 \qquad\qquad B'I'IB = \Phi_2$$

where A and B are the matrices of orthogonal eigenvectors and Φ is the (20*20) diagonal matrix of eigenvalues. We can then define $Z_1=UA$ and $Z_2=IB$ to be the 56*20 and 46*20 vectors of principal components (PCs) where each column of matrix Z_1 (Z_2) is a 56*1 (46*1) vector of

observations for one principal component. Each eigenvalue gives the proportion of the total variance of each matrix, *U* and *I*, explained by the relevant PC.

Table 1 gives the four largest eigenvalues, together with the percentage of the variance and the cumulative percentage of the variance of matrix *U* and matrix *I* explained by the first four principal components.

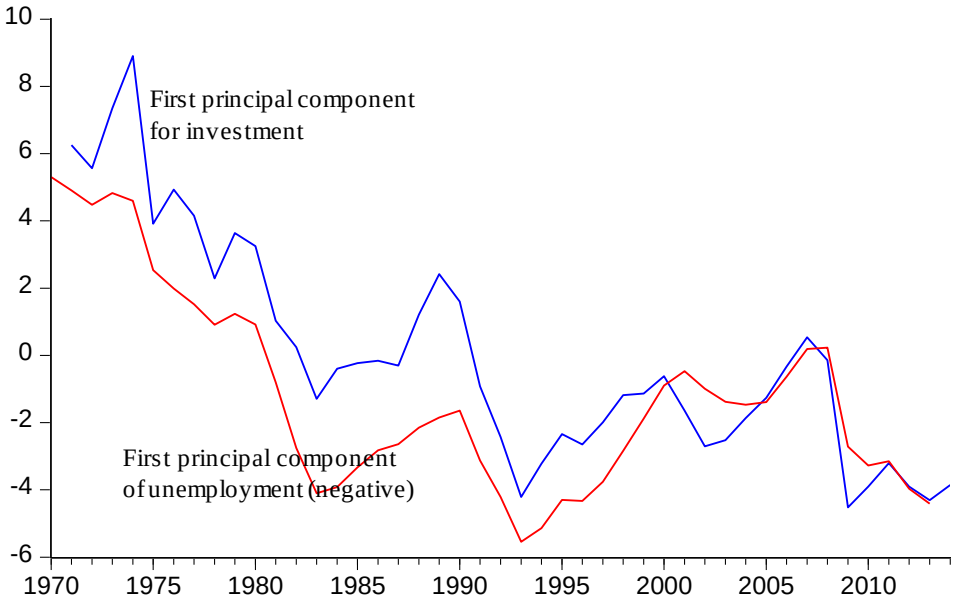
Table 1. Principal components and eigenvectors for OECD unemployment and investment

Unemployment					**Investment**				
Number	Value	Proportion	Value	Proportion	Number	Value	Proportion	Value	Proportion
1	13.02	0.65	13.02	0.65	1	10.75	0.54	10.75	0.54
2	2.84	0.14	15.87	0.79	2	2.47	0.12	13.22	0.66
3	1.45	0.07	17.31	0.87	3	1.80	0.09	15.03	0.75
4	0.79	0.04	18.10	0.91	4	1.38	0.07	16.41	0.82
Variable	PC 1	PC 2	PC 3	PC 4	Variable	PC 1	PC 2	PC 3	PC 4
Australia	0.25	-0.13	-0.25	0.08	Australia	0.16	0.34	-0.07	-0.16
Austria	0.22	0.26	0.18	0.12	Austria	0.26	-0.15	-0.17	0.18
Belgium	0.26	-0.11	-0.14	0.09	Belgium	0.23	0.16	-0.10	0.41
Canada	0.23	-0.24	-0.14	0.22	Canada	0.16	0.47	-0.04	-0.06
Denmark	0.23	-0.24	0.03	0.17	Denmark	0.24	0.09	0.11	0.13
Finland	0.22	0.22	-0.23	0.13	Finland	0.27	0.11	-0.03	-0.20
France	0.27	0.10	-0.03	-0.05	France	0.27	0.19	-0.09	0.15
Gernabt	0.23	0.21	-0.11	0.30	Germany	0.24	-0.30	-0.23	0.01
Greece	0.17	0.27	0.36	-0.44	Greece	0.27	-0.18	0.07	0.01
Ireland	0.20	-0.32	0.11	-0.33	Ireland	0.14	0.11	0.55	0.20
Italy	0.24	-0.02	-0.16	-0.40	Italy	0.27	-0.02	0.15	-0.07
Japan	0.18	0.36	0.17	0.24	Japan	0.25	-0.29	-0.17	-0.04
Netherlands	0.21	-0.34	0.02	-0.02	Netherlands	0.23	-0.25	-0.17	0.23
Norway	0.23	0.11	-0.26	0.01	Norway	0.23	0.20	-0.18	-0.28
New Zealand	0.25	0.07	-0.16	-0.19	New Zealand	0.18	0.12	0.29	-0.36
Portugal	0.19	0.02	0.54	0.00	Portugal	0.17	-0.34	0.24	-0.03
Spain	0.27	-0.03	0.07	-0.24	Spain	0.16	0.14	0.29	0.49
Sweden	0.20	0.34	0.01	0.10	Sweden	0.26	0.15	-0.21	-0.09
U.K.	0.25	-0.21	0.02	-0.01	U.K.	0.27	-0.10	-0.06	-0.20
U.S.	0.13	-0.29	0.45	0.40	U.S.	0.15	-0.22	0.42	-0.31

The factor loadings for the first PC of unemployment are similar for all countries except the United States for which they are smaller. The variable has a very low value until the first world oil shock affected unemployment in 1974-75, then another elevation in the early eighties; the recession of the early 1990s; the period of low unemployment in the early 2000s and then the effect of the Great Recession starting in 2008. Plotting the inverse (negative) of the first PC

of unemployment against the first PC of investment gives the relationship shown in Figure 1. There is a clear relationship between the two series.

