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You have to be old to be wise: Inflation, demographic trends and central bank independence[#]

Etienne Farvaque[*] (Presenter – PC 2007)

Jérôme Héricourt[*]

Gaël Lagadec[**]

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Abstract:

In this paper, we study the influence of demography on inflation in developed countries. Moreover, we consider if the recent demographic trends can be considered as a substitute or a complement to central bank independence on the road to low inflation. Our results show a time-varying relation between central bank independence and inflation: while central bank independence is important in the first periods (1960 to 1979), population aging proves more influential afterwards. In short, we show that, on the path to low inflation, it pays for societies to become older.

Keywords: Demography, Inflation, Central Bank Independence
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[*] Equippe – Universités de Lille, Faculté des Sciences Économiques et Sociales, Université de Lille 1, 59655 Villeneuve d'Ascq Cedex (France).
Contacts : Etienne.Farvaque@univ-lille1.fr ; Jerome.Hericourt@univ-lille1.fr
[**] Université de Nouvelle-Calédonie. Contact : lagadec@univ-nc.nc

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1. Introduction

In the 1960s, the young felt they had a chance to change the world. They mostly have come back from this perspective and are now entering into their retirement period. Since then, most of them have been able to accumulate some capital, and this fact would have contributed to male them much more conservative than they were in their twenties. This would have been unnoticeable except for the size of this generation, which has enabled them to translate their preferences in policies. Since the 1980s, the increase in the proportion of middle aged people and retirees has been accompanied by a reduction in inflation, and then by monetary policies geared towards low inflation.

A correlation between inflation and the age distribution has notably been exhibited by Lindh and Malmberg (1998, 2000) for the OECD countries, and it also stands for countries separately considered.[1] The mechanisms behind the correlations are probably multiple. The most evident for economists may be the one we hinted at above: a simple life-cycle saving theory. When people accumulate capital, they have all the incentives to prevent it from being eroded by inflation. One can also think of the relationship in terms of the AD-AS model: the savings process shifts the demand curve to the left, leading to a decreasing influence on the price level. Lindh (2004) also speaks of a demand channel triggered by an increasing demand for low productivity services, with the average basket used in price index computations being lowered as a consequence.

Central bankers and macroeconomists may feel shielded from such kind of upheavals by the increased degree of independence most central banks now benefit from. It is true that, at least since the last two decades, central bank independence has been thought of as a quick fix against inflation. It has also been econometrically shown that central bank independence can bear strongly on inflation (see Brumm, 2002).

However, the emphasis on central bank independence may have been too strong (Forder, 2005). One could even argue that, if demographic trends are really strong, and the ones we have seen in the last decades are of such a kind, then institutions may not even matter. In which case, the negative econometric relationship between inflation and central bank independence may even be a spurious one – at least, for some periods. Most of the studies have been conducted in the 1990s, considering the 1960-1990 period. Yet, this period includes a first phase when where baby-boomers have started to consume and contract debts and a second phase, when they have started to fret about the protection of their savings. Hence, in the literature, the coefficients on central bank independence may have captured (and in fact hidden) strong changes in preferences. If this is true, then, as Hayo and Hefeker (2002) state, central bank independence should not be treated as an exogenous variable. And to the question "Why societies need independent central banks?", the answer may be "Because people are not old enough". In other words, and for inflationary matters at least, maturity leads to wisdom, understood as low inflation.

[1] See, e.g. McMillan and Baesel (1990) for the United States, or Lindh (2004) for Sweden.

A question emerges: does central bank independence has had a role to play when underlying major demographic trends where favorable to the young, and could it be neglected by an aging society? In other words, should the merits economists have attributed to central bank independence be awarded to aging societies? Hayo and Hefeker (2002) insisted on the need for a public consensus to obtain (and maintain) price stability. In this paper, however, we test for the possibility that aging people may have a common interest in the preservation of price stability, and that this interest may be strong enough to prevail over any formal institution, even central bank independence.

