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DEMOGRAPHIC CHANGES AND CURRENT ACCOUNT IMBALANCES*

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This paper shows that international current account imbalances occur to a large degree because of major demographic shifts. We first build a small open economy model with investment and study the current account response to a demographic change. According to the model, an economy with a higher population growth demands more funds from world capital markets and experiences a current account deficit. Data on current account balances and demographics from the OECD confirm the model's hypothesis. If population growth increases by one percentage point the current account as a fraction of gross domestic product decreases by 0.7 percentage points.

Keywords: Current Account, Demographics, Aging Population
JEL Classification: E21, F32, J11

1. INTRODUCTION

A growing concern of many developed economies has been the persistent trade imbalance especially relative to some parts of the developing world. For the U.S., the trade deficit-the difference between exports and imports of goods and services-or more generally, the broader concept of the current account balance (which also includes payments to foreign holders of a country's assets, payments received from investments abroad, and transfers such as foreign aid and remittances) has been persistently negative as a percentage of the gross domestic product (GDP) since the 1990s. On the other hand,

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Japan, China, and South Korea have managed to run persistent current account surpluses over the same period. European economies also feature large differences in the current account with Germany experiencing surpluses in the last two decades while emerging economies such as Poland and the Czech Republic were experiencing persistent current account deficits but turned surpluses in the second half of the 2010s.

What explains these large international differences in current accounts? In this paper, we explore if demographics changes can explain international current account imbalances. Many researchers have documented a severe decline in population growth at least for most developed countries. In the U.S. the population growth has been in steady decline since the 1960s. The decline is even more dramatic for Japan, whose "lost decade" started just as its labor force began to decrease in the late 1980s and is argued to be the oldest country in the world in terms of the population age composition since nearly one-quarter of its population is 65 and older (Jacobsen, 2011).

We approach this question in two ways. We first establish the link between demographics and current account imbalances theoretically using a small open economy model populated by young and old households. Second, we empirically analyze how demographic changes affect the current account by comparing population growth and current account to GDP from a sample of OECD countries.

In our model there are young people (workers) who are all employed by the representative firm and old people (retirees) who do not work. Every period, the firm chooses how much to invest in physical capital (machines, tools etc.). When population grows, the number of employed workers increase so capital becomes relative scarcer and hence, productive. The firm responds by investing more in physical capital. To finance the investment the representative firm borrows funds from the world capital market. Thus, in our model, population growth is associated with current account deficits.

Intuitively, due to population growth, there is a larger demand for funds in order to increase investment but also consumption. Since domestic savings are not sufficient to cover the higher investment and consumption the country is resorting to the world capital markets. Of course, in the long run, the country should pay back the borrowed funds. This happens in terms of future current account surpluses. We do not go into detail regarding the long run dynamics of the current account but we are mostly interested on the contemporaneous correlation between population growth and current account.

To conduct our empirical investigation, we use data on current accounts and population growth for several countries from the OECD. Our data cover at most 59 countries starting as early as 1951 and ending in 2018. Our basic framework regresses current account as a fraction of GDP to population growth. All of our specifications point to a negative and statistically significant relationship between demographic changes and the current account. We find that if population growth increases by one percentage point the current account balance decreases by 0.77 percentage points. We further explore if the deterioration of the current account occurs due to a change in the investment dynamics, as proposed by the model. The empirical analysis lends some support to our theoretical mechanism: the co-existence of higher population growth and higher investment deteriorates the current account further, at least relative to countries that experience a population growth without a corresponding surge in investment.

Although we explain the current account trends through the lens of demographics, we acknowledge there are multiple other factors that influence the current account. Some are included in the regression as additional control variables. These are the real exchange rate index, the real short and long interest rate differential and labor productivity (expressed as GDP divided by total working hours). Our estimates are robust to the inclusion of such control variables. Other factors are harder to quantify but nonetheless have an important influence on current account dynamics. For example, a significant part of the U.S. current account deficit is because it has a special status in the global economy and is a very attractive investment destination.

The paper is dividen into five sections. Section 2 provides literature review. Section 3 describes the model and Section 4 describes the empirical part. Finally, Section 5 concludes the research.

2. LITERATURE REVIEW

There is an extensive literature on the topic of demographics, capital flows and current account imbalances. Higgins (1998) analyzes the relationship between age distribution, national savings and the current account balance. According to his results increases in both the youth and old-age dependency ratios are associated with lower savings rates, and differential effects on savings and investment leading to changes in the current account balance. Brooks (2003) uses a multi-region overlapping generations model with perfect capital mobility to simulate the effects of population trends on international capital flows. According to his findings, retirement saving by aging baby boomers will raise the supply of capital substantially above investment in both the European Union and North America. As a result, both regions will export large amounts of capital to other countries. Feroli (2006) examines whether aging in the trading partners of the U.S. has affected the US current account balance. To test this theory, he simulates a model calibrated to match the demographic differences among the major industrialized countries. In the model, it is found that these differences can explain some of the observed long-term capital movements. In particular, the model predicts the size and timing of U.S. current account deficits.

