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Intergenerational Transmission of Inflation Aversion: Theory and Evidence

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Intergenerational Transmission of Inflation Aversion: Theory and Evidence

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Abstract

We study the evolution of inflation aversion preferences across generations. In the theoretical part of the paper, we analyze the dynamics of such preferences in an overlapping-generations model with heterogenous mature agents characterized by different degrees of inflation aversion. We show how the stability of a society's degree of inflation aversion depends on the strength and speed of changes in the structure of the population. The empirical part then proposes two applications in support of the theoretical results. We first link demographic structures to inflation aversion, and then proceed by looking at the relations between income (in)equality and measures of inflation aversion.

Keywords: Intergenerational transmission, evolving preferences, inflation aversion, central bank independence, demographic change, income inequality

JEL classification: E24, E31, E58, J10

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1 Introduction

Is low inflation here to stay? Competing theories may provide hints about the likely permanence – or not – of the contemporary low-inflation regime. Some would probably insist on the evolution of monetary institutions, more independent and more focused on price stability now than in the last episode of Great Inflation (see, e.g., Crowe and Meade, 2007). Others, including the IMF, have pointed to globalization as a weight on inflationary pressures (see, e.g., Rogoff, 2003), in the line of an argument that had been recently restated by Gamber and Hung (2001). However, such theories, and the mechanisms implied, may do more to answer the 'how did we arrive there?' question rather than the one that naturally follows, i.e., 'where do we go from here?'.

More deeply rooted explanations of the trend toward global low inflation are thus needed to answer the second question. And in such a context inflation preferences are fundamental in shaping a nation's inflation prospects. Hence, investigating the evolution of inflation aversion is crucial to determine if low inflation is here to stay or if central bankers have to be wary of inflation, whatever their degree of independence. One thus has to focus on preferences and, to get some insight on the evolution of preferences, part of an explanation probably relies on the 'inflation culture hypothesis'. As shown by Hayo (1998), who coined the expression, preferences for low inflation may have deeply rooted foundations in a nation's culture, the latter being moulded by history. De Jong (2002) complements this theory by showing that nations are influenced by distinct features, where inflation aversion is related to inequality and uncertainty aversions, while Scheve (2004) brings in a more skeptical note showing how sensitive to business cycles those preferences are. Moreover, survey outcomes, e.g., exploited by Jayadev (2006), reveal that such preferences may also originate in an individual's relative position in society.

Hence, while most of the literature in economics assumes preferences as 'priors' which are endowed to agents and do not change, a more promising route to understand the sustainability of a low-inflation regime is to look at preferences shaped out by evolutionary forces in society. Based on such a departing hypothesis, we endogenize inflation preferences as being transmitted from one generation to another. In implementing this approach, popular in the broader field of social sciences but not that much in economics, we essentially follow Bisin and Verdier (2000, 2001). The latter authors, who build on the recent literature on endogenous preferences, e.g., Becker (1996), are among the first within the economics profession to develop and analyze formal set-ups with evolving preferences. Though Bisin and Verdier (2000, 2001) were interested in the provision of public goods, their framework has been used by Sáez-Martí and Sjögren (2008) to study the transmission of cultural traits. We here rely on a similar set-up to investigate the dynamics of inflation aversion, and – in effect – to answer our 'is low inflation here to

stay?' question.

It may seem surprising that very few papers exist on the stability of inflation aversion, though such a situation probably simply shows that most economists consider that central bank independence reveals a society's inflation aversion. Then, from such a hypothesis, everything happens as if the world has evolved towards higher inflation aversion, evidenced by the increasing number of central banks made independent or, for the ones which were already, by the increase in their degree of independence (see Guillén and Polillo, 2005, or Crowe and Meade, 2007, for example, who document this evolution). However, the stability of central bank independence as a solution to the inflation bias can be questioned. It has recently been shown by di Bartolomeo and Pauwels (2006) in a game-theoretic model that under realistic assumptions there is a limit on central bank conservativeness and, moreover, that the stability of the central bank independence solution to the inflation bias cannot be granted. Although there are no direct empirical implications of their set-up, their result can only invite new explorations into the stability of the nominal peg provided by independent central banks. Moreover, identifying the empirical relevance of the issue needs further modeling and applied investigation, a task we address in this study.

In the first part of the paper, we analyze the dynamics of inflation-aversion preferences in an overlapping-generations model, with heterogenous mature agents characterized by different degrees of inflation aversion. We show how the stability of a society's degree of inflation aversion depends on the strength and speed of changes in the structure of the population.

In two topical (and interrelated) empirical applications derived from this framework, we first show that the proportion of retirees is strongly associated with a society's inflation aversion. We attribute this relation to the retirees' preferences, as they have all the incentives to support low inflation, in order to protect their accumulated wealth. The relation is verified both in a cross-section and, for selected countries, a time-series aspect. Our findings imply that, with an aging population structure, low inflation is here to stay. We then proceed by looking into income (in)equality as a major inflation aversion driver. Results, using different measures of inflation aversion and corresponding to different cross-section samples, robustly show that the poorest have the highest inflation aversion, which can be attributed to the lack of protection of their few assets and revenues from inflation. A potential trend (back) to more egalitarian societies or to the values of the social-welfare state may thus provide another explanation, in addition to demography, for low inflation to stay longer.

The paper is structured as follows. The next section presents the model, focusing on the types of preferences and the dynamics of preference transmission across generations in relation to the evolving structure of the population. Section 3, in turn, provides two major empirical applications in support of the theoretical results, first involving changes in demography

and then in income inequality. The final section concludes, while Appendix A presents the data definitions and sources.

2 Theoretical Framework

We here build on the overlapping-generations (OLG) set-up of Bisin and Verdier (2000, 2001) and apply it to explain the transmission of preferences on inflation aversion, in theory and in the data.

2.1 Preference Types

In this set-up, a generation consists of a continuum of individuals, each living for two periods and having one offspring, so that the population is constant and the size of the mature generation is normalized to one. We consider two types, a and b, of preferences in the population defined on a private good c and a public good g which we interpret narrowly as independence of the central bank. However, only agents of type a prefer a strongly independent central bank, whereas agents of type b have milder preferences with regard to central bank independence. Hence, though all agents like central bank independence, the degree of independence depends on each agent's type of preferences. Note that in the present model the benefits of central bank independence are implicit,[1] the choice being between different degrees of independence. Preferences, then, can be represented in the following (separable) form:

$$u^i(c,g) = u(c) + \gamma^i v(g), \quad \text{with} \quad i \in \{a,b\} \text{ and } \gamma^a > \gamma^b > 0 \qquad (1)$$

where $u(c)$ and $v(g)$ are strictly concave increasing functions satisfying $u'(0) = v'(0) = \infty$. In the beginning of their mature life, all individuals receive an identical endowment ϖ. The degree of central bank independence is decided in each period by majority voting in parliament through the proportional representation of the adult generation.[2]

A particular degree of central bank independence, if voted in period t, entails however a social cost $g(\cdot)$. This is an aggregate cost to society which can come from several sources. It could notably be related to a distortion of the Phillips curve trade-off that may arise at very low levels of inflation. This argument has notably been raised by Akerlof *et al.* (1996), or Benigno and Ricci (2008)), the mechanism behind it being that the sacrifice ratio

[1] The literature has widely insisted on such benefits (see notably the survey by Berger *et al.*, 2001, or Crowe and Meade, 2007), so we avoid their discussion here, to focus on our point.

