Demographics and the current account

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This paper investigates the relationship between demographics and the current account. We analyze the impact of recent demographic changes and provide a forecast of its future impact. Overall, we find a strong and robust, non-linear demographic effect. In particular, we find a positive association between the current account and the share of a population's prime-age individuals and a negative association with the share of the elderly. Our forecast suggests that, given the dramatically aging population in most industrialized countries, demographics will likely decrease the current account balance in the near future in those countries.

JEL codes: F11, F32, F41
Key words: demography, aging, current account, savings

1 Introduction

The world is undergoing a major demographic transition. After the baby boom of the post-World War II period, fertility rates declined sharply in the late 1960s and have since remained at low levels in many countries. At the same time, life expectancy has been continuously increasing. The consequence of these trends is a dramatically changing age distribution: the share of young people is decreasing, while the share of the elderly is rapidly increasing.

Figure 1 shows the evolution of the number of young, middle-aged and elderly individuals since 1960 for OECD countries. On average, these countries have recorded a tripling in the number of elderly people to date while the number of people aged 15-64 has grown much more slowly and the youngest cohort has stagnated. According to the United Nations' "medium scenario",[2] this trend is projected to exacerbate in the future, with the share of those aged 65+ sharply increasing.

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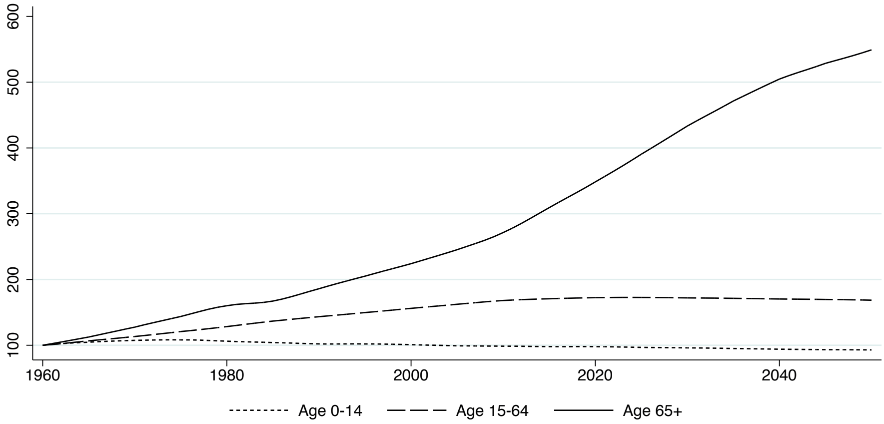
2 The medium scenario assumes that the fertility rate will stabilize at the replacement level. The replacement level fertility is defined as the fertility rate at which the domestic population exactly replaces itself from a generation to another. In industrialized countries, the replacement level fertility is around 2.1 births per woman.

Figure 1: Past and forecast population levels by age group in the OECD



Note: 1960 = 100.
Source: UN, own calculations.

In this paper, we examine the consequences of this demographic shift for the current account. Two broad approaches to modelling the current account exist. First, the elasticity approach views the current account as the sum of net exports and net investment income. It focuses on short-term factors, in which trade flows respond to exchange rates and aggregate demand (GOLDSTEIN and KHAN, 1985; MARQUEZ, 2002). Second, the absorption approach views the current account as the difference between national saving and investment. The latter approach focuses on medium-term factors such as policy stances and demographics (CHINN and PRASAD, 2003; GRUBER and KAMIN, 2007) and, given our focus on the latter, is also the approach we adopt.

Although demographics are a common current account determinant in the literature, it has proven difficult to find an empirical measure that adequately captures the entire age distribution. Most studies use the age dependency ratio, which relates the share of a population's dependents to its work force. These studies distinguish either between the old and young dependency ratio (e.g., CHINN and PRASAD, 2003; GRUBER and KAMIN, 2007; BOSWORTH and CHODOROW-REICH, 2007; CHINN and ITO, 2008a; GAGNON, 2011), the domestic and foreign dependency ratio (e.g., HUNG and GAMBER, 2010), or the current and future dependency ratio (e.g., JAUMOTTE and SODSRIWIBOON, 2010). Moreover, some studies include the fertility rate (BRISSIMIS et al., 2010) or the population growth rate (JAUMOTTE and SODSRIWIBOON, 2010) as demographic measures. Others develop theoretical models and calibrate them using a population's age composition (e.g., HENRIKSEN, 2002; DOMEIJ and FLODÉN, 2006). However, the quantitative impact of these measures is sensitive to the model specification and the sample at hand.

Fair and Dominguez (1991) introduce a more robust measure. They propose using a polynomial combination of different age groups, thereby taking into account the entire age distribution. Their polynomial approach has the advantage of minimizing the number of parameters to be estimated, yet allowing for the identification of the cohort-specific impact. In this paper, we adopt this more robust measure and construct a third-degree polynomial structure that allows accounting for non-linear age effects.

To assess the impact of demographics on the current account, we extend the analysis of Higgins (1998). We first perform year- and country-fixed effects regressions, regressing the current account balance on the demographic polynomial alongside a number of controls. In a second step, we use the estimated coefficients and construct out-of-sample predictions. For the analysis, we use a panel of 49 countries over the period from 1970 to 2016. To forecast the future impact of demographics, we use the medium fertility version of the United Nations population forecast until 2050.

We find that the age coefficients describe a hump-shaped pattern; they are negative for the very young and become positive at around 30 years of age. They reach a peak at around 54 years, before declining sharply after retirement and turning negative shortly thereafter. Calculating average effects, we find an overall positive association between demographics and the current account in industrialized countries, which is driven by the large share of prime-age workers, i.e., individuals aged between 45 and 64. Conversely, our forecast shows a negative future impact of demographics in those countries, as the share of the elderly will have increased to the extent that it will offset the positive effect of prime-age workers.

The remainder of the paper is structured as follows. Section 2 develops our theoretical background, focusing mainly on the life-cycle hypothesis. Section 3 details the empirical framework. Sections 4 and 5 present empirical results and sensitivity checks. Section 6 concludes.

2 Theoretical background

Following the absorption approach, the current account is defined as the difference between national saving and investment. In an open economy, demographics should affect the current account by influencing saving or investment or both.[3]

Expectations about the effect of demographics on aggregate saving follow from the life-cycle model of Modigliani and Brumberg (1954) and Ando and Modigliani (1963). The life-cycle hypothesis suggests that individuals smooth their consumption and saving behavior over their life-cycle. This assumption implies that during their youth, individuals consume more than their income. The gap is usually financed through borrowing. During their professional lives, individuals accumulate savings. Finally, during their retirement phase, individuals dissave. This simple theory leads to the prediction that individuals exhibit a saving rate that rises with income during their professional life, and declines and turns negative during retirement. Saving rates should thus follow a hump-shaped pattern over the life cycle.

This individual-level prediction implies that a country's aggregate saving rate depends critically on the relative size of different age cohorts within that country's population. In particular, aggregate saving should rise when declining fertility rates reduce the number of young dependents. They should remain high for populations dominated by working adults, and finally decline as an increasing portion of the population becomes old and retires. As a result, the saving rate should be positively related to the prime-age share of the population. This model prediction is consistent with the currently high saving rates in many OECD countries. The demographic projections for these countries, however, point towards considerable future decreases in saving rates due to population aging.