Domeij and Floden (2006) use a neoclassical growth framework to model international capital flows in a world with exogenous demographic change. They compare model implications and actual current account data and find that the model explains a small but significant fraction of capital flows between OECD countries. Blanchard and Milesi-Ferretti (2012) argue that current account balances reflect underlying domestic distortions (lack of social insurance, poor firm governance, poor protection of property rights, lack of competition and others). They also discuss cases where a current account deficit of surplus can benefit or harm other countries suggesting a direct role for multilateral surveillance.

Graff, Tang and Zhang (2012) examine the impact of demographic factors on the current account balance. Their method accounts for several stylized facts regarding current account balances. They propose a framework in which population aging does not appear to have discernible impacts on the current account balance. Our empirical exercise follows more standard techniques and find significant effect of population aging on current account deficit.

Gerigk, Rinawi and Wicht (2018) find a positive association between the current account and the share of a populations prime-age individuals and a negative association with the share of the elderly. Their forecast suggests that the dramatically aging population will likely decrease the current account balance in most industrialized countries.

Backus, Cooley and Henriksen (2014) consider the role of demographic trends in driving international capital flows with a focus on life expectancy. They find that demographic changes affect the aggregate accumulation of assets in two ways. First, by changing life expectancy which changes individual household saving behavior. This implies that there are more domestic funds to finance investment and a lower incentive to generate a current account deficit. Second, by changing the age distribution of the population. If the economy is heavily populated by younger people the level of savings will be different than in an economy populated by older individuals.

Eugeni (2015) investigates the relationship between East Asian countries' high propensity to save and global imbalances. The paper attributes the saving behavior of emerging economies to poor pay-as-you-go systems. The model can explain why the U.S. current account deteriorated gradually and only in the late 1990s. She finds that the higher is the percentage of the working population covered by the pay-as-you-go system the lower are savings and the current account balance in a cross-section of countries. Maestas, Mullen and Powell (2016) use predicted variation in the rate of population aging across U.S. states to estimate the economic impact of aging on state output per capita. They find that an increase in the fraction of the population ages 60+ decreases the growth rate of GDP per capita. Two-thirds of the reduction is due to slower growth in the labor productivity of workers across the age distribution, while one-third arises from slower labor force growth. Eggertsson, Mehrotra and Summers (2016) characterize three phenomena - low interest rates, below target inflation, and sluggish output growth within the global economy. They consider a simple two-country textbook model to examine how capital markets transmit secular stagnation and study policy externalities across countries.

A close paper is the work by Dao and Jones (2018) who review the relationship between demographics and long-run capital flows in both theory and in the data. According to their model, the population structure and life expectancy affects the need to save in order to meet a necessary level of consumption when being old. These savings decisions affect the need for capital inflows and hence the current account levels. They support their model by a rich panel dataset.

Barany, Coeurdacier and Guibaud (2018) investigate the importance of worldwide demographic evolutions in shaping capital flows by incorporating fertility, longevity differences as well as differences in countries ability to borrow. Their model explains a large fraction of long-term capital flows across advanced and emerging countries. Cooley and Henriksen (2018) argue that changing demographics, in particular aging populations combined with increased life expectancy, may be part of the explanation for why we observe slower growth. The authors use Japan and the U.S. in the years prior to the financial crisis as a case study and provide estimates of the growth deficit that arises from an aging cohort structure and increasing life expectancy.

3. MODEL

The goal of the paper is to explain how changes in population structure would affect the current account. The economy is a small open economy which is modeled as a representative economy. All quantities presented in the model are real and not nominal quantities. The real interest rate r is exogenous. It represents the world interest rate which means that the economy is small enough to have an impact on world capital markets and that all economies have identical interest rates.

There is a single representative firm in the economy that uses labor L_t and owns capital K_t. We assume that only the young population is working and hence receives labor income. Note that the wage w_t is not exogenous but is set in the domestic labor market. This is because we make the implicit assumption that the firm uses only domestic labor. Every period the firm is investing in new capital and make decisions on how much to save in a risk-free bond (or equivalently to issue debt). Finally, we assume that (i) neither young or old can borrow or save and (ii) the young are fully sharing their income with the old generation (large family model). Hence, there is no formal role for the government in our model in terms of taxing and redistribution.

3.1. Household's

The model is populated by young and old agents. The population of the young at time t is N_t^y and the population of the old is N_t^0. The young are endowed with one unit of productive time which they supply in the labor market to the firm (discussed below). There is no preference for leisure, so the total supply of labor in the economy is $L_t = N_t^y$. Thus, the young receive total income $w_t N_t^y$, where w_t is the wage rate (defined as the wage per unit of labor). We assume that the old own the firms in the economy and they receive every period dividend from the representative firm π_t. Neither the young or the old can save or borrow. They only receive their income-labor income for young and dividend income for old. As we explain below, all saving/borrowing occurs by the representative firm.