[2] Modeling the political system is out of the scope of this article, and we refer the reader to Faust (1996), Bullard and Waller (2004) or Berentsen and Strub (2008).

would increase at low levels of inflation. Such a situation may be felt as costly by (part of) the electorate. A complementary source could come from openness, as higher degrees of openness may also worsen the terms of the output-inflation trade-off (see Daniels and VanHoose, 2006), which some polities may find costly, as it reduces the ability of a central bank to react to negative shocks. In the spirit of the present paper, this social cost will impact the intergenerational transmission of an agent's type of preferences.[3]

Without loss of generality and following Bisin and Verdier (2000), the social cost of independence is hereafter expressed in terms of good c, i.e., it is assumed to reduce the quantity of the endowment of each individual available for private consumption and is, therefore, subtracted from it (see below). If the fraction q_t^i, with $0 \leq q_t^i \leq 1$, of type $i \in \{a, b\}$ individuals at time t is more than a half, then $q_t^i > q_t^j$, and the voting equilibrium degree of central bank independence solves the maximization program of the type i (identical) agents

$$\max_g \quad u^i(c, g) = \quad \max_g \quad u(\varpi - g) + \gamma^i \upsilon(g) \tag{2}$$

$$\text{with FOC} \quad : \quad \frac{\partial u^i(c, g)}{\partial g} = \frac{\partial \left[u(\varpi - g) + \gamma^i \upsilon(g) \right]}{\partial g} = 0 \tag{3}$$

$$\Leftrightarrow \quad u'(\varpi - g) = \gamma^i \upsilon'(g) \tag{4}$$

which implicitly defines the social cost $g_t\left(\varpi, \gamma^i\right)$ giving the preferred degree of central bank independence in period t. Plugging that optimal degree of central bank independence back into the utility yields the value function of the type i agent:

$$\begin{aligned} V^i(\varpi) &\equiv \arg\max_g \quad u(\varpi - g) + \gamma^i \upsilon(g) \\ &= u\left[\varpi - g_t\left(\varpi, \gamma^i\right)\right] + \gamma^i \upsilon\left[g_t\left(\varpi, \gamma^i\right)\right] \end{aligned} \tag{5}$$

Because of the optimality of $g_t(\cdot)$ and the positivity of $\gamma^i > 0$,

$$V^i(\varpi) > u^i(\varpi) \tag{6}$$

so that it is always in the interest of a type i mature agent to enjoy the public good, here central bank independence.

However, the exact *degree* of central bank independence is determined by the agents' preferences. From (4) above, we have:

[3] Note that one could also think about relating the social cost of central bank independence to transparency, accountability and reputational issues, which induce a (costly) degree of monitoring by the polity of the central bank's actions. However, such a cost would have to be supported by all the successive generations, and may thus not motivate a will to transfer one's preferences to her offspring.

$$\gamma^i = \frac{u'(\varpi - g)}{v'(g)} > 0 \tag{7}$$

Hence, the optimal degree of independence is shaped by the agent's endowment and the way she feels affected by the cost of central bank independence. In other words, the higher the cost, the lower the optimal degree of independence to be accepted by the agent. If an agent feels that her net consumption possibilities $(\varpi - g)$ would be reduced under a higher degree of independence, because such an independence would imply a lower level of inflation and thus, along the lines of the above argument, a deterioration of the sacrifice ratio, her opposition to an increase of the degree of independence would be stronger. To illustrate that point, and anticipating on the empirical applications provided below, one can think of active workers, fearing the consequences of a less favorable inflation-output trade-off on their probability of finding a job quickly in a recession, would support a lower degree of central bank independence than retirees, for whom such concerns resound less than the protection of their savings from inflation. This reinforces the need to consider the stability of the central bank independence solution to the inflation bias, as the mechanisms supporting this solution may not be permanently operative in the economy.[4]

2.2 Dynamics of Preference Transmission

As in Bisin and Verdier (2000, 2001) and Sáez-Martí and Sjögren (2008), we model the transmission of cultural traits and preferences as occurring through social learning. Children are born 'naive', i.e., with not well-defined preferences, but acquire them through observation, imitation and adoption of 'cultural models' with which they are matched. This matching, termed 'socialization', naturally comes in two steps and is influenced to some extent by economic choices, but mostly by parents. Children are first of all exposed to their parents model (type a or b), and are thus 'matched' with their family, in what can be termed 'vertical transmission'. Here, we suppose the child adopts his parent's preferences with a fixed (exogenous) probability τ^i, with $0 \leq \tau^i \leq 1$, $i \in \{a, b\}$. With probability $1 - \tau^i$, the child is matched randomly with another individual of the old generation (e.g., teachers, peers, role models) and adopts her preference type, i.e., 'oblique transmission'.[5]

Moreover, 'imperfect empathy' is assumed. This assumption means that parents can perceive the welfare of their children only through the filter of their own preferences. Such an assumption may sound relatively intuitive, and it has been grounded on sociological and ethnographic evidence, quoted

[4] See di Bartolomeo and Pauwels (2006) for a theoretical exploration of that point.

[5] Bisin and Verdier (2000) borrow these terms from the anthropological and psychological literature on child development, to embed them in an endogeneous preferences framework, *à la* Becker (1996), analyzing socialization as an economic choice.

in Bisin and Verdier (2000). Imperfect empathy is thus a particular form of 'myopia' which implies that parents always want to socialize their children to their own preferences and cultural traits. In our context this means that, whatever the costs of central bank independence, parents consider its benefits to be strong and desirable enough so that they feel a moral duty to bequest it. Such a conviction may arise from a kind of 'veil of ignorance' reasoning, or from experience learned from past events or transmitted to them by parent generations.[6]

Then, consider the transition probabilities at time t, P_t^{ij}, that a parent of type i has a child adopting a preference of type j:

$$\begin{aligned} P_t^{aa} &= \tau^a + (1-\tau^a)\, q_t^a \\ P_t^{ab} &= (1-\tau^a)\,(1-q_t^a) \\ P_t^{bb} &= \tau^b + \left(1-\tau^b\right) q_t^b = \tau^b + \left(1-\tau^b\right)(1-q_t^a) \\ P_t^{ba} &= \left(1-\tau^b\right)\left(1-q_t^b\right) = \left(1-\tau^b\right) q_t^a \end{aligned} \tag{8}$$

Given these transition probabilities, the fraction q_t^a of adult individuals of type a in period $t+1$ evolves according to:

$$\begin{aligned} q_{t+1}^a &= q_t^a P_t^{aa} + q_t^b P_t^{ba} \\ &= q_t^a P_t^{aa} + (1-q_t^a)\, P_t^{ba} \\ &= \left[1 + (1-q_t^a)\left(\tau^a - \tau^b\right)\right] q_t^a \\ &= (1+\rho_t^a)\, q_t^a \end{aligned} \tag{9}$$

where we have defined $\rho_t^a \equiv (1-q_t^a)\left(\tau^a - \tau^b\right)$. This parameter, ρ_t^a, is the vertical preference transmission time-varying persistence coefficient, and can be understood as the strength of intergenerational preference transmission for type a agents. Form here on, we will refer to this parameter as the vertical transmission strength.

It is clear from the last-but-one line above that the fraction of a types in the old generation may remain constant across time only if the term in square brackets is equal to 1, which is true only if the time-varying persistence coefficient in the type a preferences transmission dynamics in (9) is zero, $\rho_t^a = 0$. This could occur if either (i) $q_t^a = 1$ or (ii) $\tau^a = \tau^b$ or (iii) both. However, both situations (i) and (iii) are excluded by assumption ($0 \leq q_t^a \leq 1$), and the latter very special case implies a stable structure of the mature

[6] For example, Shiller (1997) shows that older Germans have stronger inflation aversion than their offspring, a cultural trait with an origin that can be traced back to the hyperinflation episodes experienced in 1923 and 1948.

population's preferences, as only one type of preferences survives. Therefore, only (ii) would be a relevant, symmetric option to consider, though one has to remark that such a situation defines a steady state for any initial condition, hence no evolution of the relative proportions of preferences in the society.