Expectations about the effect of demographics on investment follow from the standard neoclassical model of economic growth. Output growth is determined by the rate of growth in the labor force, labor-augmenting technological change, and increases in capital per worker. While labor-augmenting technological change is considered exogenous, a close relationship exists between the labor force and capital: population aging implies a contraction of the future workforce. A slowing workforce growth or actual labor force contraction will reduce domestic investment opportunities because employers will have less need to provide

3 In a closed economy, we would not expect any effect of demographics on the current account balance, as saving and investment would be forced to move together. However, to the extent that saving and capital are internationally mobile, this relationship decouples. The demographic effect can then drive a wedge between saving and investment. The counterpart of this wedge can be sizable net capital flows.

new equipment and facilities for additional workers. As a result, we expect the investment rate to be positively related with the share of younger individuals in the population and negatively related with the share of the elderly.

The link between demographics, saving, investment, and capital flows has been addressed in a number of studies. FAIR and DOMINGUEZ (1991) investigate effects of a changing US age distribution on various macroeconomic equations. They find that the changing age distribution has significant explanatory power in the consumption, housing-investment, money-demand, and labor-force-participation equations. Focusing on Asian countries between the 1950s and the 1990s, HIGGINS and WILLIAMSON (1997) find that increasing life expectancy and lagging declines in fertility had a significant effect on saving, investment and foreign capital flows. HIGGINS (1998) confirms this finding using a sample of 100 countries between the 1960s and the 1990s. RABAH (2011) presents evidence of a differentiated relationship between the age structure and international capital flows using a sample of 115 countries between 1970 and 2000. Many other studies emphasize the importance of demographic factors in the determination of the current account, without necessarily focusing on this subject matter (e.g., CHINN and PRASAD, 2003; CHINN and ITO, 2008a).

3 Empirical framework

3.1 Measuring demographics

Although the literature on current account determinants generally views demographics as an important explanatory factor, it has proven difficult to find a robust empirical measure that adequately captures the entire age distribution at the country level. A naive approach to measuring demographics would be to include the distribution of the population in year-age brackets. However, this approach raises two main issues. First, it would yield imprecise estimates because of the substantial multicollinearity of the many demographic variables. The finer the division of the total population, the larger the correlation between consecutive age cohorts. Second, the unconstrained coefficient estimates may jump back and forth between close age cohorts in an economically puzzling fashion.

A way of overcoming these estimation problems is suggested by FAIR and DOMINGUEZ (1991) and applied by HIGGINS and WILLIAMSON (1997), HIGGINS (1998) and most recently by SVR (2011), ARNOTT and CHAVES (2012) and JUSELIUS and TAKÀTS (2015). The idea is to limit the differences between the estimated effects of consecutive age cohorts by restricting the population coefficients to lie on a P:th degree polynomial. This approach minimizes the number of estimated parameters and still allows the identification of the demographic effect by accounting for the entire age distribution.

To derive our estimation equation, we start from the naive approach of including all age cohorts. The equation can be defined as follows:

$$y_{i,t} = \alpha_i + \theta_t + a_1 Age1_{i,t} + a_2 Age2_{i,t} + \dots + a_{17} Age17_{i,t} + \delta X_{i,t} + u_{i,t} \qquad (1)$$

where $y_{i,t}$ is the current account balance and $X_{i,t}$ is a vector of controls. α_i is a country fixed-effect, θ_t is a year fixed-effect and the error term $u_{i,t}$ is assumed to be independent and identically distributed with mean 0 and variance σ_u^2. Our main explanatory variables, $Agej_{i,t}$ (with $j = 1, 2, \dots, 17$), are 17 five-year age cohorts going from 0-4 to 80+. Each cohort is expressed as a share of the country's total population. We then follow Fair and Dominguez (1991) and define the age coefficients a as a polynomial combination. Specifically, we define the a coefficients as a cubic function of j

$$a_j = \beta_0 + \beta_1 j + \beta_2 j^2 + \beta_3 j^3 \text{ for } j = 1, 2, \dots, 17 \qquad (2)$$

Substituting equation (2) into equation (1) and rearranging the terms to factor out the β coefficients, we obtain:

$$\begin{aligned} y_{i,t} = \; & \alpha_i + \theta_t + \beta_0(Age1_{i,t} + Age2_{i,t} + \dots + Age17_{i,t}) \\ & + \beta_1(Age1_{i,t}1^1 + Age2_{i,t}2^1 + \dots + Age17_{i,t}17^1) \\ & + \beta_2(Age1_{i,t}1^2 + Age2_{i,t}2^2 + \dots + Age17_{i,t}17^2) \\ & + \beta_3(Age1_{i,t}1^3 + Age2_{i,t}2^3 + \dots + Age17_{i,t}17^3) \\ & + \delta \mathrm{X}_{i,t} + u_{i,t} \end{aligned} \qquad (3)$$

Defining the age polynomials as $Pp_{i,t} = (Age1_{i,t}1^p + Age2_{i,t}2^p + \dots + Age17_{i,t}17^p)$ for $p = 0, 1, 2, 3$, our initial estimation equation (1) modifies to:

$$y_{i,t} = \alpha_i + \theta_t + \beta_0 P0_{i,t} + \beta_1 P1_{i,t} + \beta_2 P2_{i,t} + \beta_3 P3_{i,t} + \delta \mathrm{X}_{i,t} + u_{i,t} \qquad (4)$$

The definition of $Age_{i,t}$ as the share of cohort j of the country's total population implies $P0_{i,t} = (Age1_{i,t} + Age2_{i,t} + \dots + Age17_{i,t}) = 1$. Since the country fixed effects also sum to a constant, these two items are perfectly correlated. To overcome the perfect collinearity, we further restrict the coefficients, imposing $\sum_{j=1}^{17} a_j = 0$.[4] This additional constraint implies that demographics do not enter our estimation equation if (i) there is no effect of demographics on the current account, or (ii) the population of a country is uniformly distributed across age cohorts.

Furthermore, from the zero-sum constraint in Fair and Dominguez (1991), it follows that:

$$\beta_0 = -\beta_1 \frac{1}{17} \sum_{j=1}^{17} j - \beta_2 \frac{1}{17} \sum_{j=1}^{17} j^2 - \beta_3 \frac{1}{17} \sum_{j=1}^{17} j^3 \tag{5}$$

Inserting equation (5) into equation (3), we then get the following three variables, Zp, which finally enter our estimation equation:

$$\begin{aligned} Z1_{i,t} &= (Age1_{i,t}1 + Age2_{i,t}2 + \cdots + Age17_{i,t}17) - \frac{1}{17} \sum_{j=1}^{17} j \sum_{j=1}^{17} Agej_{i,t} \\ Z2_{i,t} &= (Age1_{i,t}1^2 + Age2_{i,t}2^2 + \cdots + Age17_{i,t}17^2) - \frac{1}{17} \sum_{j=1}^{17} j^2 \sum_{j=1}^{17} Agej_{i,t} \\ Z3_{i,t} &= (Age1_{i,t}1^3 + Age2_{i,t}2^3 + \cdots + Age17_{i,t}17^3) - \frac{1}{17} \sum_{j=1}^{17} j^3 \sum_{j=1}^{17} Agej_{i,t} \end{aligned} \tag{6}$$

3.2 Estimation equation

The model we estimate treats the current account as a function of the population's age distribution alongside a number of control variables. As laid out in the previous subsection, our estimation equation is given by:

$$y_{i,t} = \alpha_i + \theta_t + \beta_1 Z1_{i,t} + \beta_2 Z2_{i,t} + \beta_3 Z3_{i,t} + \beta_3 P3_{i,t} + \delta X_{i,t} + u_{i,t} \tag{7}$$

where $y_{i,t}$ is the current account balance, $Z_{i,t}$ is the demographic vector that is constructed using a third-degree polynomial structure, and $X_{i,t}$ is a vector of controls. As previously laid out, α_i is a country fixed-effect, θ_t is a year fixed-effect and the remaining error term $u_{i,t}$ is assumed to be independent and identically distributed with mean 0 and variance σ_u^2.

