Demography, credit and institutions: A global perspective

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Demography, Credit and Institutions: A Global Perspective[*]

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Abstract

This paper examines the role of age structure and its interaction with various capital market imperfections in driving international capital flows in an empirical framework. Using panel data covering the period 1970 to 2000 for up to 115 countries, results indicate the existence of a differentiated effect in the relationship between age structure and international capital flows. Good institutions allow for a differentiated impact of age structure on saving and investment, opening the scope for an impact of age structure in driving international capital flows. In contrast, bad institutions result in no effect of age structure on international capital flows. Despite increased credit availability contributing to reduced aggregate saving, this will nevertheless magnify the role of the population age structure in driving international capital flows. Over the past three decades, age structure changes are estimated to have contributed to improve the current account position by five per cent of GDP in more advanced aging countries. However, around the year 2020, population age structure changes are projected to deteriorate the current account position in the latter countries which will experience a drop in saving. In other regions, the faster the current aging process, the sharper the projected improvement in the current account position. This improvement is projected to reverse itself, at a later stage in time in regions with a slower aging process. Also, our results suggest that in order to take advantage of their younger population in the form of increased foreign capital inflows, countries that are less advanced in the demographic transition would need to improve the quality of their institutional arrangements before the "window of opportunity" closes.
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JEL Classification: F2; F4

Keywords: demography, international capital flows, capital market imperfections, credit, institutions.

1 Introduction

Different regions of the world are at different stages of a global aging phenomenon entitled "demographic transition". More advanced countries in this process face a high old age dependency ratio. Less advanced countries are currently experiencing a relatively lower old age dependency ratio and an increasing labor force population. According to the United Nations [18] demographic differences are likely to remain important in the future.

Assuming an overlapping-generations two country model where the two countries are identical in every respect except in fertility rates. Under diminishing returns assumption, an implication of the life-cycle hypothesis is that part of the saving supply triggered by the rapidly aging country should flow to the slower aging country where capital is relatively scarce and where labor is relatively abundant.

This prediction matches with the surge in past decades of capital inflows to younger/poorer countries following their capital markets liberalization. However, those international capital flows appear to be limited compared to what neoclassical theory would predict as claimed in Lucas [13]. Indeed, capital market imperfections are likely to impede aging differences to foster international capital flows. Lucas [13] emphasizes the role of political risk in explaining the lack of capital flow from capital abundant to capital scarce countries. More recently, Shleifer and Wolfenzon [17] model how agency costs stemming from inefficient corporate governance and law enforcement mechanisms impede foreign capital from flowing to capital-scarce countries. Their results suggest poor countries receive substantially less capital inflows. Alfaro and al. [1], using cross country data, show empirically the importance of institutional factors in determining international capital inflows to emerging countries.

In parallel, another strand of literature has addressed the economic consequences of aging differences in an open economy perspective using large scale simulation models. Attanasio and Violante [3] and Brooks' [5] simulation results point to a significant role being played by demographic differences in explaining capital flow from fast aging OECD countries to slower aging emerging markets. Brooks' [5] simulations results also predict a reversal in the direction of international capital flows. Indeed, Brooks' [5] predictions suggest that capital will flow from currently younger countries to currently older regions as the former will enter into the fast aging stage of the demographic transition.[1] There is, however, an important caveat to this recent literature. These studies assume the absence of capital market imperfections, that are likely to explain the uneven distribution of capital inflows across younger/poorer countries.

In addition to being relatively scarce, international capital inflows have been unevenly distributed across younger/poorer countries. These stylized facts on international capital movements, documented in Prasad and al. [16], suggest a role for interaction between aging differences and capital market imperfections in explaining the timing, the magnitude and the distribution of international capital flows across recipient countries. However, little empirical and theoretical works have been conducted on the importance of such interactions in explaining international capital flows. Indeed, the existing literature has focused separately on the individual role of capital market imperfections or of

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[1]It should be noted that this literature is often understood in terms of the life–cycle model. However, that does not need to be the case. For instance, Cutler et al.[7] rely on the Cass-Ramsey-Solow optimal growth model shows in the case of the U.S. versus OECD countries that a similar link between age structure differences and capital flows can be obtained using that main alternative framework.

demographic changes in explaining international capital flows. One noticeable exception is Arezki [2] who analyzes the consequences of an asymmetric negative fertility shock on saving/investment imbalance in a Diamond-type overlapping-generations small open economy with capital market imperfection. The capital market imperfection is modelled through a symmetric wedge between foreign investor and domestic investor return on capital likely to arise when property rights are not enforced. The author finds that the shock is transmitted to the small open economy depending on whether the wedge is below a given threshold. If the wedge is not too high, capital first flows into the small open economy in order to exploit the difference in returns on capital. After the shock has occurred, capital is repatriated in order to finance old age consumption of the rest of the world investors. In the present paper, a reduced form estimation is used to test empirically the validity of the latter theoretical results.

Empirically, Higgins [10] estimates a reduced form estimation to quantify the impact of age structure differences in explaining international capital flows. Drawing from data for up to 100 countries over the period 1950 to 1989, Higgins results point to the significant impact that changes in population age structure have on saving. Results also point to a differentiated impact of age structure on saving and investment, opening the scope for international borrowing and lending. Bosworth and Keys [4] replicating Higgins study, use a larger sample period covering the period 1950 to 2000 and seem to confirm Higgins results. However, Bosworth and Keys [4] argue that their results are not robust and driven by South East Asian countries. The latter findings seem to suggest that the role of demography in driving international capital flows needs to be considered together with its interaction with capital market imperfections, as suggested by Arezki [2]. It appears that there are no empirical studies that test the relevance of the interaction between age structure differences and capital market imperfections in explaining international capital flows.