In all other cases, different from (i), (ii) and (iii), the intergenerational dynamics of preferences depends on two parameters: (I) the *magnitude* of the fraction of a types inherited from past history, $0 < q_t^a < 1$, relatively to that of $0 < q_t^b \equiv 1 - q_t^a < 1$, by definition, and (II) the *sign of the difference* of the fractions of those preserving the respective preference type of their own family, $\tau^a - \tau^b$, which is the vertical preference transmission probability gap, which we henceforth call the vertical transmission gap for short. Writing the last-but-one line in (9) as

$$q_{t+1}^a = q_t^a + q_t^a \left(1 - q_t^a\right) \left(\tau^a - \tau^b\right) = q_t^a + \left[q_t^a - \left(q_t^a\right)^2\right] \left(\tau^a - \tau^b\right)$$

delivers a first-order non-linear sequence, which does not admit any general solution. However, given the assumptions on τ^a and τ^b, we know that the stability points of this function are 0 and 1. The conditions for convergence are the following:

- If $\tau^a < \tau^b$, then for any initial condition q_0^a, $q_{t+1}^a \to 0$, social preferences will converge towards an economy with only type-b agents, i.e. a lower degree of central bank independence.
- If $\tau^a > \tau^b$, then for any initial condition q_0^a, $q_{t+1}^a \to 1$, social preferences will converge towards an economy with only type-a agents. In this case, we can say that inflation aversion, and central bank independence, are here to stay. Otherwise, the intergenerational stability of monetary arrangements favoring central bank independence can not be sustained.

As, by definition, $0 < q_0^a < 1$, no case can be ruled out, and everything will depend on the relative size of τ^a and τ^b. To illustrate this result, we can draw the graphs for the two opposite cases, namely where the difference between the probabilities of transmitting a parent's preference type to her child is positive, $\tau^a - \tau^b > 0$, or negative, $\tau^a - \tau^b < 0$.

As can be seen in the phase diagram in Figure 1, if the difference $\tau^a - \tau^b$ is positive, then the dynamics of the fraction of preference type a converges to the steady state S with coordinates $(1, 1)$ for any initial condition q_0^a. The process is driven by the concavity of the curves, no matter how large the vertical transmission gap may be. This result leads to an ultimate adoption of type a agents' preferences, implying a choice of a higher degree of central bank independence. Inversely, Figure 2 shows that if the difference $\tau^a - \tau^b$ is negative, then the preferences of society converge to type b at the steady

state S' with coordinates $(0, 0)$ for any initial condition q_0^a. The convexity in this case, no matter how large the vertical transmission gap may be, directs convergence to an ultimate equilibrium where only type b remains, which results into lower degree of central bank independence.

Interestingly, the speed of the convergence process depends on the size of the vertical transmission gap, which itself determines the curvature of the path of the fraction of preference type a. The larger the gap (e.g., compare the graphs for 0.9 versus 0.1 in Figure 1 and for -0.9 versus -0.1 in Figure 2), the more curved the path and the quicker the convergence process.

[Figures 1 and 2 about here]

Everything being equal, then, the degree of central bank independence will be linked to the political influence and preference types of mature people, and the exact degree will be a function of the transmission and evolution of these people's preferences. Hence, a testable structural-form equation would, for example, give the degree of central bank independence as a function of the evolution of older people's aversion to inflation. But this would assume that mature people have higher inflation aversion, an assumption we ground in the first application of the following section.

In parallel, the degree of central bank independence will also depend on the relative effort the different types of agents will provide to ensure that their preferences prevail. Hence, a testable assumption would be that in more equal societies, the relative efforts should be lower than in more unequal societies. And, depending on the prevailing type of preferences, inflation aversion would also be linked to a society's degree of inequality. The second empirical application looks at these kinds of dynamics.

3 Empirical Applications

To illustrate the relevance of our theoretical framework, the present section studies its implications with respect to two key determinants of inflation aversion dynamics, namely, demographic changes and the evolving inequality structure in a society. For purposes of robustness, we employ alternative measures of inflation aversion, different data sets and complementary, although straightforward, empirical methods to assess the role of these major factors underlying the variation of inflation aversion across time and locations.

As Shiller (1997) notes, there are striking intergenerational differences in inflation aversion, even more important than the international ones. These, in turn, have certainly been shaped out to a large extent by the ongoing demographic and income distribution transformations across the globe. Moreover, as will become clear, the latter fit well in illustrating some of the

mechanisms that were captured by the theoretical model of the preceding section.

Evolving inflation aversion perceptions have, most likely, translated into an increased degree of central bank independence. During the last two decades at least, granting more independence to the monetary authority from the government 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, among others, Brumm, 2002, and the meta-regression analysis by de Haan and Klomp, 2008). Hence, it may be the case that evolving preferences have modified – and may still modify in the future – monetary institutions. Both empirical applications we discuss below ultimately influence, via voting and legislation, central bank independence, and the present section aims at giving first evidence on the existence of these deep processes.

3.1 Dependent and Independent Variables

The dependent variable in our regressions is always the degree of (relative) inflation aversion, either in percentage changes or in levels, in compliance with the particular econometric specification as explained further down.

Our first measure of inflation aversion is the index constructed by Krause and Méndez (2005) and employed in Krause and Méndez (2008) for 34 countries over a period of 24 years. We shall refer hereafter to the Krause–Méndez (2005, 2008) data set and inflation aversion measure as the KM ones. The specific feature of the KM relative inflation aversion index, λ in their notation, is that it describes a policymaker's (relative) preferences as the weight she puts on inflation stabilization in an objective function that is optimized under the constraint of an ad-hoc economic environment. The authors compute the λ parameter, derived as a function of deeper model parameters, by substituting each parameter with its second-order vector autoregression estimate.[7] As Krause and Méndez (2008) argue, the main advantage of using their 'lambdas' instead of the actual inflation rate, as most of the related literature has done, is that macroeconomic outcomes are also affected by factors different from policy intentions (which should not change, in principle, policy behavior). Because our point of departure in this empirical section is the unique and publicly available KM data set, we essentially restrict attention to its cross-section and time-series dimensions, although we duly complement it where appropriate.

To check that our econometric results do not remain sensitive to the particular policymaker's inflation aversion measure implied by the KM (2005)

[7] Since these λ measures of inflation aversion are already empirical estimates with some underlying theoretical justification, we abstain from adding control variables in our regressions further down that attempt to attribute most of the variation in the KM index to a key demographic or income inequality determinant.

model and estimated the way they did, we use a second, differently defined and obtained, measure, now for the (relative) inflation aversion of a country's population at large. The latter is computed as the percentage of respondents to a question in the International Social Survey Program (ISSP) who would prefer to keep down inflation rather than unemployment.[8] This measure for the relative inflation aversion is employed, in a related context, in Jayadev (2006). The ISSP studies the preferences regarding the role of government in society of more than 30,000 individuals in 27 countries through a survey containing over 200 questions. The ISSP measure of the relative inflation aversion of a nation thus emerges as the average answer in a given country to one particular question of the survey (see, e.g., Jayadev, 2006, p. 68). Henceforth we refer to this alternative inflation aversion proxy as the ISSP one.

A disadvantage of the ISSP measure is that it is available only for 1996 – which prevents a time-series dimension of our analysis when employing it – and for 18 countries. A disadvantage of the KM measure may be that it is inferred indirectly through combining without explicit microfoundations a number of structural parameters characterizing the economy, themselves estimated in a particular fashion. However, the time dimension of the KM measure allows us to exploit it in two ways that would be impossible if we were to remain limited solely to the ISSP measure: (i) in a cross-section defined in terms of a 'generational'-span (15 years, in our implementation) percentage change; and (ii) in time-series analysis by representative country cases. Both inflation aversion measures are therefore employed, within differing data sets due to availability limitations, in cross-sections that permit comparisons and insights concerning their dependence on the evolution of income inequality in addition to demography.