We can aggregate the problem of young and old by considering the country's problem. We denote household-level variables by small letters and country-level variables by capital letters. The country's objective is to maximize the aggregate consumption's time path $\{C_t\}_{t=1}^{\infty}$ using the following utility function:

$$U = \sum_t^{\infty} \beta^t \ln(C_t), \tag{1}$$

$$c_t^y = w_t \quad \text{and} \quad c_t^o = \pi_t, \tag{2}$$

$$C_t = N_t^y c_t^y + N_t^o c_t^o.$$

β represents the discount factor of the country and we assume that is equal to $\frac{1}{1+r}$, where r is the exogenous real interest rate.

There is a single (representative) firm in the model. The firm owns the two assets in the economy (i) the productive capital (e.g., machines, buildings etc.) and (ii) the financial bonds (which are traded with the world capital markets). Hence, investment in the productive capital and saving/borrowing in the world capital markets occurs by the firm and not the households. A more traditional way to model the asset ownership is to think that households own the capital stock and rent it to firms in exchange for rental payments. In our case, to make things more concise, we place both decisions (investment and saving) at the firm level.

The firm produces output Y_t using labor L_t and capital K_t. The firm owns the capital in the economy. The production technology is given by the familiar Cobb-Douglas function:

$$Y_t = L_t^{1-\alpha} K_t^{\alpha}, \tag{3}$$

where α denotes the returns to scale with respect to capital input. Every period the firm invests in new capital $I_t = K_{t+1} - K_t$. We assume for simplicity that the existing capital K_t does not depreciate as we move to period $t+1$ so that at the steady state $I_t = 0$. This property holds for a steady-state economy with a stable population structure. The firm makes labor payments $w_t L_t$. Moreover, the firm can save/borrow at the world's capital markets using a one-period risk-free bond. The return to the bond is r and b_t is the net holdings of bonds at time t. If $b > 0$ then world owes to the firm while if $b < 0$ then the firm owes to the world. The distributed profits of the firm are given in the form of dividends to old generation. They are given by:

$$\pi_t = Y_t - w_t L_t - I_t - b_{t+1} + (1+r) b_t. \tag{4}$$

There are several ways the firm can finance its investment I_t. First, the firm can use its own corporate savings, b_t Second, it can borrow from the world market (denoted by b_{t+1}). Third, the company can use current profits for investment instead of distributing dividends. In principle, the firm will use a mix of all three options above.

3.2. Combining the Household's and Firms Problem

We use the budget constraint of the households (Equations 2) and multiply them with their respective population weights:

$$N_t^y c_t^y = N_t^y w_t$$

$$N_t^o c_t^o = N_t^o \pi_t$$

Adding these two we get:

$$\underbrace{N_t^y c_t^y + N_t^o c_t^o}_{\text{aggregate consumption } C_t} = \underbrace{N_t^y w_t}_{\text{aggregate labor income}} + \underbrace{N_t^o \pi_t}_{\text{aggregate profits } \pi_t}$$

We use the firm profits (which are given to owners of company which are old generation).

$$\pi_t = Y_t - w_t L_t - I_t - b_{t+1} + (1+r) b_t.$$

and receive

$$C_t = w_t N_t^y + Y_t - w_t L_t - I_t - b_{t+1} + (1+r) b_t. \tag{5}$$

Since $N_t^y = L_t$, we get the country's budget constraint

$$C_t = Y_t - I_t - b_{t+1} + (1+r) b_t. \tag{6}$$

3.3. Solving the Country's Problem

We write the Lagranzian function by combining the utility of the (large family) household with the country's budget constraint:

$$L = \sum_t^\infty \beta^t \ln(C_t) + \lambda_t \left[N_t^{1-\alpha} K_t^\alpha - I_t - b_{t+1} + (1+r) b_t - C_t\right]. \tag{7}$$

$$I_t = K_{t+1} - K_t$$

The first order conditions are taken with respect to country's consumption C_t, bond holdings next period b_{t+1} and capital tomorrow K_{t+1}. The first three gives us the following equations:

$$1/C_t = \lambda_t,$$

$$\beta/C_{t+1} = \lambda_{t+1},$$

$$-\lambda_t + (1+r)\lambda_{t+1} = 0$$

We have assumed that $\beta(1+r)\lambda_{t+1} = 1$. All these lead to the equation

$$C_t = C_{t+1}. \tag{8}$$

This suggests that the country wishes to equalize the consumption across time. This implies that the economy will adjust savings and investment if there is a change in the technology, demographics etc. in order to maintain a stable consumption path.