The purpose of this paper is to remedy this deficiency in the existing literature by providing a systematic empirical analysis of the impact of the interaction between age structure differences and capital market imperfections on international capital flows. To do so, a variety of individual regressions is performed for saving, investment and current account position, drawing from data for up to 115 countries over the period 1970 to 2000. To capture the impact of changes in population age structure on the various dependent variables, a polynomial representation is used in the regression analysis to capture countries' detailed population age structure. The channels through which demographic changes affect international capital flows will likely depend on the nature of the capital market imperfections in the country of destination of those flows. The empirical analysis thus distinguishes between "internal" and "external" capital market imperfections. The internal capital market imperfection is related to the availability of credit. The external capital market imperfection is related to the quality of institutions.

The rest of the paper is organized as follows. Section 2 presents some stylized facts on age structure differences. Section 3 presents the empirical analysis and results. Section 4 presents out of sample projections of the consequences of age structure differences on international capital flows under different scenarios of capital market imperfections. Section 5 concludes.

2 Stylized Facts

This section establishes some stylized facts on the world demographic transition. Cross-correlations between population age structure and saving, investment and current account balance over the period 1970 to 2000 are also presented.

2.1 The Demographic Transition

The world as a whole is aging. This phenomenon has been formalized by demographers into a demographic transition model. Demographic transition is operating through fertility rate decline and life span lengthening. However, the timing of the decline in fertility rate is not synchronized with the timing of the decrease in the death rates over the transition. Indeed, life span lengthening is first increasing, and is then followed by a decline in the fertility rate. As a result, one can distinguish four different stages in the demographic transition model, intrinsically linked to development stages, as described in Figure 1. The first stage corresponds to a pre-development phase and is characterized by high fertility and high death rates. The second stage is characterized by a rapid fall in the death rate due to improved living conditions, while the fertility rate remains high leading to high population growth. The third stage is characterized by a fall in the fertility rate, while the death rate remains stable, leading to a slowdown in population growth. The fourth stage is characterized by stabilized fertility and death rates, leading to a stationary population level.
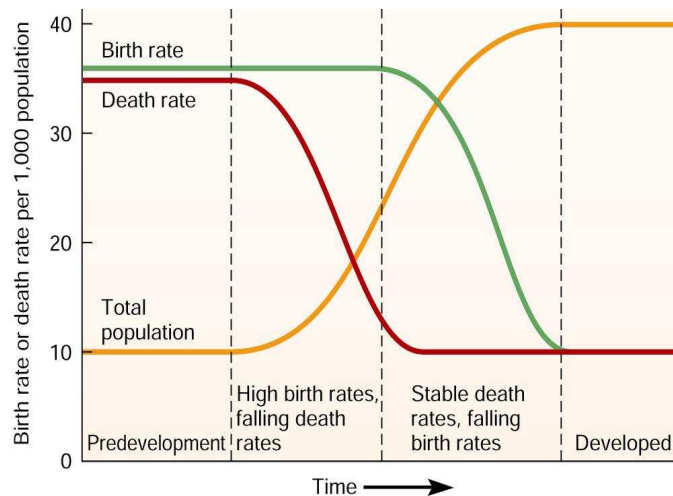
Figure 1: **Demographic Transition Model**

2.2 The Demographic Transition Around The World

Different regions of the world are at different stages of the demographic transition, resulting in an important differences in population age structure across countries. Broadly speaking, these demographic differences are shaped along income level. Indeed, more developed countries are at a more advanced stage of the demographic transition than less developed countries. For instance, the median age in the year 2000 was about 37.3 years

in more developed countries whereas it was only 24.1 years in less developed countries.[2] These population age structure differences are projected to remain sensible over the next decades. Indeed, in the year 2050 median age is projected to reach 47.7 years in Europe and 27.5 years in Africa.

Important differences also exist between the pace of the aging process, as seen previously in the demographic transition model. Over the period 1975 to 2000, the median age in the least developed region has increased by less than a year, whereas in the more developed region the median age has increased by more than six years due to differential in fertility rates and in life expectancy lengthening.

The following sections will address questions such as: How does the population age structure interact with various capital market imperfections in explaining international capital movements? Will population age structure differences play an increasing role in shaping international capital flows in the future given specific scenarios on the degree of capital market imperfections?

3 Empirical Analysis

This section presents test results on whether the interaction between age structure and capital market imperfections proxied by institutional quality gives rise to a differentiated effect, as predicted in Arezki [2]. In addition, the effect of the interaction between age structure and another form of capital market imperfections, namely domestic liquidity constraints on international capital flows is also estimated. To do so, panel data covering the period 1970 to 2000 for up to 115 countries is used.[3]

3.1 Empirical Specification and Econometric Issues

The dependent variables are national saving rate proxied by the ratio of national saving to Gross Domestic Product (GDP), investment rate proxied by net fixed capital formation to GDP (including changes in inventory value) and current account position to GDP (CAB).

Each dependent variable is assumed to follow the data-generating process below:

$$y_{i,t} = \beta_{0,i} + \beta_1' D_{it} + \beta_2' Interactive_{it} + \beta_3' X_{it} + u_{it} \quad i = 1, ..., N \quad t = 1, ..., T$$

$$Interactive_{it} = D_{it} Imper_{it} \quad with \quad Imper_{it} \in \{INSTITUTION_{it}, CREDIT_{it}\}$$

where $y_{i,t}$ represents the dependent variable in country i at time t; $D_{i,t}$ refers to a vector of demographic variables; $Interactive_{i,t}$ is the vector of interactive terms between population age structure and capital market imperfections described below, and $X_{i,t}$ represents a vector of non demographic explanatory variables that have been identified in the literature as being important determinants of saving and investment rates. They are institutional quality, credit availability, real GDP per capita growth, *de jure* restrictions in capital, goods and services transactions. The channels through which demographic changes affect international capital flows will likely depend on the nature of the capital

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[2] All the actual demographic statistics and projections presented in this paper are from United Nations [18].