Since what follows are only first empirical applications of the described theory, intended as its simplest possible illustrations, we opt to use widely applicable and straightforward statistical and econometric techniques in analyzing whether the trends in the data conform to the model basic predictions. The choice of our independent variables thus includes a relevant major determinant of inflation aversion, itself originating in the underlying transmission of preferences across generations, such as demographic or income inequality structural changes, respectively, in our two applications. To these key factors, as is usual in empirical work, we add a constant intercept and an i.i.d. disturbance process, as well as a lagged dependent variable or initial level of the regressor where deemed appropriate. We then check which particular specification, including such in percentage changes or in levels (with an initial condition), ensure the best econometric fit, as we elaborate next.

[8] The ISSP was conducted in 1996 by the Inter-university Consortium for Political and Social Research.

3.2 Inflation Aversion and Demography

Since the 1960s, demographic changes have been tremendous, as a large generation of baby-boomers is now entering into its retirement period. This generation has accumulated some capital, and this sheer fact would have contributed to make it much more conservative than it was in the 1960s. This would have been unnoticeable except for the size of this generation, which has enabled them to translate their evolving preferences into policies. The span of our data[9] across time (1960-2007) and space (the 34 countries in the KM set, to which we later add 6 from the ISSP set) provide overwhelming evidence that the share of retirees has been increasing continually and sometimes dramatically in European economies (Figure 3) as well as in non-European ones (Figure 4), either OECD members or developing countries.

[Figures 3 and 4 about here]

A stark European example of an aging population structure is Germany, while the opposite case is illustrated most clearly by Ireland; Japan and Mexico are the corresponding parallels for non-European countries. Because these four country cases represent the characteristic extremes of our sample, we return to them in the time-series analysis further down. But before getting there, we reveal some of the lessons derived from the cross-section dimension of our data.

Moreover, the increase in the proportion of middle-aged people and retirees has been accompanied since the 1980s by a reduction in inflation, and then by monetary policies geared towards low inflation. In parallel, financial systems have changed significantly, from heavily regulated to almost unregulated ones. Such changes in social preferences driven to a large extent by changes in demography and in the income distribution on national as well as global scales have not been deeply studied, and we here contribute along this direction.

3.2.1 Cross-Section Analysis on a Generation Time Span

A first, cross-section regression we estimate through the least squares method has the general form

$$d\ln \mathbf{y}(97/82) = \alpha_0 + \alpha_1 d\ln \mathbf{x}(97/82) + \alpha_2[\ln]\mathbf{x}(82) + \boldsymbol{\varepsilon} \qquad (10)$$

where $\mathbf{y}$ is a vector measure of inflation aversion, $\mathbf{x}$ is a vector of some key exogenous determinant, ln denotes natural logarithm, d first difference,

[9] Available from the World Bank *World Economic Indicators* (April 2008) database, accessed online via the UK Economic and Social Data Service (ESDS). For further detail and precision, see Appendix A.

so that $d\ln$ is percentage change, and (97/82) indicates that the percentage changes considered in equation (10) refer to comparing cross-country levels in $\mathbf{y}$ and $\mathbf{x}$ in 1997 relative to 1982, and $\boldsymbol{\varepsilon}$ is an i.i.d. vector error process. The choice of these two particular 'benchmark' years was predetermined by data availability of the KM inflation aversion index, yet it can also be thought of as roughly distinguishing a generation in terms of a typical time span within which similarity of preferences is likely to be higher relative to the conflict of tastes, often termed a 'generation gap'.[10] $\mathbf{x}(82)$ denotes the initial condition in level and $\ln \mathbf{x}(82)$ in natural logarithm: both specifications were estimated, which explains the notation $[\ln]\mathbf{x}(82)$ in (10). However, α_0 as well as α_2 did not generally come out as statistically significant, so the scatter plot summaries presented further down in fact refer to a simplified but robust version of (10), namely:

$$d\ln \mathbf{y}(97/82) = \alpha_1 d\ln \mathbf{x}(97/82) + \boldsymbol{\varepsilon} \tag{11}$$

The results from running regression (11) are illustrated in figures 5 and 6. Figure 5 shows the full KM sample, 34 countries. As can be seen, even with one extreme outlier,[11] the illustrated scatter plots in general indicate a sensible fit for a cross-section as varied as this. In particular, there is positive dependence of the percentage change in the KM inflation aversion index on the percentage change of each of three alternatively employed demographic variables. The strongest dependence comes out to be on the percentage change in the share of active population, yet there seems to be some dependence on the percentage change in the share of retired people too. Their combined influence is captured by the share of 'voters', defined as the sum of the shares of active and retired people.[12] However, when the KM index (in % change) is regressed simultaneously on the share of active population (in % change) and the share of retirees (in % change), none of the regressors is statistically significant at the 1% and 5% levels (with the share of active people becoming significant only at the 10% level, but not the share of retirees) and the adjusted R^2 is 0.01. Moreover, the measures of goodness of fit were very low for all three bivariate regressions considered here, which motivated our deeper analysis of the data, as discussed further down.

One technical problem leading to the results depicted in Figure 5 was

[10] Casual observation suggests that traits and style of role models in fashion or music (usually in their late 20s or early 30s) are largely imitated by the generation that shapes out its tastes and responsibilities (usually in their late teens). See also Sáez-Martí and Sjögren (2008) on this point.

[11] Israel, to which a miniscule index of inflation aversion was assigned at the times of the Israeli hyperinflation. This leads to a huge percentage change when later years of much higher inflation aversion are considered.

[12] Note that, as explained, we only report the best-fit equation from the alternative specifications encompassed by (10) we estimated.

that for 6 countries there were no inflation aversion indexes computed for 1982 in the KM data set. We therefore had to use instead the nearest year with available such proxy, usually 2 to 4 years later in time. To correct for the potential effects of this imperfection in the estimation of (10), we ran it again for a sample of 28 countries, all having the KM inflation aversion index available for 1982 as well as for 1997. Our results are reported in Figure 6, which is similar to the previous illustration but is more precise in quantifying the strong effect of evolving demography on the dynamics of preferences with respect to inflation. In particular, the goodness of fit has increased for all three regressions, most dramatically for the one where the explanatory variable is the percentage change in the share of active population, from an R^2 of 0.04 in the 34-country cross-section to an R^2 of 0.41 in the 28-country cross-section. To put it differently, this latter smaller-sample regression is able to explain about 40% in the cross-country variation in inflation aversion in 1997 relative to 1982 by just one major determinant, namely, the corresponding cross-country variation in the share of active population. All three regressions in the 28-country cross-section have lower standard errors and higher p-values relative to the corresponding 34-country cross-section regressions. In particular, the share of retirees (in % change) has now become statistically significant, as summarized in the right-hand side panel of Figure 6, and the magnitude of its positive influence on the KM inflation aversion index (in % change too) can be quantified at 1.21. This means that, on average, a change in the share of retirees in a given year by one percentage point leads to a resultant change in the KM index of inflation aversion by more than 1 percentage point. Such empirical results do provide initial support to the theoretically justified hypothesis we here test. However, when the KM index (in % change) is regressed simultaneously on the share of active population (in % change) and the share of retirees (in % change), the retirees regressor loses statistical significance whereas the share of active people becomes significant at all three standard levels, with the adjusted R^2 rising to 0.39. These cross-section findings suggest overall a strong influence of demographic factors, especially of the share of active population, on the dynamics of inflation aversion. Yet they are less conclusive so far with respect to the role of the share of retirees, which led us into further exploration.