Finally, the first order condition for capital K_{t+1} is

$$-\lambda_t + \lambda_{t+1}[\alpha N_{t+1}^{1-\alpha} K_{t+1}^{\alpha-1} + 1] = 0$$

Since $\lambda_t = (1+r)\lambda_{t+1}$, we have

$$r = \alpha N_{t+1}^{1-\alpha} K_{t+1}^{\alpha-1}$$

which is the familiar equation equalizing the real interest rate with the marginal product of capital. From this equation we can derive the level of capital in the economy:

$$K_{t+1} = \left[\frac{r}{N_{t+1}^{1-\alpha}}\right]^{\frac{1}{\alpha-1}}. \tag{9}$$

The optimal capital K_{t+1} is given by the intersection of the marginal cost to purchase capital, *r*, and the marginal product of capital, $\alpha N_{t+1}^{1-\alpha} K_{t+1}^{\alpha-1}$. The marginal cost r is given because the economy is small and it cannot affect the interest rate. The marginal benefit is decreasing in K_{t+1} due to law of diminishing returns. If the marginal benefit to purchase capital is higher than the marginal cost $\alpha N_{t+1}^{1-\alpha} K_{t+1}^{\alpha-1} > r$ then we are using too little capital relative to the optimal. In this case the firm invest and borrows relatively less from the capital markets and the current account balance improves. If $a N_{t+1}^{1-\alpha} K_{t+1}^{\alpha-1} < r$ then we are using too much capital and the economy would benefit from decreasing the stock of capital. In this case the economy is investing too much and the current account deteriorates.

Definitions: The Current Account

Aggregate domestic savings are given by total output Y_t minus total consumption:

$$S_t = Y_t - C_t \tag{10}$$

But we know that

$$C_t = Y_t - I_t - b_{t+1} + (1+r)b_t. \quad (11)$$

So, we have

$$S_t = I_t + b_{t+1} - (1+r)b_t. \quad (12)$$

But we also know that output should equal consumption, investment, and net exports

$$Y_t = C_t + I_t + NX_t. \quad (13)$$

So, we have

$$b_{t+1} - b_t = NX_t + rb_t. \quad (14)$$

This suggests that net exports and interest payments are equal to the net change in the amount of bonds the country has. If the country increases its holdings of bonds this happens because there is at the same time an export of goods out of the country (for a given interest payment). If the country decreases its holdings of bonds this implies that there is an import of goods to the country. Finally, we can define the current account balance as

$$CA_t = b_{t+1} - b_t. \quad (15)$$

Thus,

$$CA_t = S_t - I_t + rb_t. \quad (16)$$

This says that (for given rb_t.) when domestic savings are larger than domestic investment, we have a current account surplus (outflow of resources due to net exports). When domestic savings are smaller than domestic investment, we have a current account deficit. But note that rb_t. can represent a significant amount of current balance especially when b_t is very negative. We can finally write:

$$CA_t = Y_t - C_t - I_t + rb_t. \quad (17)$$

3.4. An Increase in the Country's Population

In this section we perform our main quantitative experiment. We assume that population becomes larger and analyze its effects on the current account. We make an assumption that makes the analysis simpler: the country at time *t* learns that population will increase in $t+1$ which implies that there is a larger young population than in time

t: $N_{t+1}^{y} > N_{t}^{y}$. This is a one-time change and the economic agents know that the change will not persist. Since the young people are the ones working we also have: $L_{t+1} > L_t$. What is the effect of population growth on the current account CA_t?

The current account is given by Equation (17). Output is given by $Y_t = L_t^{1-\alpha}K_t^{\alpha}$. In period t the capital stock is given (the decision always occurs one period before) so K_t is same. L_t is also same because we assumed the population changes in $t+1$. As a result, Y_t is same, and the economy produces an output equal to the steady-state output.

We discussed that the optimal capital choice one period later, K_{t+1}, is given by the intersection of the marginal cost to purchase capital, r, and the marginal product of capital, $\alpha N_{t+1}^{1-\alpha}K_{t+1}^{\alpha-1}$. The marginal benefit is increasing in L_{t+1}. When the firm has more workers, capital is relatively scarcer. Hence, the marginal product of one more unit of capital is higher. Thus, the firm increases K_{t+1} to equate the marginal product with the marginal cost r. Because $I_t = K_{t+1} - K_t$ and K_t as mentioned is fixed in period t, investment will increase.

There are two opposite forces affecting the wages. A higher supply of workers L_{t+1} can decrease the wage but a higher investment K_{t+1} can increase the wage. So overall labor income $w_{t+1} \times L_{t+1}$ will likely increase and so will consumption C_{t+1}. If agents know that in the future they will earn more money they increase their consumption from today (we have established that $C_{t+1} = C_t$ in Equation (8)). This implies that the country smooths its consumption across periods. Finally, b_t is fixed so it does not change in time t. Borrowing increases (or equivalently domestic saving decrease) at time t in the country which implies that b_{t+1} decreases relative to the steady state.

To sum up the effect of population growth: output Y_t is constant, investment I_t increases, consumption C_t increases, bond holdings at time t, b_t, is constant, and the current account CA_t deteriorates.

Another way to state the results is the following. From Equation (12) we have $S_t = I_t + b_{t+1} - (1+r)b_t$. Investment increases due to population growth. Borrowing has to support not only the higher investment but also the higher consumption. This leads domestic savings S_t to decrease. Lower savings and higher investment imply a current account deficit.