To recover the age-group coefficients from the demographic vector $Z_{i,t}$, we have to follow four steps. First, we define $Z1_{i,t}$, $Z2_{i,t}$ and $Z3_{i,t}$ according to equation (6). Second, we estimate equation (7) to obtain the estimated coefficients for the Zs.

4 For a detailed explanation of the restriction see Almon (1965) and Smith and Giles (1976).

Third, we construct $\hat{\beta}_0$ following equation (5). Fourth, we calculate the individual age-group coefficients using equation (2). As a consistency check, one can verify whether the individual age-group coefficients sum up to zero. Note also that the relationship given in equation (2) is linear. It is therefore straightforward to recover the standard errors for the cohort-specific estimates form the covariance matrix associated with the Zs estimates.

For the control variables, we assume a linear relationship with constant marginal effects over the population cohorts such that we can directly interpret them upon running the regression. We follow previous literature for the choice of control variables and control for domestic wealth abroad, the openness of an economy, the financial openness, the GDP growth rate and for the price level of investment as a measure of the productive capacity.

In a final step, we follow the procedure introduced by Higgins (1998) and multiply the estimated Z coefficients, β, with the country-specific Zs. This allows us to identify and isolate the marginal impact of future demographic change on the current account balance for a specific country.

3.3 Descriptive statistics

Our sample includes the 49 countries that are part of the IMF's external balance assessment (EBA). We gather yearly data from 1970 to 2016 from various publicly available sources, including the World Bank, the United Nations and the Penn World Table 9.0 (see Appendix A for an overview of the data sources and descriptions).

Table 1 shows the summary statistics. The current account spans from -17% to 17% of GDP, saving lies between -1% and 52%, and investment between 10% and 46%. Because our current account measure has a mean of almost zero (it is -0.01%), there is no need to additionally weight our current account data to achieve cross-country consistency.

Our demographic polynomials, Demographic 1 to 3 in Table 1, which correspond to $Z1_{i,t}$, $Z2_{i,t}$ and $Z3_{i,t}$, are constructed using UN population data. The dataset provides yearly observations for 17 five-year age groups, spanning from ages 0-4 to 80+. The polynomials are constructed according to equation (6) using all available cohorts. We note that $|Z3| > |Z2| > |Z1|$ because of the cubic structure explained in the subsection 3.1.

Our six control variables are the log ratio of gross national income (GNI) and GDP, used as a proxy for domestic wealth abroad; the log of the sum of exports and imports scaled by GDP to proxy the openness of an economy; and the Chinn and Ito (2006) Index to measure financial openness. Moreover, we include the GDP growth rate in t and $t-1$ to gauge the general economic development. Finally, following Taylor (1994), we also include the price level of investment to control for its possible effects on saving supply or investment demand.

Table 1: Summary statistics of the baseline sample

	Mean	**Min**	**Max**	**Std. dev.**
Current account	-0.01	-0.17	0.17	0.05
Saving	0.23	-0.01	0.52	0.07
Investment	0.23	0.10	0.46	0.05
Demographic 1	-2.02	-4.12	0.60	1.23
Demographic 2	-37.18	-67.63	8.99	19.58
Demographic 3	-597.91	-1013.57	121.86	283.54
Measure of domestic wealth abroad	-0.02	-0.21	0.19	0.04
Openness of the economy	-0.52	-2.28	1.03	0.52
Chinn-Ito index, normalized	0.57	0.00	1.00	0.37
GDP growth rate in t-1	0.09	-0.64	0.84	0.13
GDP growth rate in t	0.08	-0.64	0.84	0.13
Price level of investment	0.55	0.07	1.78	0.27

Note: The number of observations is 1,719.

4 Results

This section shows the empirical links between the national age distribution and the current account. The analysis proceeds along two lines. First, by applying panel-data techniques, we explore how the current account evolves over time in a given country in response to a changing age distribution. We estimate equation (7) with yearly data for the 49 EBA countries between 1970 and 2016. Second, we construct out-of-sample projections based on the previously estimated coefficients for an average-aged country in the sample.

4.1 Panel regressions

Table 2 shows the results of our baseline regression. The demographic polynomials, Demographic 1 to 3, are all statistically significant. We test the joint significance of our three demographic variables by means of an F-test, which strongly rejects the null hypothesis of no joint significance.

Table 2: Baseline estimation results

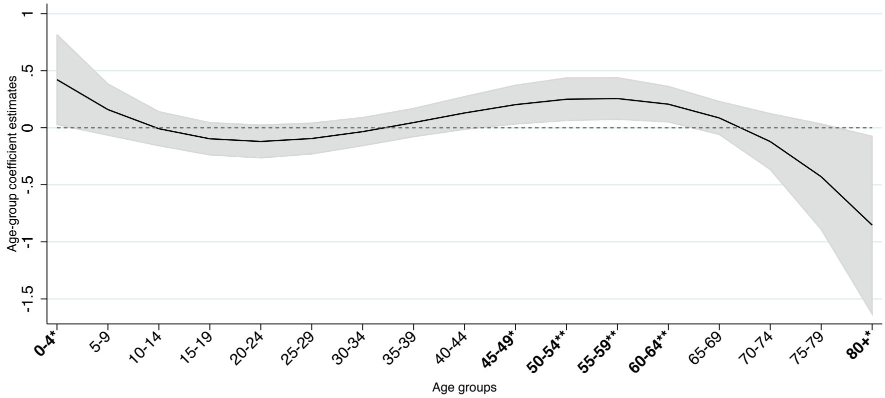
	Currrent account
Demographic 1	-0.432** [0.19]
Demographic 2	0.062** [0.03]
Demographic 3	-0.003** [0.00]
Measure of domestic wealth abroad	0.069 [0.08]
Openness of the economy	0.000 [0.01]
Chinn-Ito index, normalized	-0.009 [0.01]
GDP growth rate in t-1	-0.039*** [0.01]
GDP growth rate in t	0.016
Price level of investment	-0.035** [0.02]
Constant	-0.098 [0.07]
Year and country FE	Yes
Observations	1719
Countries	49
R2	0.190

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in brackets and clustered at the country level. See Appendix A for variable definitions. The value of the F-test is $F(3, 1667) = 39.52$ for column (1), $F(3, 1667) = 86.75$ for column (2) and $F(3, 1667) = 55.87$ for column (3).

Although it is tempting to interpret the sign and the magnitude of the polynomials, this is not straightforward. We first need to deconstruct the *Z*s as described in the previous section to know which age cohorts significantly contribute to our dependent variables.

To engage in a discussion of the demographic factor, we need to look at the implied age-distribution coefficients. Figure 2 shows the age-distribution coefficients with their 90% confidence intervals. The coefficients show the marginal effect of the relative size of an age cohort on the dependent variable. The estimates point to statistically significant and economically powerful demographic effects. The age coefficients describe the "hump" pattern predicted by the life-cycle hypothesis.[5] They are negative for the young and become positive at around 30 years of age. They reach a peak in the mid-50s, decline sharply after retirement, and turn negative shortly thereafter.