Testing the influence of demography on inflation is then important both on academic and practical grounds. From a theoretical point of view, the verification of the hypothesis would support Forder's (2005) case that the importance of independence has been overstated. In which case, the links between age structure and inflation should be studied more thoroughly, following, for example, Faust (1996) or Bullard and Waller (2002).

From an empirical point of view, the demographic trends that have occurred since the 1960s would contain important consequences, and a central bank forecasting demographic tendencies would obtain precious information on the underlying variations in inflation. Though we have no direct evidence of central banks explicitly considering the (dis)inflationary consequences of recent demographic trends[2], this does not mean that the relationships are not important. The obvious consequence is clearly opposite: if the connections between demography and inflation are present, inflation measures should take into account demographic trends to obtain an accurate measure of the core (or underlying) inflation rate. Instead, monetary policies may prove over- (or under-)reactive.

In this paper, we test for the respective influences of central bank independence and demography on inflation. We consider developed countries, for which central bank independence indexes have been shown to be influential (see notably Cukierman, 1992) and, to keep in line with the literature and be able to compare our results, we consider the 1960-1994 period. The conclusion contains lessons that can be drawn for the following periods. But before, the second section deals with the data sources, and methods, and the third section presents the results.

2. Data and method

The reduced form model we estimate is close to Lindh and Malmbergh (1998). Therefore, inflation will be explained by five age group shares of the population: 15-29 years old, 30-49 years, 50-64 years, 65-74 years and the category we are especially interested in, the old people – aged 75 years and above[3]. An important contribution of this paper consists in adding a Central Bank Independence (CBI) index in order to distinguish between the influence of the latter and the part played by the elderly in the disinflation process across the years. We also include a quadratic term for the elderly, in order to account for possible non-linearities in the relationship between the 75 years-old and above and inflation. Our intuition is that the old people may have an absolute marginal decreasing impact on inflation. In other terms, we expect a negative relationship between inflation and the old people until their share reaches a specific proportion after which the relationship may become positive. Eventually, we add two

[2] However, it seems that the ECB may have found an interest in the relations between demography and the macroeconomy, see Maddaloni et al. (2006).
[3] Several motivations for the suppression of the 0-14 year old share are provided by Lindh and Malmberg (1998).

control variables which have been extensively used in the literature (see, for example, Campillo and Miron, 1997), namely an output variable and the openness rate of the economy. For an increase in the output gap is expected to create additional inflationary pressures. And, conversely, the extra competitive pressure related to an increase in the openness rate is likely to exert a negative influence on prices. The regression equation is:

$$infl_{it} = \beta_0 + \sum_{age=15\text{-}29}^{75+} \beta_{age} (age\ share)_{it} + \beta_{quadr} (share\_75plus)_{it}^{\ 2} + \beta_{cbi} CBI_i + \beta_g g_{it} + \beta_{or} or_{it} + \varepsilon_{it} \qquad (1)$$

where indexes *i* and *t* refer respectively to country and year, g_t is the output gap[4], computed as the difference between real output and potential output, divided by potential output. The latter has been generated using a Hodrick-Prescott filter, with a smoothing parameter equal to 100, the value recommended by Hodrick and Prescott (1997) for annual data. or_{it} is the openness rate, defined as the ratio of the sum of exports and imports to GDP. The use of country-fixed effects is *de facto* impossible, since we use a time invariant CBI index coming from Cukierman (1992). He computed this index from the central bank charters of the 1980s and, we use it as a measure of independence for the whole period. The use of the same index for the whole period is usual in the literature since the case for independence has been made (prominently by Alesina and Summers, 1993). For comparison purposes, we will also run regressions excluding the CBI index, in order to point out the exact influence of age structure on inflation:

$$infl_{it} = \beta_0 + \sum_{age=15\text{-}29}^{75+} \beta_{age} (age\ share)_{it} + \beta_{quadr} (share\_75plus)_{it}^{\ 2} + \beta_g g_{it} + \beta_{or} or_{it} + \varepsilon_{it} \qquad (2)$$