3.2.2 Time-Series Analysis on Selected Countries

To exploit the time-series dimension of the KM data set and gain further insight into the empirics of evolving inflation preferences, we now turn to four illustrations of the extremes in our data: Germany, Ireland, Japan and Mexico. As stated above, they offer cases of, respectively, European and non-European, developed and developing countries, with contrasted demographic and inflation experiences. Germany and Japan have witnessed a

large increase in the proportion of their retirees; as is also well known, inflation outcomes in these two countries have generally produced low and stable rates, with the exception of the years following German re-unification. The proportion of retired people is relatively stable in Ireland, while for Mexico it is much lower but slightly increasing over time; both these countries have experienced prolonged episodes of higher actual inflation rates. For each of these countries we run four time-series regression specifications based on annual data for the years when the KM inflation aversion index is available. The most general of these specifications is of the form

$$\mathbf{z}_t^i = \beta_0^i + \beta_1^i \mathbf{w}_t^i + \beta_2^i \mathbf{z}_{t-1}^i + \boldsymbol{\epsilon}_t^i \tag{12}$$

where $\mathbf{z}_t^i$ is the employed inflation aversion vector measure (in level) for the selected country i in year t, $\mathbf{w}_t^i$ is the vector share of retirees in percentage of total population, and $\boldsymbol{\epsilon}_t^i$ is a country-specific i.i.d. disturbance vector process. (12) encompasses three potential less general specifications, with $\mathbf{z}_{t-1}^i$ excluded, with β_0^i excluded instead, and with both $\mathbf{z}_{t-1}^i$ and β_0^i excluded, which we also test econometrically. For all these four countries the regression discarding only the lagged dependent variable had its intercept and slope always significant at the 10% or lower level.[13] For all four countries too the simplest regression retaining $\mathbf{w}_t^i$ as the sole regressor always displayed a coefficient p-value of 0.0000. Based on such criteria of econometric output and comparability across countries, we thus select as our preferred specification the following

$$\mathbf{z}_t^i = \beta_0^i + \beta_1^i \mathbf{w}_t^i + \boldsymbol{\epsilon}_t^i$$

whose estimation results are presented in Figure 7.

[Figure 7 about here]

As can be seen, our simple time-series demographic regressions explain between 21% (for Ireland) and 52% (Mexico) of the observed evolutions. Moreover, coefficient estimates show that a one percentage point increase in the proportion of retirees increase inflation aversion by a magnitude going from 3 (Japan) to 38 (Ireland) basis points. In the terms of the outlined model, these coefficients can be interpreted as revealing differentiated efforts by retirees to transmit their preferences. And, interestingly in this perspective, it is in Ireland (respectively, in Japan), the country with a notoriously high (respectively, low) inflation experience over the period that

[13] For Japan and Mexico the lagged dependent variable came out statistically significant only when the intercept was excluded, and not otherwise; for Germany and Ireland it was found statistically significant in both these cases, but eliminating the statistical significance of the remaining variables in the most general, encompassing equation (12).

the highest (respectively, lowest) efforts to transmit low inflation preferences are revealed.[14]

Hence, though one could find these estimates as rough, we believe that, under the limitations of the data, they provide results which are supportive of the thrust of the theoretical predictions. First, they show that the underlying evolution of a society's preferences is fundamental to observed macroeconomic trends such as, in our case, inflation. Second, they suggest that individuals may vary their efforts to transmit their preferences, depending on the context and the relative incentives they have to do it within.

3.3 Inflation Aversion and Income Inequality

As already stated, structural changes in income inequality are partly originating in the demographic transitions that are ongoing throughout the world. But they may well have other, independent drivers, which also influence inflation aversion perceptions and – through transmitting and legislating them – ultimately, inflation outcomes. To explore this important role of social inequalities in determining the evolution of inflation aversion, we move now to our second empirical application of the model we started with.

Widely accessible and comparable data on national income distributions across time are, unfortunately, not available. This precludes any further exploration of the time dimension of the inflation aversion measure borrowed from Krause and Méndez (2005, 2008). Yet it provides the opportunity to check the findings based on our two proxies for inflation aversion here, now adding the ISSP one, in a cross-section (in)equality context. Moreover, the respective data sets have only a minor intersection (of 12 countries and 1 year) in common, and have methodologically differing backgrounds. This avenue, then, offers a test of how robust our cross-section results would be to the definition of the dependent variable and to regressing it on different data sets.

3.3.1 Cross-Section Analysis Based on KM Inflation Aversion

We first present our results based on the KM proxy and sample for the year 1997, the latest year with full data for all 34 countries (and for some consistency with the end-point of the 'generational' percentage change in inflation aversion estimated earlier). To get a feel for the data and for the potential similarity or discrepancy between the two available proxies to employ as dependent variable, consider the spread of the Gini index in Figure 8 (ranging from around 25 for the 'egalitarian' societies of Japan, Denmark, Sweden and Norway to around 50 for the 'unequal' societies of Colombia,

[14] For a discussion of the inflation experiences of those countries see, among others, Nelson (2008) for Ireland and Okina *et al.* (2001) for Japan.

Chile, Mexico and Peru) and the alternative inflation aversion measures in Figure 9 of the 12 countries common to the KM and ISSP samples.

[Figures 8 and 9 about here]

We ran simple cross-section regressions of the form

$$\mathbf{u}(\text{circa } 96-97) = \gamma_0 + \gamma_1 \mathbf{v}(\text{circa } 00) + \boldsymbol{\eta} \tag{13}$$

where vector **u** denotes the dependent variable, either the KM measure and then the sample includes 33 countries in 1997, or the ISSP measure and then the sample is of 18 countries dated 1996; vector **v** is the key explanatory variable, and can be (i) the Gini index, (ii) the richest income quintile or (iii) the poorest income quintile, with each of the respective sample (KM vs ISSP) remaining characteristics; vector $\boldsymbol{\eta}$ is an i.i.d. error process. Most income inequality data were sampled in 2000, but for some countries these refer to closest earlier or later years (for the precise date by country, refer to the note below Figure 8).[15]

[Figure 10 about here]

The findings from running equation (13) in its specifications corresponding to (i), (ii) and (iii) just above when the KM sample was used are presented in the left-hand side, middle, and right-hand side panels of Figure 10, respectively.

3.3.2 Cross-Section Analysis Based on ISSP Inflation Aversion

The parallel findings from equation (13) in its specifications corresponding again to (i), (ii) and (iii) but now with the ISSP sample instead are presented in the left-hand side, middle, and right-hand side panels of Figure 11, respectively.

[Figure 11 about here]

It is easily seen comparing the corresponding panels in figures 10 and 11 that the qualitative essence – and to a large extent even the quantitative detail – of our income inequality cross-section regression results based on the two alternative data sets[16] is preserved. Basically, the Gini index agrees with the top 20% share in the income distribution, in their capacity of acting as the sole independent variable, that inflation aversion depends negatively

[15] Like the demographic data, these were available via online ESDS access to the World Bank *World Economic Indicators* (April 2008) database.

[16] Whose common intersection of only 12 cases indicates no particular correlation pattern, as marked in Figure 9; though 12 observations only is too low a number for valid statistical inference.

on the degree of social inequality measured so. Inversely, the share of the bottom 20% in the income distribution, as a measure of a higher social equality (deriving from the lower tail of the distribution at least) influences positively inflation aversion across countries. These results are econometrically well supported (see the summary of the regression output we propose in the mentioned figures).