We have derived the basic testable hypothesis of our model. A country with population growth has a current account deficit because it increases investment and consumption without having *yet* a higher output to finance the investment and consumption. Thus, the country relies on higher imports of goods $NX_t < 0$ and the current account deteriorates $CA_t < 0$. Current account deteriorates also because of the higher debt service cost. We can similarly think of a situation where the economy is aware that a significant fraction of the employment force will retire and exit employment. In this case the firm decreases its investment because the marginal product of capital is lower than the (given) marginal cost. In this case the economy will feature a current account surplus.

There is an important assumption in our analysis. The population growth occurs only once at time $t+1$. One can think of a more realistic environment where population growth increases permanently from period *t* and beyond. Intuitively, the country would increase investment and consumption pushing the current account to a higher deficit. To confirm if these conclusions remain intact if population growth is more persistent, we would have to build a fully dynamic model. We use a simpler approach to highlight the basic mechanism of our model and leave the explicit dynamics for future research. Moreover, in reality, the adjustment of current accounts to population growth may take several years and occur in a more gradual fashion. Our model can potentially generate such patterns if we had assumed that the population does not increase once but gradually. Another way it is possible to generate a gradual adjustment in the current account is to assume that capital does not adjust quickly but it takes some time to build and install it.

4. EMPIRICAL INVESTIGATIONS

The empirical investigations are divided into three major parts. First, we analyze our data and sources. Second, we demonstrate the empirical framework and the main regression and in the last part we conduct some diagnostic tests.

Table 1. Descriptive Statistics

Variables	# Countries	Year avail.	#Observations
Current Account/ GDP	52	1955-2018	1,247
Population growth	44	1951-2014	2,545
Short Term Interest Rate	43	1956-2018	1,362
Long Term Interest Rate	40	1954-2018	1,342
Inflation	52	1916-2018	2,557
Exchange rate	61	1950-2019	3,637
Purchase Power Parity	58	1960-2020	2,598
GDP/working hours	47	1970-2019	1,761

4.1. Data Description

To conduct our empirical analysis, we use data from the Organization for Economic Cooperation and Development (OECD) from the national accounts database. The main variable of interest is the current account which is the dependent variable. The current account balance of payments is a record of a country's international transactions with the rest of the world. Such transactions involve transactions that involve economic value such as goods and services. Our indicator is measured as a percentage of GDP.

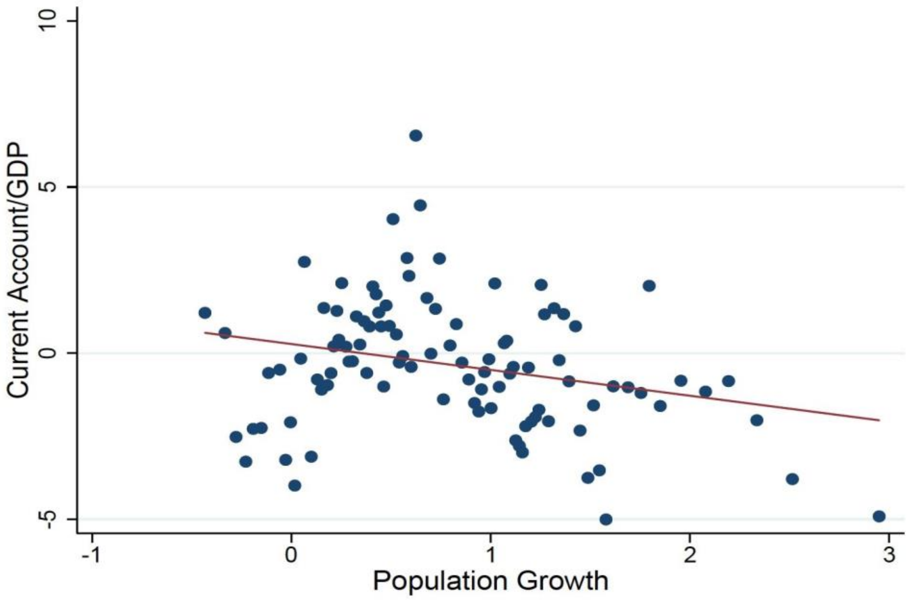
The main regressor is demographic changes and the most natural measure of demographic changes is population growth. Population is defined by the OECD as all nationals present in, or temporarily absent from a country, and aliens permanently settled in a country. This indicator shows the number of people that usually live in each country. Population growth rates are the annual changes in population resulting from births, deaths and net migration during the year. Population growth may be driven by both, an increase in birth rates and a decline in death rates (as well as inflow of immigrants). These two can have very different implication for savings and interest rates. Nonetheless, according to Pew Research Center (Attitudes about Aging: A Global Perspective, 2014) worldwide birth rates have trended down since 1950, and the gap with respect to death rates has narrowed sharply, leading to a slowdown in population growth. At the same time, life expectancy has improved significantly and has contributed to the aging of population. In general, falling birth rates have been the leading cause of the decline in population growth worldwide.