[3] Figure A.1 in appendix A.1 provides the list of countries included in the empirical analysis.

market imperfections in the country of destination of those flows. The empirical analysis thus distinguishes between "internal" and "external" capital market imperfections. The internal capital market imperfection is proxied by CREDIT that is the domestic credit to the private sector available from World Bank, World Development Indicators [19]. The external imperfection is proxied by INSTITUTION that is the sum of all the ten ratings components from International Country Risk Guide, The Political Risk Services Group [15]. These individual components range from 0-6 where a higher score means a lower risk. The composite index is the sum of the indices of government stability, socioeconomic conditions, internal conflict, external conflict, corruption, military in politics, religion in politics, law and order, democratic accountability and bureaucracy quality. This index takes values from 0 to 10 for each country, where a higher score means lower risk. A detailed description of the remainder of the individual variables used in the statistical analysis is provided in appendix A.2.

This model specification assumes that country-specific unobservable characteristics are invariant over time. The Hausman test validates the hypothesis of fixed effect against random effect specification for each regression. Time effects are also included in the estimation, in order to capture time specific shocks common to all countries.

To capture the impact of a change in population age structure on the various dependent variables, a detailed population age structure consisting of 17 population age shares: 0-4, 5-9,..., 75-79 and 80+ from United Nations [18] is used.[4] Following Fair and Dominguez [8], three geometric combinations of age shares, denoted D_j, are constructed to capture the information embodied in those 17 population age shares as described in appendix A.3. The estimation of δ_j associated with these geometric combinations allows to obtain a detailed picture of the effect of age structure, while maintaining a parsimonious econometric specification.

The coefficients associated with population age structure are expected to be distributed in an hump shaped fashion in the saving regression, as predicted by the life-cycle hypothesis (see Modigliani and Brumberg [14] and [6]). However, the presence of liquidity constraints is likely to impede such life-cycle saving behavior, thus flattening the distribution of the coefficients associated with the effect of age structure on saving.

The coefficients associated with population age structure in the investment regression are expected to be distributed similarly to the coefficients in the saving regression in the context of poor institutions. Indeed, poor institutions prevent foreign investment. The economy is *de facto* closed so that domestic investment is financed only through national saving. In contrast, in presence of good institutions, the distribution of the coefficients associated with population age structure in the investment regression is expected to be hump shaped, but skewed to the left compared to the coefficients in the saving regression. Investment is no longer constrained to equalize domestic saving when institutions are good.

The results of the systematic econometric analysis are presented in the following subsection.

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[4]F-test of joint significance of coefficients cannot reject the cubic polynomial representation of population age structure in the various individual regressions.

3.2 Results

Our results show that good institutions significantly foster investment and deteriorate the current account, but do not significantly affect savings. Our results also show that demography has a material impact on capital flows only for countries with good institutions. Elsewhere, domestic savings serves as a binding constraint on domestic investment. In addition, our results show that credit availability has a negative impact on the saving rate, but do not significantly affect investment. Our results also show that increased credit availability favors significantly a deterioration of the current account position. The latter result is driven by the effect of increased credit availability on saving.

On the role of the interaction between age structure and institutions in explaining international capital flows

According to the results displayed in Figure 2, individually good institutions significantly foster investment and deteriorate the current account position, but do not prove to significantly affect saving.[5] Those results are robust over various specifications and the use of various indicia for institutions. Indeed, poor institutional quality captures the presence of sovereign risk and poor governance, which are likely to deter investment. This result confirms Alfaro and al. [1] who provide empirical evidence using a cross country analysis that institutional quality matters in determining international capital flows.

Figure 2 presents individual population age share coefficients combined with their interactions with INSTITUTION for the corresponding saving, investment and current account regressions. In order to retrieve these coefficients, I add to the estimated coefficients of the individual effects of change in population age shares, the estimated coefficients of the interaction between population age shares and INSTITUTION evaluated at two different levels of institutional quality.[6] The solid line and dashed line displayed in Figure 2 correspond to those retrieved coefficients evaluated respectively at a high and low level of institutional quality. Those coefficients associated with population age structure are not behavioral coefficients. They are best interpreted as a resulting impact of a change in population age structure on national saving, domestic investment and the current account.

The results provide empirical evidence of a differentiated effect in the relationship between age structure and international capital flows. Indeed, F-tests of joint significance both for investment and current account regressions, shown in Figure 2, point to a significant interactive effect between age structure and institutional quality.[7] The corresponding plot of coefficients associated with population age shares shows that in presence of high institutional quality, the distribution of the effect of change in population age structure on the current account position displays an inverted U shape. In contrast, when institutional quality is low, the distribution of the effect of population age structure is rather flat, implying a looser effect of change in population age structure on the current account.

When institutional quality is high, the distribution of the effect of population age structure on saving and investment appears to be decoupled. This result opens the scope for age structure to play a role in determining international borrowing and lending. In

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[5]The coefficient associated with the institutional quality index is significant at the ten per cent level in the current account regression.

[6]The high level of institutional quality corresponds to the high income OECD countries' mean over the sample period. The low level of institutional quality corresponds to the low income countries' mean.

[7]F-tests associated with age structure and its interaction with institutional quality on the current account balance indicate significance at the ten per cent level for both the individual effect of age structure and its interaction.