Thus, a key result that emerges from our empirical work in a relatively robust way across the two samples employed in the inequality cross-section regressions is that the richer is the poorest quintile of the population, the more inflation averse the nation is. Using logistic regressions based on the ISSP data set, Jayadev (2006) notably finds that 'the poor' would prefer more inflation rather than more unemployment. They are, hence, "less likely than the rich to prioritize combating inflation rather than unemployment" (p. 67, abstract). This result only seemingly contradicts ours. Since the poorest are mostly living on fixed money amounts in terms of social assistance benefits or low salaries, they are the biggest losers from inflation and have no alternative stores of value, neither can they save much in the first place. So, they should be more inflation-averse relative to the richest people, as our regressions demonstrate, no matter that they still may have preference for suffering from inflation rather than ending up without a job.

In the deeper context of the model we presented, our main empirical findings also point to the mutually reinforcing effects of global aging and a likely trend toward more egalitarian societies, both implying an increased role for the social-welfare state. Under this scenario, stronger inflation aversion and, consequently, lower actual inflation, is here to stay for some time. If, however, transmission of cultural and social values in favor of equality and social protection of the most vulnerable is threatened, for example, by burgeoning social security burdens and the risk of public debt unsustainability, population aging and income inequality may not act in the same direction to keep low inflation down for long, especially if the demographic trends also change dramatically in a more distant future.

4 Concluding Remarks

In this paper, we have proposed a theoretical framework appropriate to study the transmission of inflation aversion across generations that builds on Bisin and Verdier (2000, 2001). We show that the stability of a society's degree of inflation aversion depends on the strength and speed of changes in the structure of the population. The empirical part of the paper provides robust evidence that both demographic and income inequality dynamics influence considerably the evolution of inflation preferences. Our findings, thus, support the suggested theory, notably stressing how fundamental it is to understand the underlying trends in individuals' preferences and the

mechanisms behind their intergenerational transmission.

Theoretically, an interesting extension of the framework would endogenize socialization efforts from parents to their offspring, which would of course pave the way for other empirical applications. A logical aim is, therefore, to follow these two directions in further research.

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A Data Definitions and Sources

- **share of retirees in the population**
  - World Bank, *World Development Indicators* (April 2008), access via ESDS; Item Code: 587; Default Label: Population ages 65 and above (% of total) (SP.POP.65UP.TO.ZS).
  - *Definition:* Population ages 65 and above is the percentage of the total population that is 65 or older.
  - *Source:* World Bank staff estimates from various sources including census reports, the United Nations Population Division's World Population Prospects, national statistical offices, household surveys conducted by national agencies, and Macro International.

- **Gini inequality index**
  - World Bank, *World Development Indicators* (April 2008), access via ESDS; Item Code: 268; Default Label: GINI index (SI.POV.GINI).
  - *Definition:* Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.
  - *Source:* World Bank staff estimates based on primary household survey data obtained from government statistical agencies and World Bank country departments. Data for high-income economies are from the Luxembourg Income Study database. For more information and methodology, please see PovcalNet (http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp).

- **share of top income quintile**
  - World Bank, *World Development Indicators* (April 2008), access via ESDS; Item Code: 368. Default Label: Income share held by highest 20% (SI.DST.05TH.20).

  - *Definition:* Percentage share of income or consumption is the share that accrues to subgroups of population indicated by deciles or quintiles.
  - *Source:* World Bank staff estimates based on primary household survey data obtained from government statistical agencies and World Bank country departments. Data for high-income economies are from the Luxembourg Income Study database. For more information and methodology, please see PovcalNet (http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp).

- **share of bottom income quintile**

  - World Bank, *World Development Indicators* (April 2008), access via ESDS; Item Code: 370. Default Label: Income share held by lowest 20% (SI.DST.FRST.20).
  - *Definition:* Percentage share of income or consumption is the share that accrues to subgroups of population indicated by deciles or quintiles.
  - *Source:* World Bank staff estimates based on primary household survey data obtained from government statistical agencies and World Bank country departments. Data for high-income economies are from the Luxembourg Income Study database. For more information and methodology, please see PovcalNet (http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp).

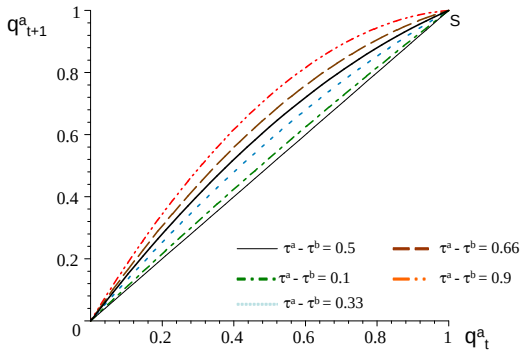

Figure 1: Convergence to Type-*a* Preferences

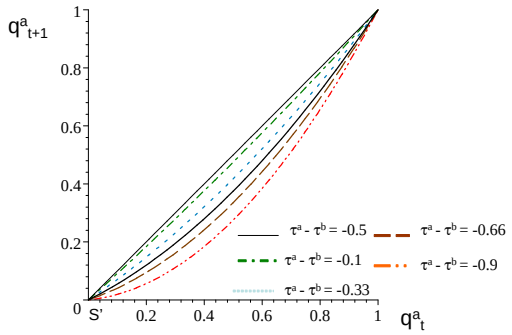

Figure 2: Convergence to Type-*b* Preferences

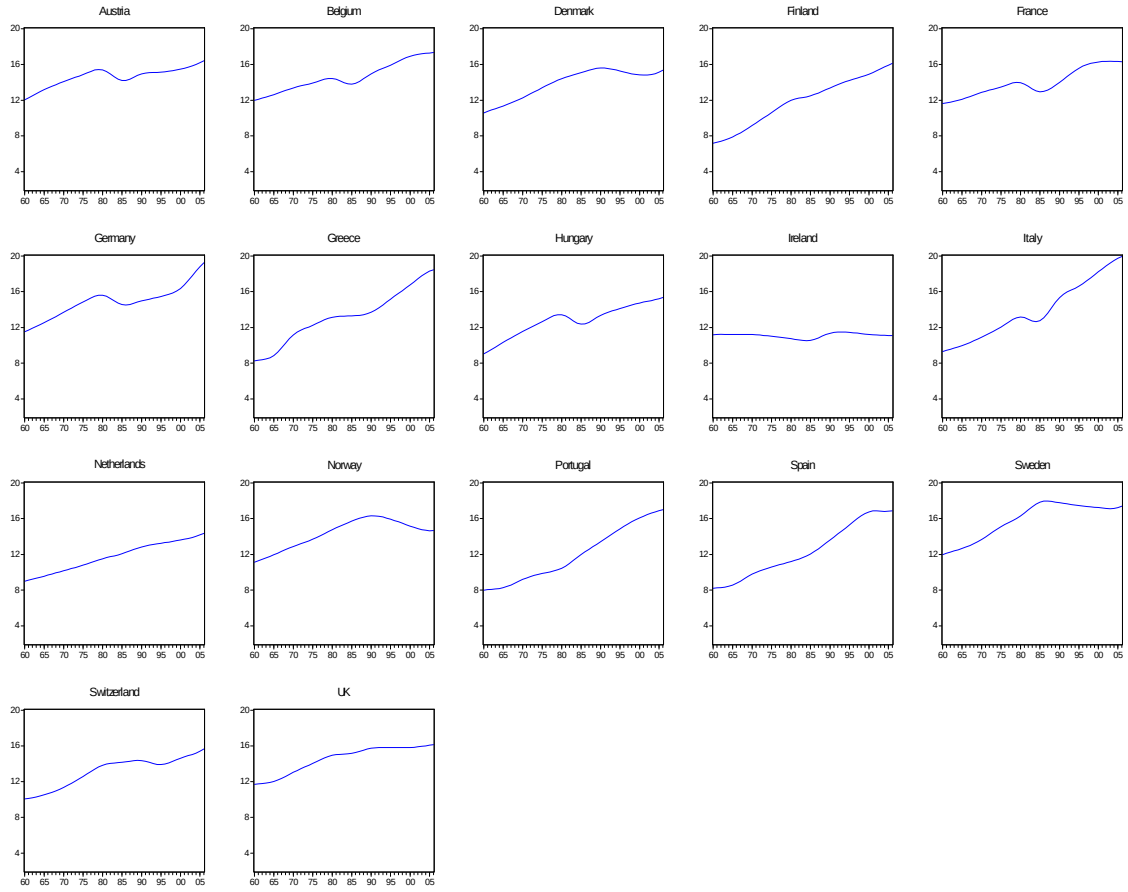

Figure 3: Share of Retirees in 17 European Countries, annual data, 1960-2007. Source: World Bank, *World Development Indicators* (April 2008), access via the UK Economic and Social Data Service (http://www.esds.ac.uk/).