Figure 2: Age-group coefficients decomposition of the baseline regression



Note: Taking the βs estimates from equation (7) and generating $\hat{\beta}_0$ following equation (5), we define the 17 age-group coefficients as $\hat{a}_j = \hat{\beta}_0 + \hat{\beta}_1 j + \hat{\beta}_2 j^2 + \hat{\beta}_3 j^3$ for $j = 1, 2, \ldots, 17$. The 90% confidence interval is depicted in grey.

The coefficients are statistically significant for the cohort aged 0-4, those cohorts between 45 and 64, and the cohort aged 80+. The coefficients for the very young (0-4) and the very old (80+), however, have to be interpreted with caution due to the small number of observations.

Note that the negative coefficients for the elderly need not indicate that they are actually drawing down their stocks of assets. Instead, the burden of supporting the elderly might lead to lower saving by younger households. Alternatively, prime-age households with elderly parents might save less in anticipation of bequest receipts. The age coefficients are not behavioral parameters that describe the actions of agents belonging to different age groups, but instead capture the overall impact of individual age cohort sizes on the population's saving behavior.

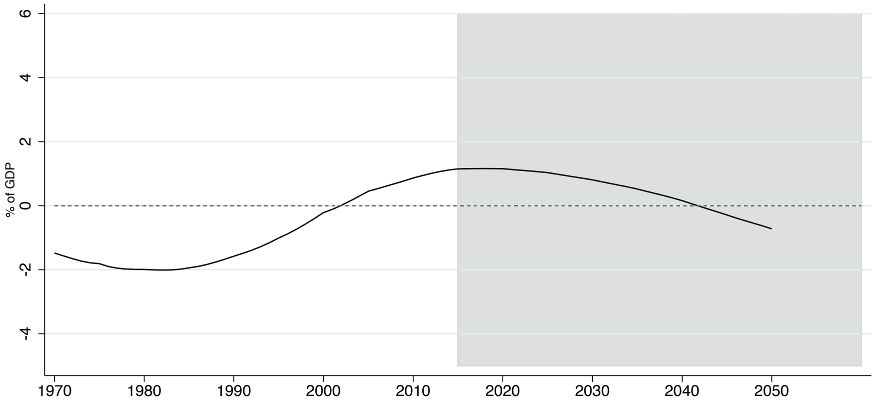
5 The "hump" pattern is also due to the assumption of a third-degree polynomial structure. Had we chosen a second-degree configuration as Fair and Dominguez (1991), we would have obtained a parabolic shape. See Smith and Giles (1976) for the different polynomial structures and the resulting shape of the coefficients' diagram.

Our results are in line with previous findings, notably by Higgins and Williamson (1997), Higgins (1998), Fair and Dominguez (1991) and SVR (2011) and Arnott and Chaves (2012). However, note that the coefficients of the demographic variables capture how national saving and investment rates evolve in response to a changing national age distribution. Yet, the estimates are also influenced by changes in the world age distribution that take place during the sample period. The effects of a given change in a country's own age distribution on its current account balance might be different when it occurs against the backdrop of a world population which is growing steadily older rather than steadily younger.

4.2 Forecast

Combining the demographic coefficients with the population forecast allows us to identify the marginal impact of demographic change on the current account. We simply multiply the estimated *Z* coefficients with the country-specific *Z*s.[6] The caveat of this analysis is that these out-of-sample projections are *ceteris paribus* analyses and can neither capture global demographic change nor any change in the control variables. The cross-country consistency cannot be guaranteed.

Figure 3: Demographic factor projection for an average-age country



Note: The demographic impact on the CA balance is calculated as $\hat{\beta}_1 Z1 + \hat{\beta}_2 Z2 + \hat{\beta}_3 Z3$. We use UN data, which provide forecasts of the population trends for several countries from 2017 to 2050.

6 Please note that we take the estimates of the previous regression without time fixed effects.

Figure 3 depicts the forecast for a country with the typical median age in our sample.[7] Figure 3 shows that this average-age country had a negative contribution of the demographic factor to the current account of about -2% of GDP from the 1970s until the 1990s. The negative contribution started to decrease in the 1990s and was around zero in 2000. Demographics have since positively contributed to the current account and is currently estimated to have reached the peak of its contribution, at around 1.5% of GDP. We forecast that the contribution of the demographic factor is likely to decrease to 0% by the beginning of 2040 and then turn negative again.

In the Appendix, we show the demographic factor projections for additional countries that might be of interest. For example, for Guatemala, the country with the youngest population in our sample, we observe that demographics have a strong negative effect on the current account. Currently, the impact is estimated at -4% of GDP. As the Guatemalan population is expected to age over time, our *ceteris paribus* forecast projects that the negative impact of demographics on the current account will steadily decrease over the coming decades and turn slightly positive by the year 2050. In contrast, for Japan, the country with the oldest population in our sample, we observe that the demographic influence on the current account reached its peak around 20 years ago. The impact of demographics on the current account was positive and increasing from the mid 1970s until 2000 and has been decreasing since. According to our forecast, Japan will switch from a positive to a negative contribution of the demographic factor at the end of the 2020s.

5 Sensitivity checks

This section presents a series of robustness checks of our main findings. First, as the current account is defined as the difference between saving and investment, we re-run our main regression and replace the dependent variable, the current account balance, with its respective components, saving and investment. Second, we replace our demographic polynomials with age-group cohorts to investigate the robustness of our demographics measure. Third, we investigate subsamples, differentiating between advanced and emerging market economies as well as between countries with young and old populations. Finally, we consider alternative control variables, following a recent contribution by Gagnon (2017).

7 In the Appendix, we show the demographic factor projections for different countries that might of interest. We include Guatemala, Japan, Switzerland and the United Sates.

5.1 Saving and investment

Following the absorption approach, the current account is defined as the difference between national saving and investment. In an open economy, demographics should affect the current account by influencing saving or investment or both. We therefore re-run our baseline regression replacing our dependent variable with saving and investment. Table 3 shows the regression results and Figure 4 the age coefficients.

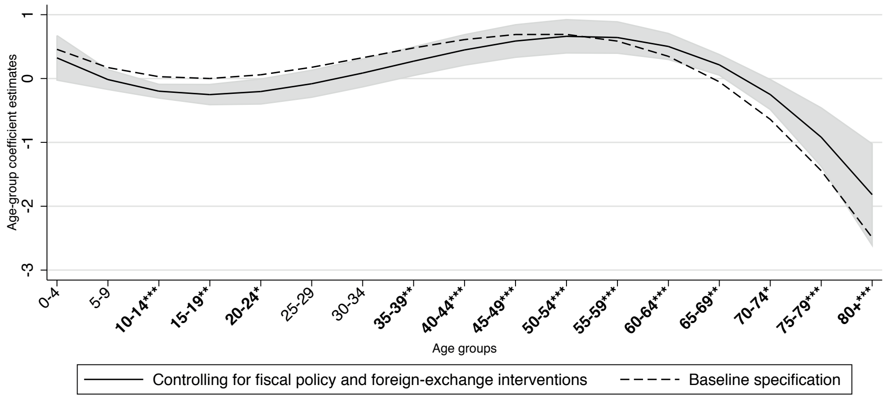
Table 3: Results for saving and investment