We use annual data of consumer price index (CPI), of real GDP, exports and imports for 21 OECD countries[5], all provided by the International Monetary Fund (*International Financial Statistics*). Age distribution data are taken from United Nations population report (2004). Since age data refer to end-of-the year estimates, the inflation variable is constructed as inflation in year *t* equal to $\log(CPI_{t+1}/CPI_t)$. Estimates are performed over the 1960-1994 period, the one used by Lindh and Malmberg (1998, 2000). Besides, it covers the ones used in most of the literature on the effects of central bank independence (see Hayo and Hefeker, 2002). Overall, we have 670 exploitable observations, instead of the 735 (21 countries times 35 years) technically expected. This comes from the fact that some data of real GDP and/or CPI are missing for Austria, Denmark, Italy, Netherlands, and Norway at the beginning of the sixties, or for the whole decade; GDP observations are even missing until 1977 for Portugal.

To test our intuition that the relationship between inflation and age structure/CBI index is non-linear and unstable over the considered period, we divide our sample in three sub-periods: 1960-1972 (*significant but controlled inflation*), 1973-1979 (*stagflation*) and 1980-1994 (*sustained disinflation*). Besides their obvious economic foundations, Hausman/Wald tests[6] support their statistical relevance[7].

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[4] The output gap seems a better indicator of inflationary pressures *per se* than GDP growth. In that respect, it is widely used in standard monetary transmission models, either backward (see e.g. Rudebusch and Svensson, 1999) or forward-looking (see Clarida et al., 1999).

[5] Australia, Austria, Belgium, Canada, Denmark, United States, Finland, France, Germany, Greece, Ireland, Italy, Japan, New Zealand, Norway, Spain, Portugal, Sweden, Switzerland, United Kingdom, United States. It is worth noting that our panel includes Germany, contrary to Lindh and Malmbergh's one.

[6] More details upon these tests available from the authors on request.

[7] An observation on non-stationarity concerns. The current panel unit root tests (Levin and Lin, 2002; Im *et al*., 2003; Maddala and Wu, 1999) often disagree on the persistence of the data, so that it would not be clear whether the variables in (1)/(2) are indeed integrated or co-integrated, whatever Pedroni's (2001) panel cointegration test

3. Results

Preliminary investigations pointed out two kinds of problems. Firstly, Greece and Portugal appear as consistent outliers according to current mean/standard deviation criteria for the 1980-1994 period. Interestingly, no significant presence of outliers could be highlighted by the same criteria or the Hadi (1994) test for the two other sub-periods, or for the whole 1960-1994 period, apart from one or two observations. Secondly, a possible endogeneity problem of right-hand side variables has to be considered. Indeed, while both Hausman and Nakamura-Nakamura tests[8] agree to accept the hypothesis of exogeneity for age shares and CBI index, they support strong evidence of endogeneity for the output gap and the openness rate. Instrumenting the output gap and the openness rate with their own lags and estimating by two stage least square (2SLS) provided an adequate solution. Depending of the considered sub-periods, the number of lags used as instruments turned out to be two or three[9]. Finally, residuals have been corrected for heteroskedasticity using the White estimator of variance, and for autocorrelation using Bartlett kernel (Newey-West)-based estimations.

The results appear in Table 1. Interestingly, they differ depending on the period / sub-period considered, revealing an unstable impact of central bank independence and of some age cohorts on inflation. For each period and sub-period, we report estimates for equations (1) and (2). We first compare the results for the whole period to those for the sub-periods, and then focus on the apparent monetary regime switches revealed by sub-periods analyses.