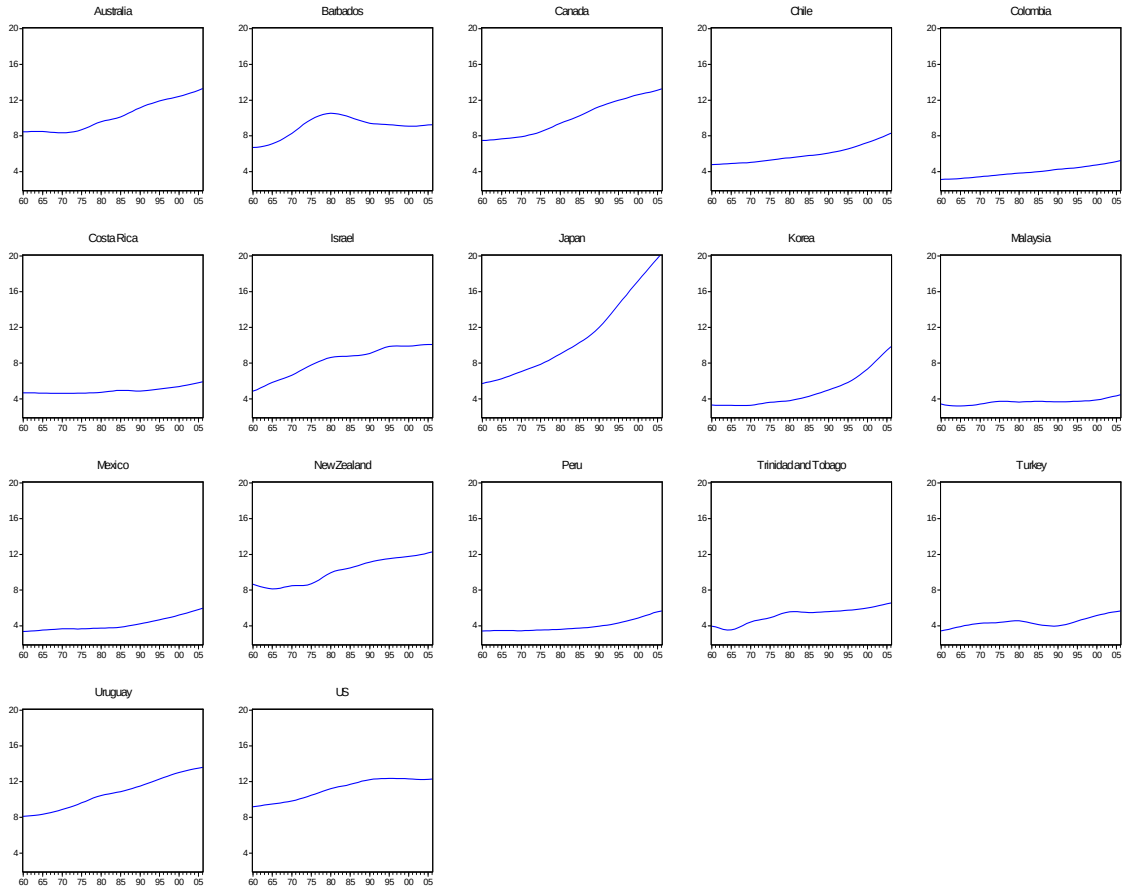

Figure 4: Share of Retirees in 17 Non-European Countries, annual data, 1960-2007. Source: World Bank, *World Development Indicators* (April 2008), access via the UK Economic and Social Data Service (http://www.esds.ac.uk/).

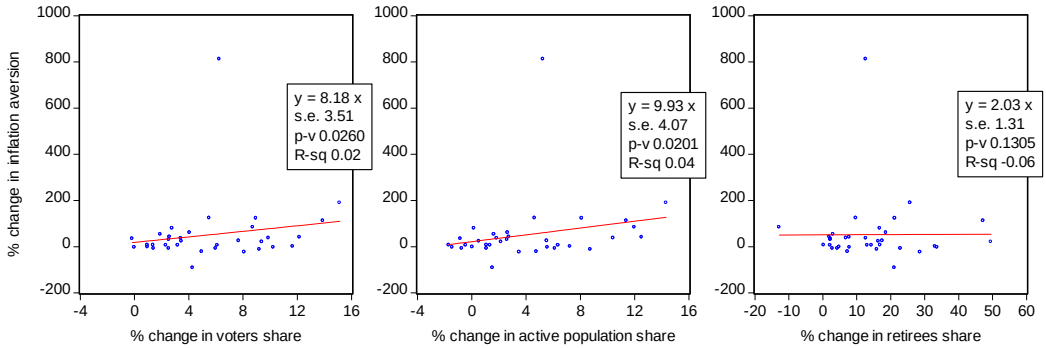

Figure 5: Cross-Section Demographic Regression, all 34 countries in the Krause–Méndez sample, percentage change in 1997 relative to 1982

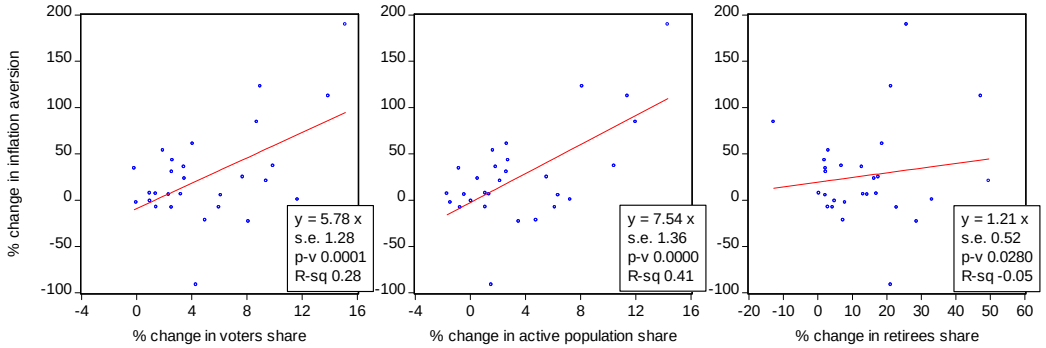

Figure 6: Cross-Section Demographic Regression for 28 Countries in the Krause–Méndez Sample, 1997 relative to 1982 (excluding the following 6, for lack of data in 1982: Colombia, Hungary, Israel, Portugal, Turkey, Uruguay)