As a second step, we include different control variables that may influence the current account. First, we include information about the real exchange rate of each country. The real exchange rate index between country A and country B is computed as the nominal exchange rate between countries A and B multiplied by the ratio of prices between these countries (purchase power parity or PPP). Nominal exchange rates are measured in terms of national currency per U.S. dollar. PPPs are simply price relatives that show the ratio of the prices in national currencies of the same good or service in different countries. A strong real exchange rate may influence negatively the exports and favor imports. Thus, the exchange rate is an important determinant of the current account.

Next, we construct an interest rate differential for short and long-term interest rates. Short-term interest rates are the rates at which short-term government bonds are issued or traded in the market. According to the OECD, short-term interest rates are generally averages of daily rates, measured as a percentage. Those interest rates are based on three-month money market rates where available. As the OECD explains, long-term interest rates are implied by the prices at which the government bonds are traded on financial markets, not the interest rates at which the loans were issued. To translate our nominal into real interest rates we subtract the country specific inflation rate over the relevant period of time from the country specific nominal interest rates. We obtain the inflation rates from the OECD which are measured by the consumer price index (CPI), defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households. For our analysis we will use the interest rate differential which is defined as the real interest rate of each country minus the real interest rate of the U.S. A positive real interest rate differential for a country implies either an inflow of capital to finance investment which will deteriorate the current account.

Finally, we include a measure of country’s labor productivity which is defined as GDP per hour of work. It measures how efficiently labor input is combined with other factors of production and used in the production process. This indicator is measured by the OECD in USD (constant prices 2010 and PPPs) and indices.

Our analysis certainly omits many variables that can potentially have explanatory power on current account. Financial regulation, foreign capital flows, indicators of how competitive a country is, household saving rates are all factors that can affect the current account. Although a comprehensive analysis of current account dynamics is certainly worthwhile, we prefer to keep the analysis simple and focus on variables that first, are easy to measure and second, are considered standard in panel data regressions of demographic changes and current account dynamic. Table 1 provides some descriptive statistics of our variables.



Notes: The figure plots a scatter of current account divided by GDP and population growth among OECD countries. Each point represents a bin of countries.

Figure 1. Scatter plot of Current Account/GDP and Population Growth for OECD Countries

All variables are available at annual frequency. Our analysis covers as many as 61 economies starting in many countries as early as 1916 and ending in 2019. The period analyzed depends on the specification and the availability of each variable. In the benchmark specification that includes only population growth the time period is 1951-2014. A sample of countries included in our data, which are all the available countries from the OECD data set, include Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, Norway, New Zealand, Poland, Portugal, Russia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, the United Kingdom, the United States and Turkey.

Table 2. Demographics and Current Account (No Fixed Effects)

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-0.77***	-0.69***	-0.75**	-1.00***
	(0.25)	(0.25)	(0.31)	(0.33)
Real exchange rate		-0.73***	-2.72***	-3.45***
		(0.25)	(0.49)	(0.57)
Short-term interest diff.			-0.31***	-0.21*
			(0.11)	(0.12)
Long-term interest diff.			-0.01	-0.09
			(0.11)	(0.11)
GDP/Hours				-0.04**
				(0.01)
# Observations	828	823	634	608

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

4.2. Regression

To estimate the effect of demographics on current account we use the following linear regression:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_{it} + D_i + D_t + \varepsilon_{it}, \tag{18}$$

where Y_{it} is our main variable of interest, the current account divided by GDP of country i in period t. Moreover, X_{it} represents the population growth of country i in period t. Z_{it} represents a vector of control variables, namely short- and long-term real interest rate differentials, real exchange rate index and labor productivity (GDP/working hours). D_i is a country fixed effect and D_t is a time fixed effect. Coefficient β gives us the change in the current account if the population growth rate changes by one percentage point. Coefficient α represents the constant in the regression. Finally, ε_{it} is the residual in the regression.

4.3. Results

In this section, we report the results of our empirical exercise. Before reporting the result of the regression, we plot a simple scatter of population growth and current account in Figure 1. The scatter reveals a clear negative association between population growth and current account for our sample of OECD countries.

Table 3. Demographics and Current Account (Country Fixed Effects)

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-1.53***	-1.53***	-1.18***	-1.32***
	(0.27)	(0.27)	(0.31)	(0.31)
Real exchange rate		1.71***	2.14***	2.67***
		(0.37)	(0.63)	(0.71)
Short-term interest diff.			-0.51***	-0.47***
			(0.07)	(0.07)
Long-term interest diff.			0.32***	0.31***
			(0.07)	(0.07)
GDP/Hours				0.02**
				(0.01)
# Observations	828	823	634	608

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

This is what our theoretical model also predicts. A higher population growth implies higher demand for resources from outside the country resulting in an inflow of foreign good into the country and hence, current account deficit. To analyze the effect of controlling for other characteristics we run regression reported in equation 18. The total number of observations is more than three thousand and eight hundred since we have data on many countries for relatively long period of time. We report our results using first, a specification without time or country fixed effects (Table 2), second, a specification with country fixed effects (Table 3), third, a specification with time fixed effects (Table 4) and finally, a specification with both country and time fixed effects (Table 5). We explain one by one the coefficients in our regressions.