	(1) Saving	(2) Investment
Demographic 1	-0.549** [0.27]	-0.005 [0.20]
Demographic 2	0.099** [0.04]	0.021 [0.03]
Demographic 3	-0.005*** [0.00]	-0.001 [0.00]
Measure of domestic wealth abroad	0.878*** [0.14]	0.181 [0.12]
Openness of the economy	0.076*** [0.02]	0.061*** [0.01]
Chinn-Ito index, normalized	-0.011 [0.01]	0.007 [0.01]
GDP growth rate in t-1	0.016 [0.01]	0.055*** [0.01]
GDP growth rate in t	0.072*** [0.01]	0.031*** [0.01]
Price level of investment	0.014 [0.02]	0.060*** [0.02]
Constant	0.092 [0.07]	0.189*** [0.05]
Year and country FE	Yes	Yes
Observations	1719	1719
Countries	49	49
R2	0.425	0.308

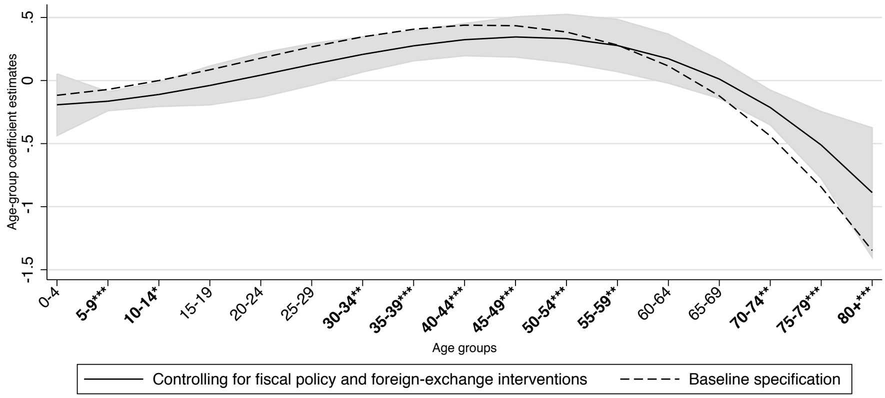
Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in brackets and clustered at the country level. See Appendix A for variable definitions. The value of the F-test is $F(3, 1667) = 39.52$ for column (1), $F(3, 1667) = 86.75$ for column (2) and $F(3, 1667) = 55.87$ for column (3).

Figure 4: Age-group coefficients decomposition for saving and investment

(a) Saving



(b) Investment



Note: Taking the βs estimates from equation (7) and generating $\hat{\beta}_0$ following equation (5), we define the 17 age-group coefficients as $\hat{a}_j = \hat{\beta}_0 + \hat{\beta}_1 j + \hat{\beta}_2 j^2 + \hat{\beta}_3 j^3$ for $j = 1, 2, \dots, 17$. The 90% confidence interval for the specification including controls is depicted in grey.

When using saving as the dependent variable, we find the same demographic pattern as for the current account. However, the positive contribution starts earlier, at around age 24. The coefficients are positive and statistically significant from age 30 to around age 69, they turn negative and significant from age 70 onward. For the young, the coefficients are not significant. Therefore, while we find no support for the youth-dependency effect in this specification, we find a strong positive association of saving with prime-age workers and a strong negative association with the elderly.

For investment, the shape of the age group diagram is more parabolic than for saving and the current account. Although the *Z*s' estimates are not significant in the regression, many cohorts show significant estimates after the decomposition. We see in Figure 4 that the age group spanning from 25 to 54 has a significantly positive impact on investment, whereas those older than 69 have a significantly negative impact. We further note that the peak for investment contribution is around 40 and 49 years, while for saving and the current account it is around 55 and 59 years of age. This pattern is in line with the intuition that investment demand should be closely linked to labor force growth.

5.2 Different age categories

To address the question of whether the polynomial is driving our results, we estimate our baseline equation while replacing the $Z_{i,t}$ with dummies for three, five and seven age categories.

Table 4 presents the result for the estimation with three, five and seven age categories in three different columns. In column 1, while the sign of the coefficients is in line with the predictions of the life-cycle hypothesis, the significance completely vanishes for the current account. Similar to the interpretation issues surrounding the use of dependency ratios, it seems that such a coarse distinction of cohorts does not adequately capture the demographic effects. Column 2 shows the result for a finer categorization, where we include five age categories. We can confirm the positive contribution of prime-age cohorts and the negative contribution of older cohorts. Moreover, we find a negative contribution of young cohorts to the current account. A similar pattern emerges upon inclusion of seven instead of five age cohorts. Column 3 shows that the impact of prime-age individuals is clearly positive, while the elderly have a negative impact. For the younger cohort, the evidence is again less clear.

Overall, we can therefore confidently reject the claim that the polynomial is driving our findings.

Table 4: Different age categories

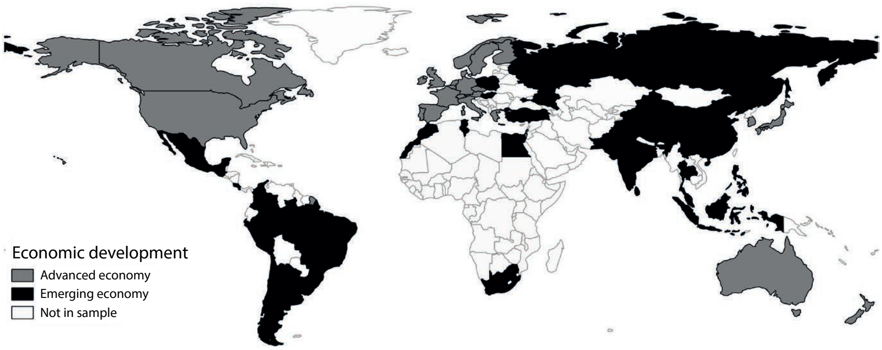
	(1) Three categories	(2) Five categories	(3) Seven categories
Age 0-29	-0.013 [0.05]		
Age 30-64	0.055 [0.08]		
Age 65+	-0.349 [0.35]		
Age 0-19		0.080 [0.07]	
Age 20-34		-0.353*** [0.13]	
Age 35-49		0.102 [0.15]	
Age 50-64		0.364** [0.15]	
Age 65+		-0.522 [0.36]	
Age 0-4			-0.274 [0.25]
Age 5-19			0.210** [0.09]
Age 20-34			-0.375*** [0.11]
Age 35-49			0.118 [0.17]
Age 50-64			0.377** [0.14]
Age 65-79			-0.532 [0.56]
Age 80+			-0.289 [0.65]
Year and country FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	1719	1719	1719
Countries	49	49	49
R2	0.530	0.551	0.554

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in brackets and clustered at the country level. See Appendix A for variable definitions.

5.3 Subsamples

In a further sensitivity check, we look at different subsamples. We investigate two dimensions: the degree of economic development and the median age of the population. This distinction is important because not all old populations are located in advanced economies, and vice versa. First, following the IMF classification, we classify 24 out of 49 countries as advanced economies and 25 as emerging market economies. Figure 5 shows the geographic distribution of this subsample; advanced economies are depicted in grey, while emerging market economies are in black.

Figure 5: Advanced and emerging market economies



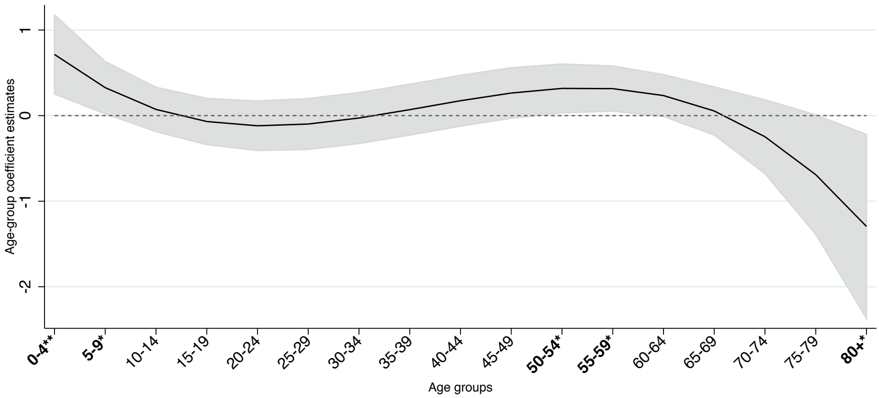
Note: See Appendix A for a detailed sample description.
Source: IMF, own compilation.