Age Structure and Institutional Quality

National Saving

GROWTH	0.199***
	(4.49)
CREDIT	-0.020
	(1.22)
RESTRICTION	3.373***
	(4.12)
INSTITUTION	0.078
	(0.40)
Demographic Effect	1.22
Interactive Effect	0.04
Joint Effects	4.96***
Countries	101
Observations	1340
R-squared	0.74

Investment

GROWTH	0.177***
	(4.67)
CREDIT	0.017
	(1.57)
RESTRICTION	0.322
	(0.50)
INSTITUTION	0.482***
	(3.24)
Demographic Effect	10.24***
Interactive Effect	7.01***
Joint Effects	6.12***
Countries	101
Observations	1340
R-squared	0.67

Current Account Balance

GROWTH	0.021
	(0.38)
CREDIT	-0.036*
	(1.80)
RESTRICTION	3.051***
	(3.31)
INSTITUTION	-0.404*
	(1.73)
Demographic Effect	2.12*
Interactive Effect	2.06*
Joint Effects	1.91*
Countries	101
Observations	1340
R-squared	0.60

The lines show the direct and combined effect associated with the labeled level of institutional quality.
Fixed effects and time effects are also included in the above specification but their estimations are not shown.
Robust absolute t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 2: Interactive Effect of Age Structure and Institutional Quality on Saving, Investment and CAB

contrast, when institutional quality is low, the effect of population age structure on saving and investment is synchronized along age distribution leading to a looser effect of change in population age structure on the current account. Indeed, the corresponding plot of the effect of age structure on saving shows that the effect of age structure on saving is similar for low and high levels of institutional quality. However, for investment the "mass" of the distribution of the effect of change in population age structure appear to occur earlier in age in presence of high institutional quality than in the case of low institutional quality. Indeed, when institutional quality is high the impact of a change in population age structure on investment is concentrated around 15 to 40 years old, whereas the effect is concentrated around 40 to 70 years old when institutional quality is low. Indeed, countries experiencing poor institutional quality rely heavily on national saving to finance their domestic investment, as the presence of sovereign risk prevents them access to external sources of financing, such as foreign investment which takes advantage of a cheaper labor force in these younger countries.

In presence of good institutions, a higher 40-65 share leads to an improvement in the current account position. In this context, an increase in the younger age population share (up to 40) leads to a current account deterioration, whereas an increased elderly share population (above 70) leads to a current account deterioration. Those results contribute to the literature on capital flows to developing and emerging markets by shedding light on the specific channels through which demographic changes interact with capital market imperfections to explain the magnitude and the distribution of capital flows from countries with relatively older population to countries with younger population. Little empirical and theoretical works have been conducted on the importance of such interactions in explaining international capital flows. Indeed, the existing literature has focused separately on the individual role of capital market imperfections or of demographic changes in explaining international capital flows. One noticeable exception is Arezki [2] who underlines the existence of differentiated effects of changes in age structure on international capital flows. Indeed, the author finds that demographic shocks are transmitted internationally depending on the degree of existing capital market imperfections. If the capital market imperfection is not too large, capital first flows into the country with a younger population in order to exploit the difference in returns on capital. After the shock has occurred, capital is repatriated in order to finance old age consumption of the country with a older population. The empirical findings presented in this paper are in line with Arezki's [2] theoretical predictions.

These results also suggest that the bulk of the effect of age structure on saving occurs rather late in age, reaching a peak around 50. Furthermore, the elderly population age share tends to have a negative impact on national saving rather late in the age distribution starting, around 65. The distribution of the effect of age structure on saving appears to be skewed to the right, compared to what the life-cycle hypothesis would predict.

On the role of the interaction between age structure and domestic liquidity constraints in explaining international capital flows

Individually, credit availability has a negative impact on the saving rate, as shown in Figure 3. This result is in line with Japelli and Pagano [12] who provide empirical evidence that financial deregulation could help explain the decline in saving observed during the 1980s in OECD countries. Theoretically, credit availability favors the efficiency of the intermediation sector, that may trigger more investment. However, the coefficient associated with credit availability in the investment regression is positive but not significant.

As a result, increased credit availability favors significantly a deterioration of the current account position. The latter result is driven by the effect of increased credit availability on saving.

The presence of restrictions increases saving and improves the current account position. Restrictions, through their signalling effect, act as a liquidity constraint that prevents countries from borrowing, in turn increasing domestic saving and deterring foreign investment. However, this result does not appear to be robust over various specifications, as shown for instance in Figures 2 and 3.