The effect of population growth and other control variables on current account: Coefficient β gives the change in percentage points of current account if population growth increases by one percentage point.

Table 4. Demographics and Current Account (Time Fixed Effects)

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-0.70**	-0.57**	-0.70**	-1.05***
	(0.27)	(0.27)	(0.33)	(0.35)
Real exchange rate		-0.94***	-3.21***	-3.92***
		(0.26)	(0.52)	(0.62)
Short-term interest diff.			-0.25	-0.21
			(0.15)	(0.15)
Long-term interest diff.			-0.13	-0.21
			(0.13)	(0.13)
GDP/Hours				0.14***
				(0.04)
# Observations	828	823	634	608

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

All specifications show that population growth and current account/GDP are negatively related. Our benchmark specification without country or time fixed effects (Table 2) shows that if population growth increases by 1% the current account decreases as a fraction of GDP between 0.7 to 1.0 percentage points. Hence, even when we add multiple control variables the negative relationship, we plotted in Figure 1 remains intact. Interestingly, when we incorporate country fixed effects the negative relationship becomes even stronger. According to Table 3, if population growth increases by 1%, the current account decreases as a fraction of GDP between 1.1 and 1.5 percentage points. When we incorporate time fixed effects (Table 4) we find that if population growth increases by 1% the current account decreases as a fraction of GDP between 0.5 to 1.0 percentage points. Finally, when we include both country and time fixed effects (Table 5) we find that if population growth increases by 1% the current account decreases as a fraction of GDP between 1.0 to 1.7 percentage points. Overall, we find the current account deterioration as a response to population growth to be a robust phenomenon and the negative relationship quite sizable.

We also discuss here the effect of our control variables on the current account. An increase in the real exchange rate index (numerically) means a devaluation/depreciation of the domestic currency relative to the U.S. This should lead to increase in exports and decrease in imports because the price of imported goods increases while exports become cheaper. Thus, an increase the real exchange rate means an improvement in the current account. Our regressions produce a positive relationship between real exchange rate and current account as a fraction of GDP in the case of country fixed effects (Table 3) and the case of country-time fixed effects (Table5).

Table 5. Demographics and Current Account (Country and Time Fixed Effects)

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-1.72***	-1.71***	-1.22***	-1.08***
	(0.29)	(0.28)	(0.32)	(0.32)
Real exchange rate		1.96***	2.49***	4.15***
		(0.48)	(0.90)	(0.96)
Short-term interest diff.			-0.42***	-0.44***
			(0.10)	(0.10)
Long-term interest diff.			0.40***	0.46***
			(0.08)	(0.08)
GDP/Hours				0.19***
				(0.03)
# Observations	828	823	634	608

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Increasing interest rate differential can have two conflicting effects on current account. First, a higher interest rate encourages domestic households to save more and thus, reduces spending on imports which leads to an improvement on current account. Second, higher interest rates induce a demand for the domestic currency by foreign investors (hot money flows) causing an appreciation in the real exchange rate and worsening of the current account. Moreover, the increase in interest rate increases the debt service cost which also deteriorates the current account. Thus, the overall effect of interest rates on current account is uncertain. In our regressions we find sometimes positive and sometimes negative effect.

Finally, increasing labor productivity can have two conflicting effects on current account as well. First, an increase in labor productivity increases international competitiveness of the economy. This would result in an increase in the current account balance. Second, large increases in labor productivity are caused by large investments which leads to a current account deficit. Our results support the first effect: the current account increases when GDP over hours (a proxy for labor productivity) increases.

4.4. Diagnostic Checks

In this section, we perform some standard diagnostic tests regarding panel data analysis. We first evaluate if a fixed effect or a random effect specification is more appropriate for our exercise by running a Hausman test. We next explore our estimates if we adjust for heteroscedasticity.

4.4.1. Fixed effects versus random effects: Hausman test

To evaluate if a fixed effect or a random effect model is more appropriate for our exercise we run a Hausman test. The test evaluates whether errors are correlated with the regressors or not. The null hypothesis in the test is that they are correlated.

Table 6. Hausman test

	Fixed Effects	Random Effects	Difference	Stand. Error
Population Growth	-0.70	-0.77	0.07	0.08
prob. > χ^2		0.42		

Notes: The table reports the Hausman test for analyzing the difference between fixed effect and random effect coefficient.

Since the probability is higher than 5 percent which implies that the difference is not significant, we conclude that the fixed effect model does not produce significantly different results from the random effect model. That is why we show different variants of the model specification.

4.4.2. Heteroscedasticity

We check for the presence of heteroscedastic standard errors. We adjust the standard errors by implementing the White correction technique.