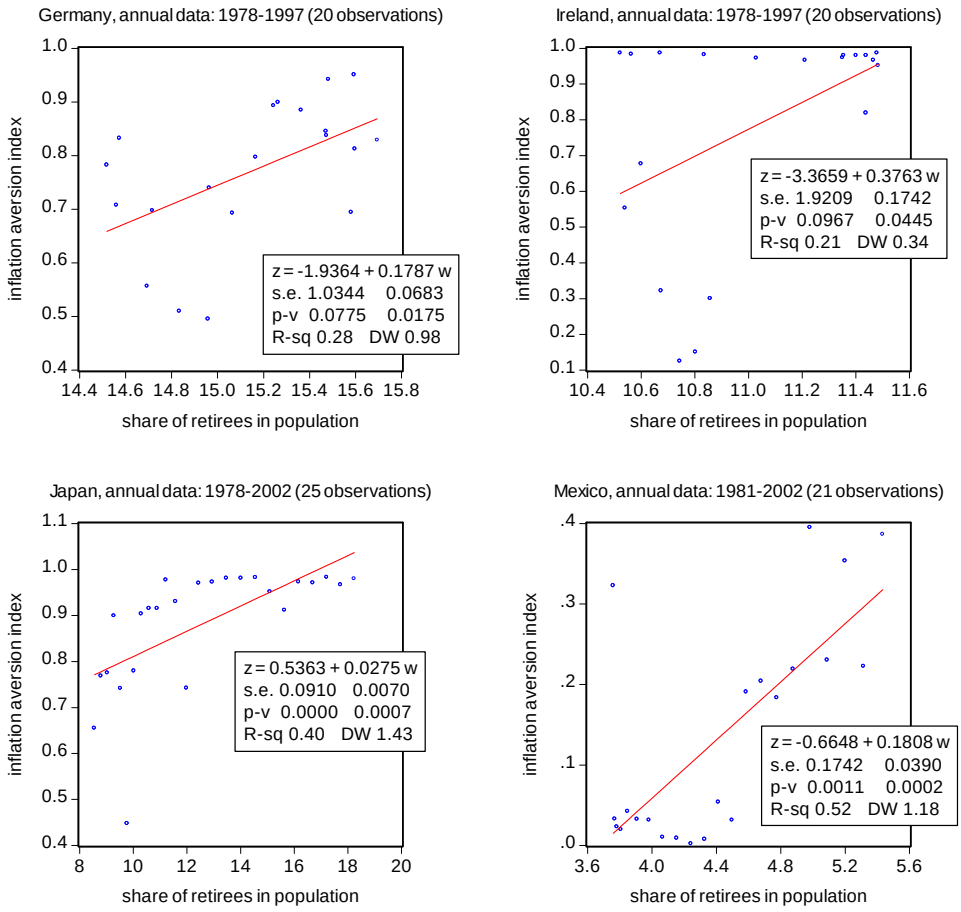

Figure 7: Time-Series Demographic Regressions for Representative Cases

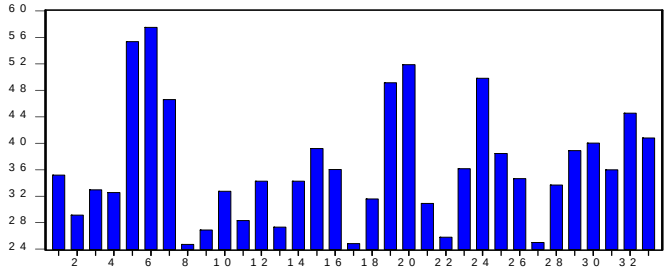

Figure 8: Gini Index for 33 Countries in the Krause–Méndez sample, excluding Barbados for lack of income inequality data: 1=Australia (1994), 2=Austria (2000), 3=Belgium (2000), 4=Canada (2000), 5=Chile (2000), 6=Colombia (2000), 7=Costa Rica (2000), 8=Denmark (1997), 9=Finland (2000), 10=France (1995), 11=Germany (2000), 12=Greece (2000), 13=Hungary (2000), 14=Ireland (2000), 15=Israel (2001), 16=Italy (2000), 17=Japan (1993), 18=Korea (1998), 19=Malaysia (1997), 20=Mexico (2000), 21=Netherlands (1999), 22=Norway (2000), 23=New Zeland (1997), 24=Peru (2000), 25=Portugal (1997), 26=Spain (2000), 27=Sweden (2000), 28=Switzerland (2000), 29=Trinidad and Tobago (1992), 30=Turkey (2000), 31=UK (1999), 32=Uruguay (2000), 33=US (2000)

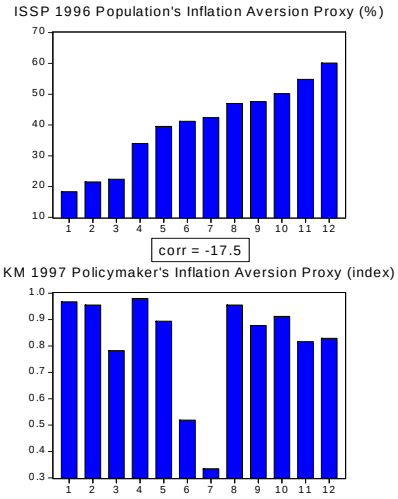

Figure 9: Correlation between 12 Common Countrries' KM (1997) and ISSP (1996) Inflation Aversion Proxy: 1=France, 2=Spain, 3=Italy, 4=Ireland, 5=Canada, 6=Australia, 7=Israel, 8=US, 9=New Zealand, 10=Japan, 11=Hungary, 12=Germany

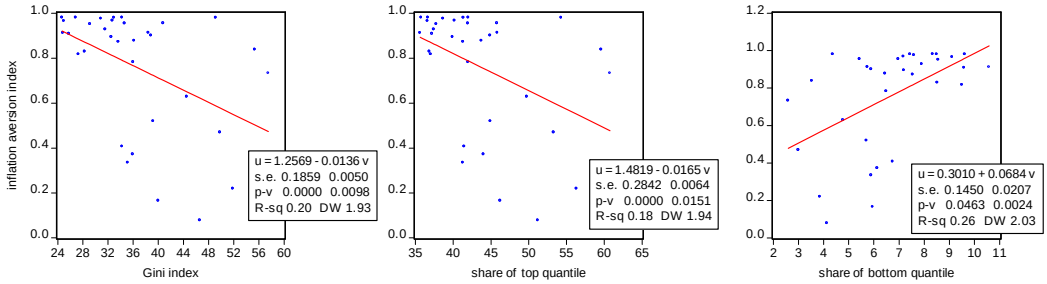

Figure 10: Cross-Section Inequality Regression of KM Inflation Aversion Index (1997) on Gini Index, Top Income Quintile and Bottom Income Quintile (all measures with values around 2000), 33 countries (excluding Barbados for lack of income inequality data)

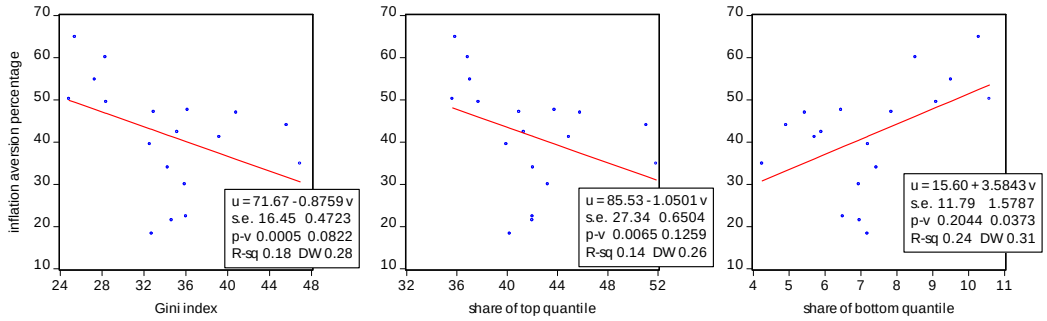

Figure 11: Cross-Section Inequality Regression of ISSP Inflation Aversion Percentage (1996) on Gini Index, Top Income Quintile and Bottom Income Quintile (all measures with values around 2000), 18 countries