Figure 3 presents individual population age share coefficients combined with their interactions with CREDIT retrieved from the corresponding regression on saving, investment and current account. The solid line and dashed line displayed in Figure 3 correspond to the joint effect of age structure and its interaction with CREDIT evaluated respectively at a high and low level of credit availability.[8] Results provide empirical evidence that lower domestic liquidity constraints magnify the effect of relative change in age structure in shaping international capital flows. Indeed, F-tests of joint significance both for saving and current account regressions in Figure 3 point to a significant interactive effect of credit availability and age structure in explaining saving and current account position. The hump shaped distribution of the population age share coefficients in the saving regression implies that in the presence of a high level of credit availability, the life cycle hypothesis appears to be more at play than in the case of lower credit availability. Indeed, for a high level of credit availability, younger and older population age shares have stronger negative impacts on aggregate saving than is the case with lower credit availability. Moreover, the interaction between age structure and credit availability is of limited relevance in the investment regression when compared to the saving regression. Thus the effect of change in population age structure on the current account position is magnified by a high level of credit availability.
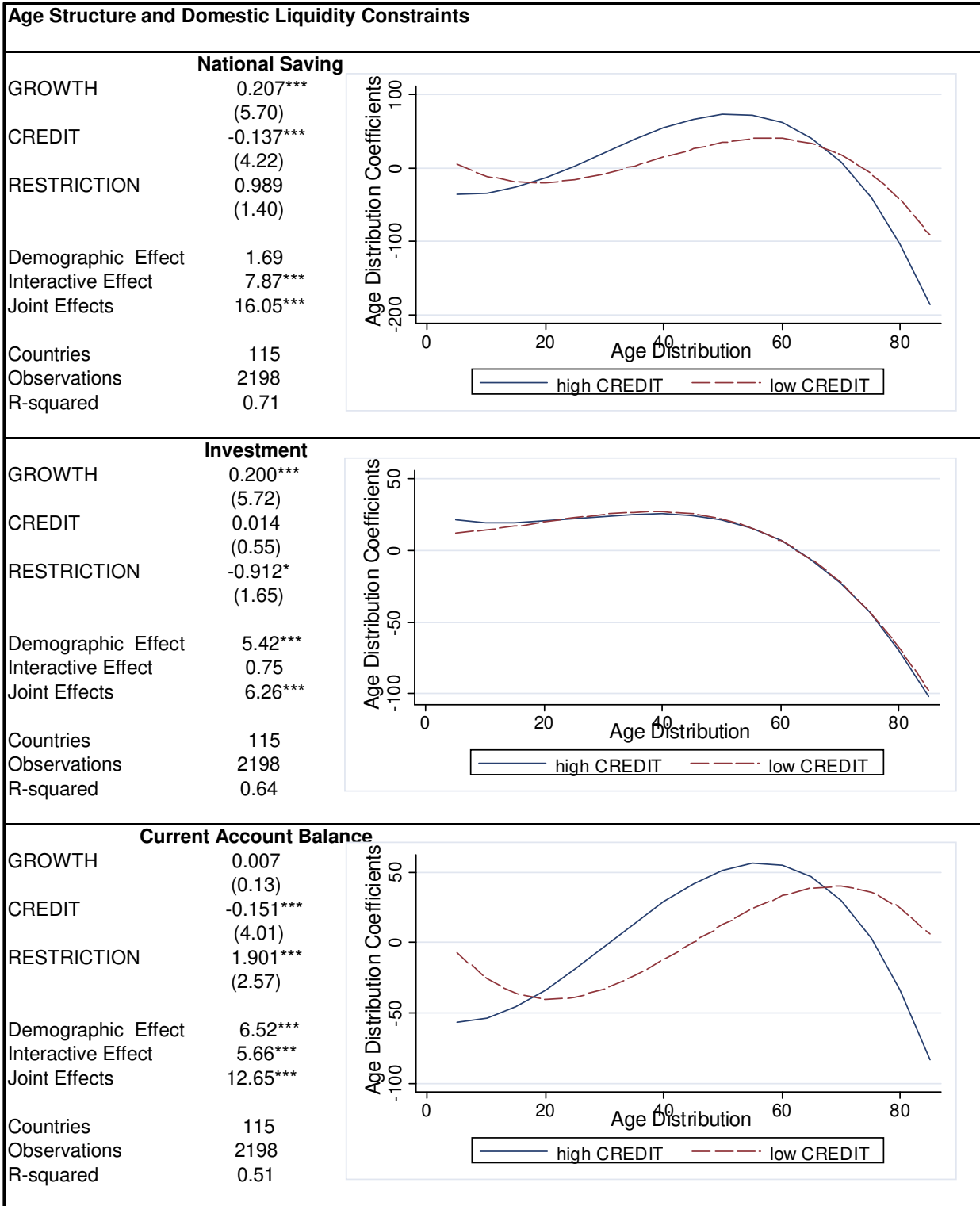
3.3 Robustness Checks

In order to determine whether or not the empirical results presented above are robust, two directions were explored. First, the robustness of the results with respect to the presence of outliers was investigated. The main results are found not to be driven by outliers. Indeed, the combined effect between age structure and its interaction with both institutional quality and credit availability on saving, investment and the current account position remains significant at the one per cent level. Moreover, results obtained after deletion of influential observations lead to an even more pronounced differentiated effect of age structure on the current account position than in the results presented above.

Secondly, the robustness of the above results to various specifications was investigated. Variables included in the above specifications were excluded one by one and combinations of them. The main results are found robust to those modifications. Potential biases resulting from omitted variables such as income level were also explored. The resulting estimates of the combined effect of age structure and its interaction with various capital market imperfections remained significant at the one per cent level. The distribution of age structure coefficients was similar to the above regression results.[9] The existence of

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[8] The high level of credit availability corresponds to high income OECD countries mean over the sample period. The low level of credit availability corresponds to the low income countries mean.

[9] However, the size of the coefficients associated with age structure appeared to be lower in absolute value when compared to the previous estimation results.

Age Structure and Domestic Liquidity Constraints

National Saving

GROWTH	0.207***	
	(5.70)	
CREDIT	-0.137***	
	(4.22)	
RESTRICTION	0.989	
	(1.40)	
Demographic Effect	1.69	
Interactive Effect	7.87***	
Joint Effects	16.05***	
Countries	115	
Observations	2198	
R-squared	0.71	

Investment

GROWTH	0.200***	
	(5.72)	
CREDIT	0.014	
	(0.55)	
RESTRICTION	-0.912*	
	(1.65)	
Demographic Effect	5.42***	
Interactive Effect	0.75	
Joint Effects	6.26***	
Countries	115	
Observations	2198	
R-squared	0.64	

Current Account Balance

GROWTH	0.007	
	(0.13)	
CREDIT	-0.151***	
	(4.01)	
RESTRICTION	1.901***	
	(2.57)	
Demographic Effect	6.52***	
Interactive Effect	5.66***	
Joint Effects	12.65***	
Countries	115	
Observations	2198	
R-squared	0.51	

The lines show the direct and combined effect associated with the labeled level of credit availability.
Fixed effects and time effects are also included in the above specification but their estimations are not shown.
Robust absolute t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 3: Interactive Effect between Age Structure and Domestic Liquidity Constraints on Saving, Investment and CAB

a differentiated effect in the relationship between age structure and international capital flows is a robust result.

3.4 Endogeneity Issues

So far there has been no discussion of endogeneity issues. One concern about the above regressions is that they are plagued with simultaneity bias. Indeed, the direction of causality between income growth/availability of credit/institutional quality and the various dependent variables, namely saving and investment rates, is not necessarily clear-cut. Unfortunately, both data unavailability for the popular instruments used in the literature and their lack of time series dimension, prevent the use of those instruments in the present study. Lagged values were used as instruments for credit availability/institutional quality.[10] The estimated coefficients associated with age structure and with its interactive terms in all the various regressions using 2SLS are virtually not affected, compared to those obtained in the above subsection.