Table 7. Demographics and Current Account (w/ Robust Standard Errors)

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-0.77***	-0.69**	-0.75**	-1.00***
	(0.28)	(0.29)	(0.34)	(0.37)
Real exchange rate		-0.73	-2.72***	-3.45***
		(0.24)	(0.54)	(0.71)
Short-term interest diff.			-0.31***	-0.21
			(0.11)	(0.13)
Long-term interest diff.			-0.01	-0.09
			(0.12)	(0.13)
GDP/Hours				-0.04***
				(0.01)
# Observations	828	823	634	608

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

Table 7 replicates the specification in Table 2 but adjusts for heteroscedasticity. So naturally, the coefficients are identical but the standard deviation changes. As we can see from Table 7, when we adjust for heteroscedasticity the standard errors increase slightly but overall, coefficients are still statistically significant at the 1 percent.

4.5. Exploring the Mechanism

Our benchmark regression establishes a negative relationship between the current account and population growth. Nonetheless, the regression is not suggestive of how exactly this mechanism takes place. In the theoretical model we argued that a country with higher population growth (i.e. growing labor force) is demanding funds from abroad to finance new investment. That mechanism deteriorates the current account. Do our data from the OECD support such a mechanism?

In this section, we inspect the models' main mechanism by including country-level information on investment. According to OECD, investment or the gross capital formation is defined as the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their own use, minus disposals. The relevant assets relate to assets that are intended for use in the production of other goods and services for a period of more than a year. The definition does not include the purchase of land and natural resources. The data is an unbalanced panel of 57 countries from 1960 to 2019.

We next interact population growth with the investment-to-GDP ratio and run the following regression:

$$Y_{it} = \alpha + \beta Pop.Growth + \gamma \frac{Investment}{GDP} + \delta Pop.Growth \times \frac{Investment}{GDP} + D_i + D_t + \varepsilon_{it}. \tag{19}$$

Y_{it} is our main variable of interest, the current account divided by GDP of country i in period t. The list of regressors includes population growth of country i in period t, investment-to-GDP ratio of country i in period t and more importantly, their interaction. As in the benchmark regression, D_i is a country fixed effect and D_t is a time fixed effect. Coefficient β gives us the change in the current account if the population growth rate changes by one percentage point. Coefficient δ gives the additional change in the current account due to investment-to-GDP changing.

Adding these new variables broadly preserves the negative coefficient of the population growth to current account. Regarding the interaction term between population growth and investment-to-GDP the evidence is mixed. Some specifications point to a negative and statistically significant coefficient (at the 1 percent). A negative coefficient suggests that the current account deteriorates even further if countries with high population growth also experience a surge in their investment. This relationship is in line with our theoretical model and validates the proposed mechanism. In other specifications we find a small and positive coefficient. Nonetheless, the estimates are small and noisy. None of these estimates are statistically significant at the 10 percent.

Table 8. Exploring the Transmission Mechanism

Dependent Variable: Current Account/GDP

Specification	(1)	(2)	(3)	(4)
Population Growth	-0.53*	-1.84***	-0.42	-1.97
	(0.28)	(0.30)	(0.29)	(0.31)
Investment/GDP	0.02***	-0.21***	0.02***	-0.22***
	(0.005)	(0.03)	(0.006)	(0.00)
Population Growth × Investment/GDP	-0.01***	0.00	-0.01***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
# Observations	790	790	790	790
Country Fixed Effects	No	Yes	No	Yes
Time Fixed Effects	No	No	Yes	Yes

Notes: The standard errors are given in parentheses. One, two, and three stars denote significance at the 10%, 5%, and 1% levels, respectively.

We conclude that the empirical analysis lends some support to the theoretical mechanism proposed in the model. The co-existence of higher population growth and higher investment deteriorates the current account further, at least relative to countries that experience a population growth without a corresponding surge in investment.

5. CONCLUSION

In this paper, we analyze the relationship between the current account and demographics. The goal of the paper is to explain whether current account deficits can be explained to some extent by changes in the rate of population growth. There are definitely many other reasons why some countries are experiencing persistent current accounts deficits or surpluses. For example, researchers have highlighted the roles of monetary policy and exchange rate regimes. Another factor has been the ability of financial markets in developed countries to attract savings from all over the world. The aim of this paper is not provide a comprehensive analysis of current accounts determination but to merely highlight the role of demographics.

We approach the question in two steps. First, we build a small open economy model. A representative firm is investing every period in capital. When domestic savings are not sufficient to cover the demand for investment, the firm turns to world capital markets to borrow. When population increases, the firm finds investment in capital more beneficial so it borrows generating a current account deficit for the country. The country's savings is given by $S_t = I_t + b_{t+1} - b_t + r_t b_t$ Investment increases due to population growth. At the same time borrowing (negative b_{t+1}) increases to an even larger degree. This leads domestic savings S_t to decrease. Because S_t decreases and output Y_t is the same, consumption C_t increases.

In the second step of the exercise, we provide empirical evidence of the proposed theoretical link. In particular, we collect data on current accounts and demographics from the OECD. We find that if population growth increases by one percentage point the current account (as a fraction of GDP) decreases by 0.7 percentage points. Our estimates are robust to the inclusion of other control variables such as the real exchange rate index, interest rates differentials, and labor productivity. This confirms the theoretical link of the model that population growth can explain international differences in current accounts.

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