Because we cannot make direct inferences about the sign and the magnitude of the estimated polynomial coefficients, we show the decomposition of the age group coefficients in Figure 6. For advanced economies, the estimated coefficients are positively significant only for the cohorts 50 to 59. This result shows that for advanced economies, demographics make a significantly positive contribution to the current account, which is mainly due to the relatively large population share of prime-ager workers.

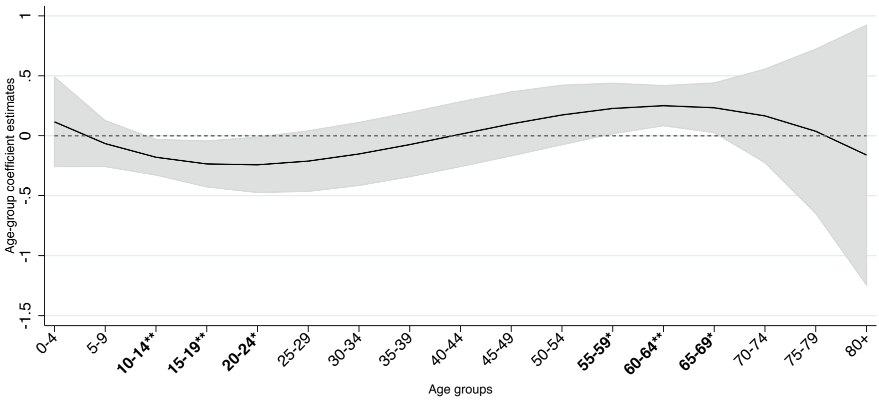
For emerging market economies, the cohorts aged between 55 and 69 have a positively significant effect on the current account, while the cohorts aged between 10 and 24 have a negatively significant impact. Therefore, the overall impact of demographics on the current account is smaller for emerging market economies than for advanced economies, as the negative impact of the young counter-balances the positive impact of the old in emerging market economies.

Figure 6: Age-group coefficients decomposition of advanced economies and emerging market economies

(a) Advanced economies



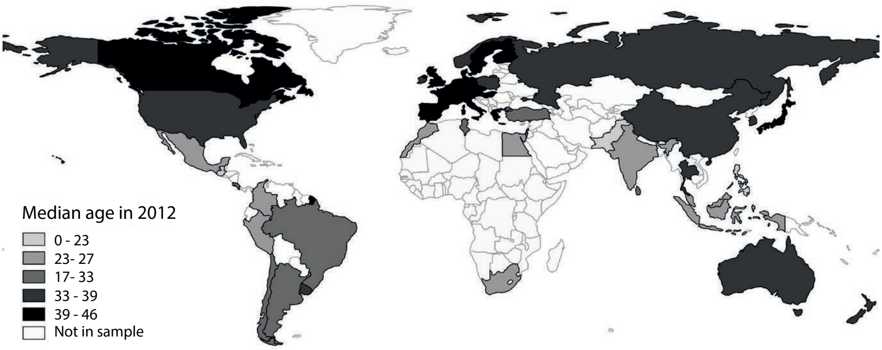
(b) Emerging market economies



Note: Taking the βs estimates from equation (7) and generating $\hat{\beta}_0$ following equation (5), we define the 17 age-group coefficients as $\hat{a}_j = \hat{\beta}_0 + \hat{\beta}_1 j + \hat{\beta}_2 j^2 + \hat{\beta}_3 j^3$ for $j = 1, 2, \ldots, 17$. The 90% confidence interval is depicted in grey.

Figure 7 shows countries categorized by their median age in 2012. As the overall impact of demographics depends on the relative size of a country's age cohort, we distinguish between countries according to their median age. Countries with a young population are those with a median age below 36 years, whereas countries with an old population are those with a median age above 36 years.

Figure 7: Young and old populations

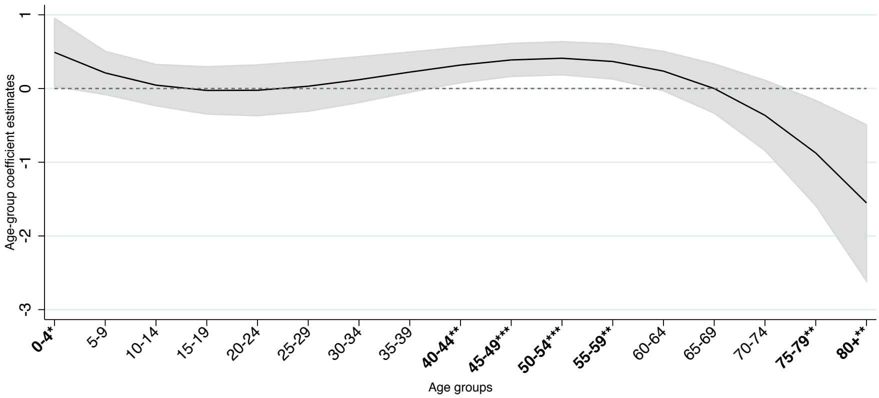


Note: See Appendix A for a detailed sample description.
Source: UN, own compilation

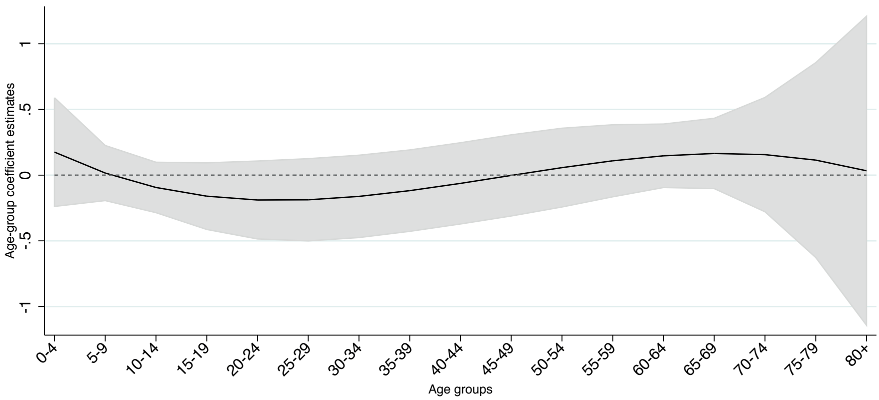
Figure 8 shows the decomposition of the age group coefficients for the subsample of young and old populations. For countries with old populations, we observe a positive and significant impact of the age groups between 40 and 59, and a negative and significant impact for cohorts older than 74. Cohorts below 40 years of age do not have a statistically significant effect. This pattern is the same as the one we find in our baseline regression, although the size and the significance of the coefficients are more pronounced than in the baseline results. Finding stronger effects for those aged above 40 in this subsample is straightforward given the relatively larger size of older cohorts. For countries with young populations, the hump pattern is difficult to identify; none of the estimated coefficients is significant. Therefore, it appears that our findings are driven by the relatively old countries in our sample.