4 Past, Present and Projected Consequences of Global Demographic Changes

The past, present and projected impacts of the global aging phenomenon on international capital flows were evaluated. To do so, countries' past and projected population age structure information was exploited together with previously estimated coefficients of the effect of population age structure, and its interaction with capital market imperfections on the current account position.[11] Demography is expected to play an important role in shaping future world economic developments, future international capital flows being one important aspect of those developments. Homogenous demographic regions are thus considered when investigating the consequences of aging on international borrowing and lending.[12]

As seen previously, there is evidence of a differentiated effect in the relationship between age structure and international capital flows. As a benchmark case, a medium scenario of capital market imperfections is chosen to quantify the overall effect of age structure on saving, investment and international capital flows. The medium scenario of capital market imperfections corresponds to a scenario where all group of countries are assumed to face the same quality of institutional arrangements after 2000 that of their averages over the period 1970-2000. The levels of the effect of age structure change on current account are of limited interest, as they are arithmetic averages of age structure effects on country cluster members. Changes in the levels of age structure effect are the relevant features to be analyzed. The age structure impact in terms of change relative to the period 1970 to 1975 are therefore presented. It should also be noted that our out of sample projection exercise is *ceteris paribus* by nature. Indeed, given the present focus of the paper, no attempt is made to forecast the individual evolution of non-demographic

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[10]Using lagged values as instruments could be problematic if credit availability/institutional quality shocks are persistent and instruments are insufficiently lagged.

[11]United Nations [18] median scenario projection covering population age distribution from 2000 to 2050 was used.

[12]Four countries groups on the strict basis of population age structure differences was constructed in an attempt to match the four stages of the demographic transition model described in Figure 1. A cluster analysis was performed to design those groups using population age distribution in the year 2000 as a criteria. Figure A.1 in Appendix A.1 presents the country composition of the different clusters.
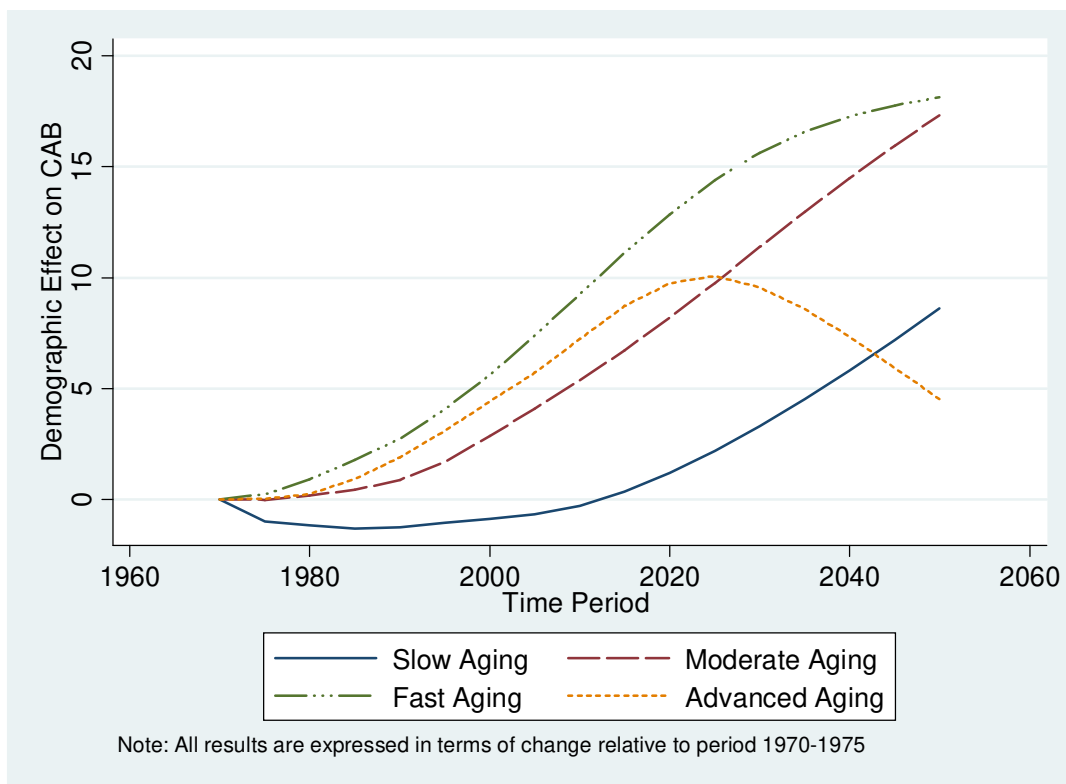
Figure 4: Past, Present and Projected Impact of Age Structure on CAB

variables such as INSTITUTION, CREDIT, GROWTH and RESTRICTION, that are however relevant in determining the future changes in the current account position. As shown in Figure 4, age structure change is projected to improve the current account position in advanced aging countries up to the year 2020. That improvement in current account in advanced aging countries is driven by the decline in investment in a context of strong institutions, as shown in Figure 2. Over the past three decades, age structure changes are estimated to have contributed to improve the current account position by five percent of GDP in more advanced aging countries. After 2020, age structure changes are projected to deteriorate the current account position for advanced aging countries as these changes will start to put downward pressure on saving. Age structure changes are also projected to put downward pressure on investment for less advanced countries in the demographic transition, but in a delayed fashion with respect to the more advanced countries, the delay is shorter, the more advanced the country is in the demographic transition process. As a result, age structure changes are projected to also improve less advanced countries current account position in the future (see Figure 4) as those countries are also aging rapidly.