The first column in Table 1 shows the results for the whole 1960-1994 period. As appears from model (1) estimation, the set of age structure variables and the central bank independence index are significant, with signs conform to economic intuition. The two control variables are also almost always significant and rightly signed, i.e. positive for the output gap and negative for the openness rate. Furthermore, the influence of the different age shares is qualitatively identical over the global period and the sub-periods, except for the 15-29 category. For this class, the influence on inflation turns negative in the 1973-1979 sub-periods. Though young adults are likely to consume more than save, in these years their behavior has probably been credit-constrained and/or, for those already in debts, their attention has probably been brought to inflation[10]. It is also worth emphasizing that these outcomes are qualitatively very similar to the ones of Lindh and Malmbergh (1998), the share "75 and more" excepted. Though correctly signed, the share of the elderly does not significantly impact inflation on the whole period, whereas the CBI index displays the expected significant negative impact. These results do not hold on all sub-periods, however (cf. *infra*). This tends to show that the breaks suffered by the model across time are clearly related to the elderly (share 75 and more) and the CBI index. Our hypothesis is that central bank independence may have not played its generally attributed role during the whole period. If the age structure hypothesis is true, then central bank independence should have a strong weight on inflation when most necessary. That is, when demographic trends are creating by themselves an inflationary bias.

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would tell. Besides, the sub-periods we are considering are too short (5 to 14 years) for imposing any meaningful restrictions. We can therefore perform estimations in levels, since we are *de facto* interested in the short-term relationships between inflation and right-hand side variables.

[8] Results are available from the authors upon request.

[9] Hansen overidentification test never rejected our sets of instruments, at least at the 5% level. Complete results available upon request.

[10] This phenomenon probably contributes to explain their subsequent fear of inflation.

Turning to sub-periods analysis (columns (2) to (4)), it is striking to see that in the first two sub-periods, age structure variables and central bank independence are strongly significant. Everything thus happens, in the first two sub-periods, as if societies had to protect themselves from inflationary pressures notably coming from the demand side, as economies had to cope with the consumption needs of baby-boomers. This result is in accordance with the view proposed by Farvaque (2002) or Hayo and Hefeker (2002), that more inflation adverse societies build institutions fitting their feelings. In other words, *ceteris paribus*, central bank independence appears as a rational social choice, adopted by inflation adverse societies confronted with rising inflationary pressures.

Notwithstanding, demography appears to dominate the influence of institutional frameworks over the 1980-1994 sub-period. In the latter, central bank independence appears as completely insignificant, while the weight of the retirees on inflation is strongly significant and negatively signed. These results thus support our hypothesis, as independence is no longer needed when people have matured enough to resist the siren's song of inflation. Given the strong belief among economists in the benefits of central bank independence, this result is quite innovative.

A note has to be made for the non-linear impact of the share of elderly. As shown in Table 1, the case for non-linearity is not overwhelming. The coefficient of the squared share of the elderly is in most cases negative and non-significant, though it turns significantly positive for the last sub-period, 1980-1994, but only at the 10 % level. For the latter, this means that there might be a threshold from which the proportion of elderly acts positively on inflation. As the share of elderly becomes too important, then more people would be consuming than saving, and pressure could be felt on prices (the traditional demand-pull inflation, potentially coming in this case from an increase in government consumption, at least partly driven by health services for example).

To check the robustness of these results, we undertake several sensitivity checks. First, the inclusion over the last sub-period of dummy variables for European Monetary System membership and the adoption of inflation targeting frameworks for some countries lead to quantitatively and qualitatively similar results. Second, we estimate models (1) and (2) using GDP growth instead of output gap. This brings quantitative identical results, while affecting very marginally significance in a few cases. More interestingly, controlling for intra-group correlation[11] leads to only one major change in the results presented in table 1: on the whole period 1960-1994, the coefficient on CBI index becomes clearly non-significant (t-stat equal to -0.87). This clearly strengthens the idea that age structure could be a better and stronger predictor of inflation than central bank independence, whose influence may have been overestimated.