Figure 8: Age-group coefficients decomposition of young and old countries

(a) Old populations



(b) Young populations



Note: Taking the βs estimates from equation (7) and generating $\hat{\beta}_0$ following equation (5), we define the 17 age-group coefficients as $\hat{a}_j = \hat{\beta}_0 + \hat{\beta}_1 j + \hat{\beta}_2 j^2 + \hat{\beta}_3 j^3$ for $j = 1, 2, \ldots, 17$. The 90% confidence interval is depicted in grey.

5.4 Additional controls

To further investigate the robustness of our demographic variables, we introduce two additional control variables – namely, fiscal policy and foreign-exchange interventions – following a recent study by Gagnon (2017). We also follow Gagnon's empirical strategy and run 2SLS regressions on the current account and the demographic polynomials presented in equation (6).

The first additional control variable is net official flows (NOF), defined as the acquisition and disposition of assets and liabilities denominated in foreign currency by public sector institutions in the reporting country. This measure can be seen as an indicator of foreign-exchange interventions. The second additional control is the fiscal balance adjusted for the output gap,[8] in an attempt to capture some features of the fiscal policy at the aggregate level.

Following Gagnon (2017), we further interact the controls with the lag of an index of capital mobility.[9] The rationale behind this is that the impact of the variables could vary with the degree of capital mobility. The rest of the controls remain the same as in the baseline specification.[10]

Because net official flows may be endogenous to shocks to the current account, Gagnon (2017) suggests using instrumental variable techniques. The challenge is to isolate the variation in net official flows that is not caused by shocks that simultaneously affect the current account. To account for the creation of reserves for precautionary reasons following a crisis period, Gagnon (2017) suggests using a dummy variable for the occurrence of a financial or currency crisis in the previous three years as an instrument. Furthermore, to account for sovereign wealth funds and development loans, which do not respond systematically to exchange rate shocks, he suggests using the portion of net official flows that is not related to foreign exchange reserves as instrument.

Columns 1 and 2 of Table 5 show the first stage results, where we regress the endogenous explanatory variables on the instruments and the controls. While the dummy for past currency crisis and non-foreign-exchange net official flows have a significant impact on the total net official flows individually, an F-test shows that all four instruments jointly prove to be highly significant and relevant instruments. This is also the case when looking at the first stage for the net official

8 We take the values from Gagnon (2017), who calculates the adjusted fiscal balance as a residual from regressing the fiscal balance on the level and growth rate of the output gap.
9 Similar to Gagnon, we use the capital mobility index developed by Aizenman et al. (2013).
10 We control for domestic wealth abroad, the openness of an economy, the financial openness, the GDP growth rate and for the price level of investment.

flows interacted with capital mobility. On the individual level, only the interaction of the non-foreign-exchange net official flows has a significant impact on the total net official flows interaction.

Table 5: Following Gagnon (2017)

	(1) NOF interacted with capital mobility (first stage)	(2) NOF (first stage)	(3) Current account (second stage)
Demographic 1	-12.817 [15.13]	-4.450 [5.68]	-0.597*** [0.22]
Demographic 2	1.948 [2.22]	0.656 [0.83]	0.081*** [0.03]
Demographic 3	-0.090 [0.10]	-0.030 [0.04]	-0.003** [0.00]
Currency crisis dummy	-1.765* [1.05]	0.124 [0.28]	
interacted with mobility	1.872 [1.62]	-0.835 [0.77]	
Non-foreign-exchange NOF	0.990*** [0.04]	0.020 [0.02]	
interacted with mobility	0.037 [0.08]	0.971*** [0.06]	
Net foreign assets (NOF)			0.001 [0.00]
interacted with capital mobility			0.002 [0.00]
Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	1208	1208	1208

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors in brackets and clustered at the country level.

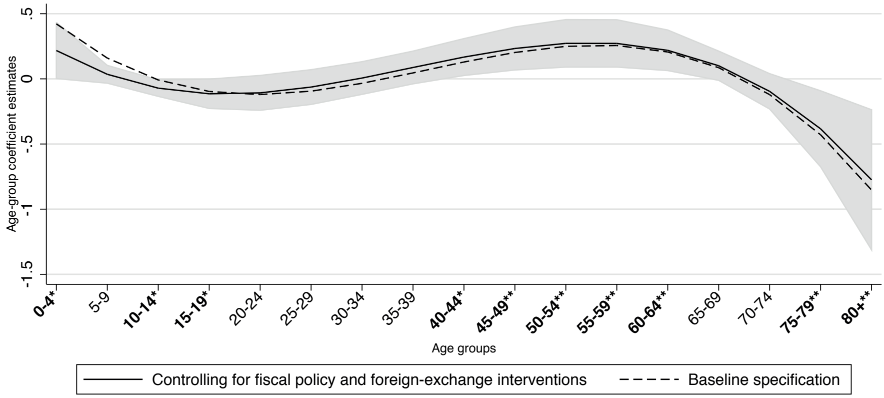
Column 3 shows the results of the second stage. We find the same levels of significance for our polynomial as in our baseline regression. Only on a joint level do the two indicators of foreign-exchange interventions have a significant impact on the current account, as found by Gagnon (2017).[11] We find some discrepancies in the sign of the coefficient on net official flows compared to Gagnon (2017). This is likely due to our dependent variable being defined as the current account balance in percent of GDP, whereas Gagnon excludes net

11 F-statistics of 18.85 respectively 16.28 and 2.28 with saving and investment as dependent variables.

investment income from the current account to remove the relatively predictable influence of income on asset stocks and thus focuses more on trade in goods and services. Similar to Gagnon, we also find a positive and significant impact of the interacted fiscal balance on the current account and no significant effect of the non-interacted fiscal balance.

Figure 9 shows the decomposition of the age-group coefficients of the second stage. The pattern is similar to the one of our baseline regression depicted by the dashed line. Hence, it appears that the demographic variables are robust to the model specification.

Figure 9: Age-group coefficients decomposition following Gagnon (2017)



Note: Taking the βs estimates from equation (7) and generating $\hat{\beta}_0$ following equation (5), we define the 17 age-group coefficients as $\hat{a}_j = \hat{\beta}_0 + \hat{\beta}_1 j + \hat{\beta}_2 j^2 + \hat{\beta}_3 j^3$ for $j = 1, 2, \ldots, 17$. The 90% confidence interval is depicted in grey. For an overview of the additional controls depicted in the solid line, please see subsection 5.4.

6 Conclusion

This paper investigates the relationship between demographics and the current account. Although the literature on current account determinants views demographics as an important explanatory factor, it has proven difficult to find a robust empirical measure that adequately captures the entire age distribution. We propose using a measure introduced by Fair and Dominguez (1991). Their idea is to limit the differences between the estimated effects of consecutive age cohorts by restricting the population coefficients to lie on a P:th degree polynomial. This procedure reduces the number of estimated parameters and yet allows the identification of the demographic effect by accounting for the entire age distribution. Moreover, allowing different age cohorts to have different effects through a population polynomial substantially increases the explanatory power of demographics compared to more traditional measures such as dependency ratios.

For the empirical analysis, we use a panel of 49 countries over the period from 1970 to 2016. We first perform year- and country-fixed effects regressions with the current account as our dependent variable. We then use the estimated coefficients and construct out-of-sample predictions to forecast the future impact of demographics.

We find a statistically and economically significant relationship between the age structure of a population and the current account. Specifically, we find that the age coefficients describe a hump-shaped pattern for the current account: they are negative for the very young and become positive at around 30 years of age. They reach a peak at around 54 years, decline sharply after retirement, and turn negative shortly after. In a series of sensitivity checks, we confirm the robustness of our findings.