A different scenario of capital market imperfections is now presented whereby all groups of countries would have the same quality of institutions as the most advanced aging countries that roughly corresponds to OECD countries. Figure 5 present the age structure impact in terms of change relative to the period 1970 to 1975 under that scenario. More advanced countries in the demographic transition are virtually unchanged compared to the above scenario, However, that scenario leads to a more pronounced ef-
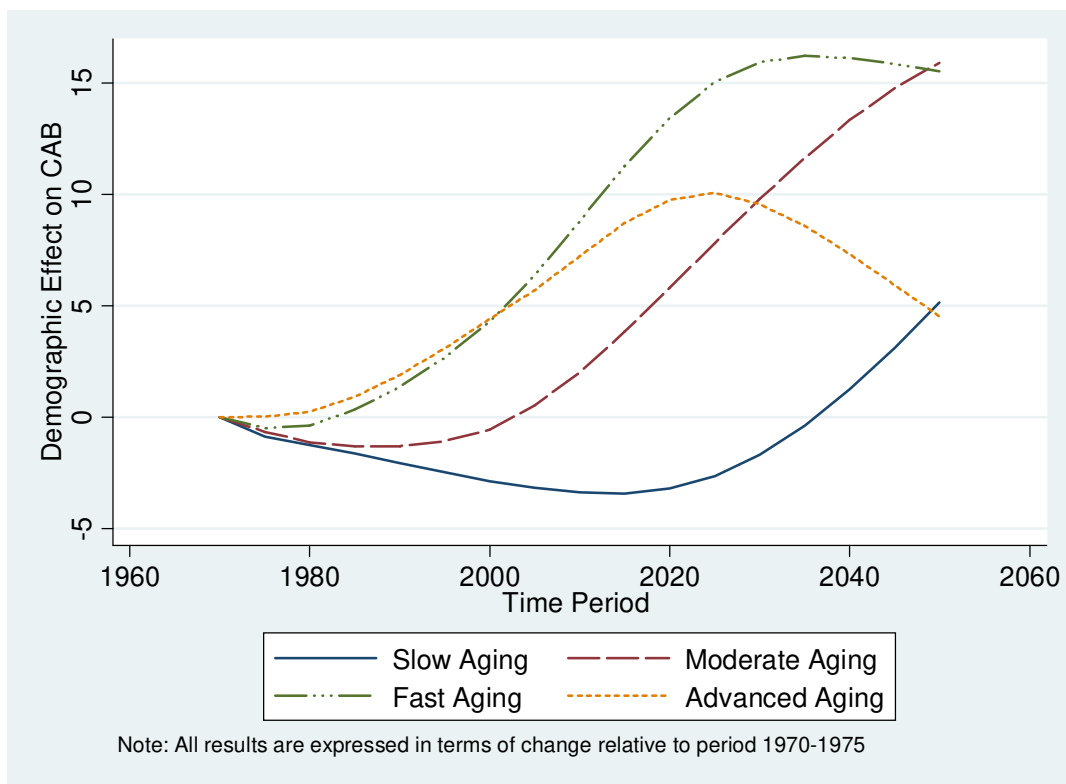
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Figure 5: Past, Present and Projected Impact of Age Structure on CAB under a Different Scenario

fect of age structure on the current account of countries that are less advanced in the demographic transition. Indeed, Figure 5 show that moderate and slow aging groups experience a longer period during which their current account deteriorate compared to the case where there existed important difference in institutional quality as displayed in Figure 4. The reason why countries that are less advanced in the aging process will experience such deterioration is that investment will not be constrained by domestic saving during the period they have a relatively younger population that the other groups that are more advanced in the demographic transition. Our results suggest that in order to take advantage of their younger population in the form of increased foreign capital inflows, countries that are less advanced in the demographic transition would need to improve the quality of their institutional arrangements before the "window of opportunity" closes.

This prediction of a global improvement in current account balance is impossible as changes in current account position should theoretically cancel out. Indeed, our statistical exercise suffers from the caveat that it does not allow for adjustments through prices. For instance, the general equilibrium effect of aging on world interest rate will limit the amount of international capital flows triggered by age structure differences. In this respect, these results are certainly overestimating the impact of age structure changes on international capital flows. However, these results are delivering important insights both on the direction and the importance of the international capital flow induced by age structure differences. Indeed, these results point to the substantial role of age structure in shaping international capital flows from currently more advanced to less advanced countries in

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the demographic transition, both in the past and in the coming decades. Everything else being equal, these results open the scope for a future reversal in the direction of international capital flows around the year 2020, from currently less advanced/poor to more advanced/rich countries. Also, our results suggest that in order to take advantage of their younger population in the form of increased foreign capital inflows, countries that are less advanced in the demographic transition would need to improve the quality of their institutional arrangements before the "window of opportunity" closes.

5   Conclusion

Our objective in this paper has been to empirically investigate the consequences of changes in age structure and its interaction with capital market imperfections in explaining international capital movements. Using a sample of up to 115 countries for the period 1970 to 2000, a systematic empirical analysis of the role of age structure and its interaction with capital market imperfections was undertaken.

Our results point to the existence of a differentiated effect in the relationship between age structure and international capital flows, thus validating Arezki's [2] main theoretical predictions. Good institutions allow for a differentiated impact of age structure on saving and investment, opening the scope for an impact of demography in driving international capital flows. In contrast, bad institutions result in no effect of age structure on international capital flows. Despite increased credit availability contributing to reduced aggregate saving, this will nevertheless magnify the role of the population age structure in driving international capital flows.

Over the past three decades, age structure changes are estimated to have contributed to improving the current account position by five percent of GDP in more advanced aging countries. Around the year 2020, age structure changes are projected to deteriorate the current account position in the latter countries. In other regions, the faster the aging process, the sharper the expected improvement in the current account position. This improvement is expected to reverse itself, at a later stage in time in regions with a slower aging process. Also, our results suggest that in order to take advantage of their younger population in the form of increased foreign capital inflows, countries that are less advanced in the demographic transition would need to improve the quality of their institutional arrangements before the "window of opportunity" closes.

This work suffers from several caveats. However, it is important to mention that these results may overestimate the effect of age structure on capital flows as the feedback effect of demographic change on the world interest rates was not taken account. Moreover, demography should be accounted in labor efficiency units that will considerably scale down the age structure differences and explain the potential lack of flow in certain regions, as discussed in Lucas [13]. In addition, the adjustment could also take place through migration, which could lead to overestimation of the future capital flows induced by projected age structure relative differences.