Figure 1. The first PCs of unemployment and investment



3. Panel estimation

In Table 2 we estimate a panel equation using both annual data and decadal averages for the countries reported in Table 1. Columns (1)-(4) depict the results of an unbalanced panel estimation for the 1960-2000 period (starting in 1970 for some countries) using both annual data and decadal averages, controlling for real oil prices in columns (2) and (4)[1]. All equations include country fixed effects in order to capture country specific characteristics. The coefficient on investment is negative and statistically significant in all cases while using decadal averages increases its value. In column (4) a rise in investment as a percent of GDP by 3% will decrease unemployment by about 2.5%. Note that the relationship is stronger (the coefficient larger) when using decadal data, which implies that the medium-term relationship is stronger than the short-term relationship.

In columns (5)-(10) we expand our sample for the 1960-2015 period. The coefficient on investment in columns (5)-(8) remains negative and statistically significant with a lower value, possibly because the financial crisis affected the relationship.

[1] All results are very similar when we take averages over 5-year periods..

Table 2. Relationship between Unemployment and Investment in the OECD, 1960-2015

	1960-2000				1960-2015					
	Annual	Annual	Decadal averages	Decadal averages	Annual	Annual	Decadal averages	Decadal averages	Annual	Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Investment (% gdp)	-0.198***	-0.214***	-0.828***	-0.854***	-0.179***	-0.170***	-0.563***	-0.518***	-0.159***	-0.167***
	(-4.33)	(-4.70)	(-3.08)	(-3.02)	(-4.69)	(-4.18)	(-4.10)	(-3.04)	(-3.97)	(-4.07)
Investment (% gdp) x DFC									0.090**	0.065
									(2.30)	(1.70)
DFC									0.999**	0.659*
									(2.84)	(1.83)
Real price Oil		0.168**		0.292		0.173***		0.096		0.136*
		(2.10)		(0.99)		(3.69)		(0.75)		(2.08)
N	618	607	64	64	933	906	104	104	933	906
R^2	0.384	0.404	0.595	0.610	0.357	0.381	0.551	0.554	0.377	0.385

Notes: All regressions include country fixed effects. *t* statistics based on robust standard errors clustered at country level in parentheses
* p<.10, ** p<.05, *** p<.0

Table 3. Relationship between Unemployment Investment and the Current Account in the OECD, 1960-2015

	Annual	Annual	Decadal averages	Decadal averages	Annual	Annual
	(1)	(2)	(3)	(4)	(5)	(6)
Investment (% gdp)	-0.170***	-0.160***	-0.562***	-0.517***	-0.151***	-0.156***
	(-4.54)	(-3.93)	(-3.79)	(-2.87)	(-3.89)	(-3.90)
Current account (% gdp)	0.018	0.021	0.000	0.000	0.020	0.024
	(1.39)	(1.50)	(0.03)	(0.02)	(1.39)	(1.59)
Real price Oil		0.186***		0.096		0.168**
		(4.02)		(0.75)		(2.32)
Investment (% gdp)* DFC					0.084**	0.058
					(2.19)	(1.57)
Current account (% gdp)* DFC					-0.018	-0.021*
					(-1.55)	(-1.91)
DFC					0.940**	0.555
					(2.69)	(1.56)
N	933	906	104	104	933	906
R^2	0.365	0.390	0.551	0.554	0.384	0.395

Notes: All regressions include country fixed effects. *t* statistics based on robust standard errors clustered at country level in parentheses
* p<.10, ** p<.05, *** p<.0

In the last two columns of Table 2 we test for this the impact of the financial crisis by including a dummy DFC that takes the value 1 for the period 2008-15. DFC is positive and statistically significant in both columns implying the expected positive effect of the financial crisis on the level of unemployment. Furthermore, when multiplying DFC with investment as a share of GDP we see in columns (7) and (8) that the financial crisis decreases the coefficient on the investment ratio, which still remains negative and statistically insignificant.

Finally, in Table 3 we add the current account surplus for the crisis years following Bertola (2016) and find that an increase in the current account surplus raises unemployment as predicted while leaving the coefficient of the investment ratio unchanged. However, it is only significant at the 10% level when investment is also included. This is not surprising since the positive effect of deficits was supposed to work through investment.

4. Conclusions

The medium-term relationship between investment and unemployment remains a stylized fact and is significant even when the years of the financial crisis and the Great Recession are included. This relationship may also account for the relationship between the current account and unemployment in the years preceding and following the financial crisis since investment rose in the capital inflow countries and then fell when the inflow suddenly stopped.

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