Combining the estimated demographic coefficients with the United Nations population forecast data allows us to isolate the marginal impact of future demographic change on the current account. Our forecast shows that the contribution of demographics to the current account will change sharply over the next few decades, as the share of the elderly is projected to increase significantly across countries.

Depending on a country's current demographic composition, the contribution will become either positive or negative. For countries with a relatively young population, such as Guatemala, the current demographic impact on the current account is negative, but our forecast shows that the impact will become positive at around 2030. For countries with a relatively old population, such as Switzerland, the demographic impact on the current account is positive to date, while it will decrease and turn negative at around 2040.

Demographic change is persistent and predictable. Therefore, its consequences are manageable if policies are forward-looking and adjust to these trends. For most industrialized countries, the priority will be to counteract the decline in the number of active persons. This goal could be achieved by increasing the employment of women and spurring the immigration of workers. At the same time, policies will have to target households' incentives to supply capital and labor over their life-cycles – in particular, late-working-life labor supply. More subtle policies may try to affect households' productivity as they age.

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Appendix

A Data

The data we use in our analysis are in yearly frequency and span from 1970 to 2016. The sample contains the 49 countries of the IMF's External Balance Assessment (EBA). Those are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, the Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Guatemala, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, the Russian Federation, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, the United Kingdom, the United States and Uruguay.

Table A1: Data definitions and sources for baseline regression

Variable	Definition	Source and description
Current account	Current account balance relative to GDP	Yearly frequency. Defined as the sum of net exports of goods and services, net primary income, and net secondary income divided by domestic GDP. Data retrieved from the World Bank.
Saving	Gross national savings relative to GDP	Yearly frequency. Defined as gross national income less total consumption, plus net transfers. Data retrieved from the World Bank
Investment	Gross fixed capital formation relative to GDP	Yearly frequency. Contains land improvements, plant, machinery, equipment purchases, the construction of roads, railways, buildings and the like as well as net acquisitions of valuables. Data retrieved from the World Bank.
Demographic 1	First demographic variable constructed as defined in equation (6)	Yearly frequency. The 17 age groups are a formed as a 5-year cohort spanning from 0-4 to 80+. Data retrieved from the UN.
Demographic 2	Second demographic variable constructed as defined in equation (6)	Yearly frequency. The 17 age groups are a formed as a 5-year cohort spanning from 0-4 to 80+. Data retrieved from the UN.
Demographic 3	Third demographic variable constructed as defined in equation (6)	Yearly frequency. The 17 age groups are a formed as a 5-year cohort spanning from 0-4 to 80+. 80+. Data retrieved from the UN.
Measure of domestic wealth abroad	Logarithm of the ratio GNI to GDP	Yearly frequency. The ratio is a proxy for the foreign position of the domestic country vis-a-vis the rest of the world. Data retrieved from the World Bank.
Openness of the economy	Logarithm of the sum of exports and imports to GDP	Yearly frequency. The ratio is a proxy for the openness of the economy. Data retrieved from the World Bank.
Chinn-Ito Index, normalized	Openness in capital account transactions	Yearly frequency. The index measures the degree of capital account openness of an economy. For more information see Chinn and Ito (2006) and Chinn and Ito (2008b). Data retrieved from http://web.pdx.edu/~ito/Chinn-Ito_website.htm
GDP Growth rate	Growth rate of current GDP	Yearly frequency. Data retrieved from the World Bank.
Price level of investment	Price level of investment (capital formation)	Yearly frequency. It indicates the price level of the share of GDP that is represented by investment, relative to the price level of GDP in the United States, where 2011 = 1. Data retrieved from the Penn World Table 9.0.

B Additional figures

Figure B1: Demographic factor projection for Guatemala, the youngest country in the sample

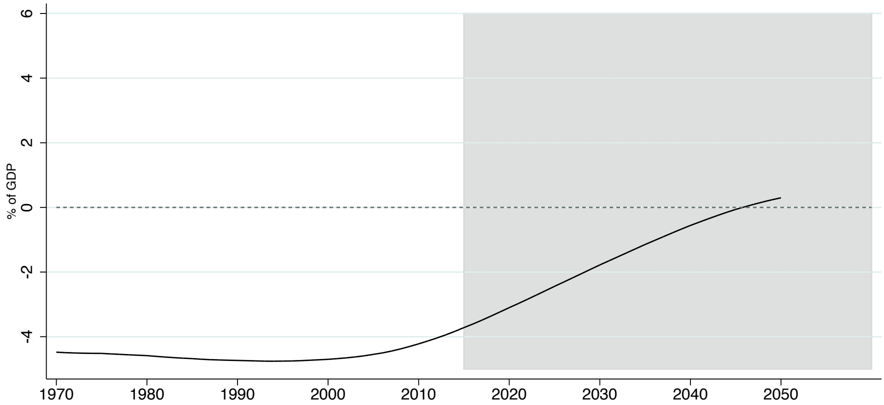

Figure B2: Demographic factor projection for Japan, the oldest country in the sample

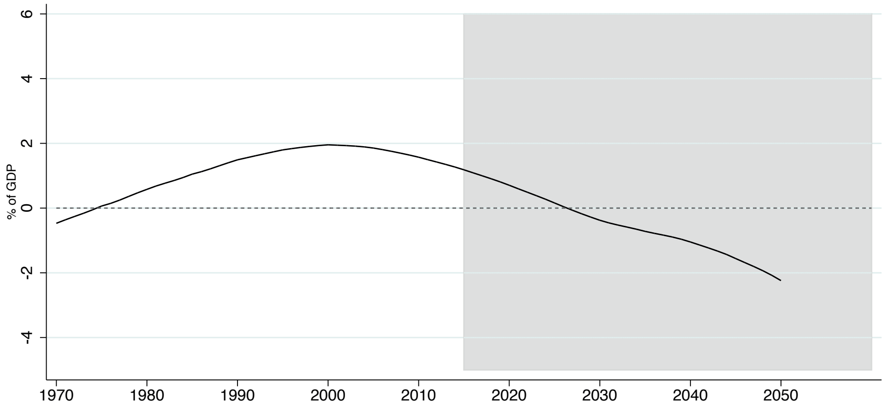

Figure B3: Demographic factor projection for Switzerland

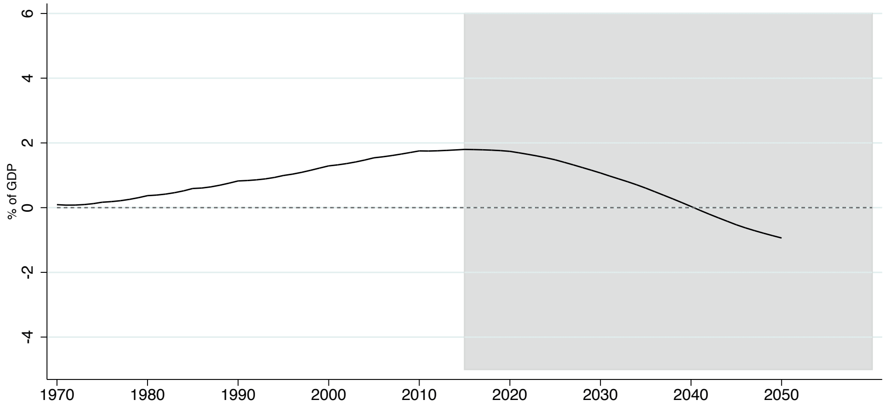

Figure B4: Demographic factor projection for the United States