Although this work demonstrates the importance of age structure and its interaction with capital market imperfections in shaping international capital flows, it is silent on broader questions such as welfare effects of such an induced increase in world financial integration. These issues have been studied in the literature but not in a context of changing age structure. For instance Gourinchas and Jeanne [9] argue that standard theoretical arguments tell us that countries with relatively little capital benefit from financial inte-

gration as foreign capital flows in and speeds up the process of convergence. In contrast, they show in a calibrated neoclassical model that conventionally measured welfare gains from this type of convergence appear relatively limited for the typical emerging country. They argue that the gain from financial integration are negligible relative to the potential welfare gain of a take-off in domestic productivity of the magnitude observed in some of these countries. A stimulating area for future research can consist in investigating the welfare consequences of such financial integration for different cohorts in an overlapping-generations open economy framework. Indeed, different cohorts may benefit differently from financial integration especially in a context of changing population age structure.

A Appendix

A.1 Cluster Membership

Cluster 1: "Fertility Trapped" Countries

Angola	Kenya	Sierra Leone
Benin	Malawi	Tanzania
Burkina Faso	Mali	Togo
Burundi	Mauritania	Uganda
Chad	Mozambique	Zambia
Ethiopia	Niger	Zimbabwe
Ghana	Nigeria	
Guatemala	Rwanda	
Guinea	Senegal	

Cluster 2: "Slow Aging" Countries

Algeria	Egypt	Mexico	Philippines
Bangladesh	El Salvador	Mongolia	Saudi Arabia
Bolivia	Honduras	Morocco	South Africa
Cameroon	India	Nepal	Sudan
Central African Rep.	Iran, I.R. of	Nicaragua	Syrian Arab Republic
Colombia	Jordan	Pakistan	Turkmenistan
Côte d'Ivoire	Kyrgyz Republic	Papua New Guinea	Venezuela, Rep. Bol.
Dominican Republic	Lao People's Dem.Rep	Paraguay	Vietnam
Ecuador	Malaysia	Peru	

Cluster 3: "Fast Aging" Countries

Albania	Ireland	New Zealand
Argentina	Israel	Panama
Armenia	Jamaica	Singapore
Azerbaijan	Kazakhstan	Sri Lanka
Brazil	Korea	Thailand
Chile	Kuwait	Tunisia
China,P.R.: Mainland	Lebanon	Turkey
Costa Rica	Macedonia, FYR	Uruguay
Indonesia	Moldova	

Cluster 4: "Advanced Aging" Countries

Australia	Finland	Norway	Ukraine
Austria	France	Poland	United Kingdom
Belarus	Germany	Portugal	United States
Belgium	Greece	Romania	
Bulgaria	Hungary	Russia	
Canada	Italy	Slovak Republic	
Croatia	Japan	Spain	
Czech Republic	Latvia	Sweden	
Denmark	Netherlands	Switzerland	

Cluster Membership

A.2 Data Source

The basic data set draws from World Bank, World Development Indicators [19] (WDI2K4), from International Monetary Fund, Annual Report on Exchange Rate Arrangements and Exchange Restrictions [11], from The Political Risk Services Group, International Country Risk Guide [15], from United Nations, World Population Prospects: The 2002 Revision [18] (U.N.). It covers the period 1970 to 2003 for up to 173 countries. RESTRICTION is the mean of all the 4 dummies variables from International Monetary Fund, Annual Report on Exchange Rate Arrangements and Exchange Restrictions [11]. Those individual dummies variables take the value 1 in the presence of the corresponding restrictions or 0 otherwise.

A.3 Population Age Structure Coefficients Polynomial Representation

This appendix illustrates the polynomial representation used in the estimations to identify population age structure coefficients. For simplicity, the dependent variable y_t is assumed to follow the following the data generating process:

$$y_t = \delta_1 p_{1,t} + ... + \delta_J p_{J,t} + \alpha + u_t \tag{1}$$

$p_{1,t}, ..., p_{J,t}$ represent J population age shares; α is a constant term and u_t is an iid perturbation.

In order to avoid the regression being plagued by multicollinearity, a polynomial representation of population age share coefficients following Fair and Dominguez [8] is used. The following two assumptions are made. First, the sum of all individual coefficients associated with the J population age shares are assumed to be equal to zero, in order to avoid multicollinearity with the constant as expressed formally in equation (2a). Second, each of the individual coefficients are assumed to have a cubic polynomial representation as formally expressed in equation (2b):

$$\sum_{j}^{J} \delta_j = 0 \tag{2a}$$

$$\delta_j = \gamma_0 + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 \qquad \forall j = 1, ..., J \tag{2b}$$

Combining equations (2a) and (2b) with equation (1) leads to expression (3).

$$y_t = \gamma_1 (\sum_{j}^{J} p_{j,t} - \frac{1}{J}\sum_{j}^{J} j) + \gamma_2 (\sum_{j}^{J} j^2 p_{j,t} - \frac{1}{J}\sum_{j}^{J} j^2) + \gamma_3 (\sum_{j}^{J} j^3 p_{j,t} - \frac{1}{J}\sum_{j}^{J} j^3) + \alpha + u_t \tag{3}$$

This expression can be rewritten as expression (4) using the corresponding D_j which are geometric combination of $p_{j,t}$.

$$y_t = \gamma_1 D_{1,t} + \gamma_2 D_{2,t} + \gamma_3 D_{3,t} + \alpha + u_t \tag{4}$$

γ_1, γ_2, γ_3 are directly obtained from the estimation of equation (4).

γ_0 can be easily retrieved using expression (5) obtained from the combination of expressions (2a) and (2b).

$$\gamma_0 = -\frac{1}{J}(\gamma_1 \sum_{j}^{J} j + \gamma_2 \sum_{j}^{J} j^2 + \gamma_3 \sum_{j}^{J} j^3) \tag{5}$$

Given the sequence of γ_j, the value of the coefficients associated with the $p_{j,t}$, namely the δ_j can easily be retrieved.

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