[11] Intra-group correlation means that the error terms are correlated within groups, but not across groups.

4. Conclusion

How can one reconcile our results with the now pervasive view about the need for central bank independence? As shown by Forder (2005), the belief in the benefits of central bank independence has spread quickly, and policymakers and politicians have endorsed the idea. In the years following the sample period under study, central banks have become much more independent. Independence has even been a precondition for European countries preparing to enter the monetary union.

Hence, even though the countries in our sample have seen their people becoming older (to the point that it now creates doubts about the sustainability of, e.g., pensions or health systems), they have transformed their institutions beyond what was required. This is consistent with the view that institutions should be there to serve not just the current, but also the future generations. And, should the latter become more numerous, younger, and more turbulent, they would appreciate the bequest of central bank independence.

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Table 1: ***Inflation explained by age shares, CBI, output gap and openness rate***

	1960-1994 2SLS, HAC residuals		1960-1972 2SLS, HAC residuals		1973-1979 2SLS, HAC residuals		1980-1994 2SLS, HAC residuals	
Dep. var. infl.	with CBI	no CBI	with CBI	no CBI	with CBI	no CBI	with CBI	no CBI
Constant	0,056	0,056	-0,020	0,118	0,543	0,661	0,423	0,417
	1,120	*1,120*	*-0,220*	*1,320*	*3,310*	*3,930*	*3,770*	4,000
shr_15_29	0,472	0,461	0,449	0,277	-0,960	-1,116	-0,223	-0,206
	4,260	*4,170*	*3,190*	*1,990*	*-3,490*	*-4,260*	*-1,040*	*-1,070*
shr_30_49	-0,606	-0,605	-0,404	-0,411	-0,836	-0,950	-0,972	-0,962
	-7,190	*-7,090*	*-2,520*	*-2,520*	*-3,200*	*-3,760*	*-5,960*	*-6,340*
shr_50_64	-0,075	-0,064	-0,433	-0,319	-0,125	0,292	0,014	0,011
	-0,440	*-0,390*	*-2,730*	*-2,010*	*-0,290*	*0,560*	*0,090*	*0,070*
shr_65_74	1,841	1,940	2,075	1,698	0,768	0,587	1,463	1,437
	5,820	*6,040*	*3,700*	*2,850*	*0,820*	*0,550*	*4,270*	*4,330*
shr_75plus	**-0,655**	**-1,255**	**3,086**	**-3,341**	**3,572**	**-2,112**	**-4,259**	**-4,171**
	-0,690	***-1,330***	***0,980***	***-1,320***	***0,840***	***-0,500***	***-2,830***	***-2,860***
square75	**-5,364**	**-0,548**	**-67,600**	**21,039**	**-69,571**	**-11,489**	**23,476**	**23,035**
	-0,650	***-0,070***	***-1,520***	***0,600***	***-1,540***	***-0,240***	***1,890***	***1,880***
cuk8094	**-0,027**	**-**	**-0,055**	**-**	**-0,075**	**-**	**0,004**	**-**
	-2,100	-	***-3,610***	-	***-2,900***	-	***0,350***	-
output gap	0,640	0,640	0,413	0,415	0,773	0,755	0,357	0,357
	5,790	*5,800*	*3,680*	*3,830*	*3,480*	*3,320*	*5,200*	*5,200*
or	-0,023	-0,023	-0,001	0,003	-0,066	-0,060	-0,016	-0,016
	-3,450	*-3,360*	*-0,120*	*0,370*	*-4,650*	*-4,150*	*-2,430*	*-2,410*
N	630	630	164	164	134	134	283	283
Centered R^2	0,363	0.356	0,345	0.278	0,538	0,500	0,536	0,535

t-statistics in italic. 2SLS indicates that all regressions have been performed using two-stage least squares. HAC means that t-statistics have been computed from White/Newey_West estimates of heteroskedasticity and autocorrelation consistent standard errors.