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Economic Convergence With Safe Assets

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Ly Dai Hung

hunglydai@gmail.com

Vietnam Institute of Economics (VIE), Hanoi

Abstract

The paper characterizes the convergence of economic growth across economies on accounting for the sovereign debts rating, a measure of the safety of government debts. The empirical analysis combines a cross-section with a panel data regression on a sample of 180 economies over 1990-2019. The evidence records that there exists the convergence of economic growth (β -convergence): an economy with lower initial per capita GDP has a higher average growth rate of per capita GDP. Moreover, on cross-section data, the sovereign debts rating amplifies the convergence process, and also exerts a positive effect on the steady state level of per capita GDP relative to that level of world leading economy. And on panel data, the convergence only applies for an economy attains a high enough sovereign debts rating (higher than a threshold of 10.8 established by the data). This result also constitutes an inverted-U-shaped dependence pattern of economic growth on the per capita GDP. These analysis together uncover one mechanism for the convergence that a higher sovereign debts rating raises both the domestic investment and foreign capital inflows, then, stimulating the capital stock accumulation toward the steady state per capita GDP.

Key Words: Convergence of Economic Growth; Safe Assets; Cross-Section Regression; Fixed-Effect Panel Regression.

JEL Classifications: E52; F21; F41.

1. Introduction

The recent globalization witnesses a new phenomena on the income difference across economies: the economic growth rate experiences a reversal tendency from the divergence to the convergence across economies. While the cross-country distribution of world gross domestic product (GDP) did not shrink over 1960-1990 (Sala-i-Martin, 1996), the updated evidence covering up to 2020 records that the distribution has shrunk since the poor countries have grown faster than the rich ones (Kremer et al, 2021; Cartone et al, 2021; Patel et al, 2021). However, one remained question is open on which factor determines the success of economic growth convergence across economies. And our paper aims to fill in this research gap.

The current paper investigates the convergence of economic growth by employing the sovereign debts rating, which is a proxy for the reputation of one government on the international capital market. Our analysis is based on the combination of cross-section with panel data regression on a data sample of 180 economies over the 1990-2019 period. The cross-section regression can capture the economic growth convergence implied by the theoretical model with a unique steady state, the panel-data regression can be aligned with the theoretical model with multiple steady states (Galor, 1996). Therefore, the paper is consistent with both the classical approach, summarized by Sala-i-Martin (1996) and the critique against this approach, summarized by Quah (1996).

The empirical evidence records the existence of the convergence of economic growth across economies. For an economy with a lower per capita GDP in the initial year (i.e, 1990) tends to have a lower averaged economic growth rate over the time period (i.e, 1990-2019). And the convergence of economic growth tends to be stronger on accounting for the institutional quality including the economic openness and the government effectiveness. Furthermore, the economic growth convergence depends on the sovereign debts rating. In particular, the cross-section evidence shows that the sovereign debts rating raises

the likelihood of convergence as well as exerts a positive effect on the steady state level of per capita GDP. And the panel data evidence establishes that the economic growth convergence only applies for the economies with high enough sovereign debts rating, i.e, higher than a threshold of 10.8, which is uncovered by the empirical evidence. This result also constitutes an inverted-U-shaped dependence pattern of economic growth on the per capita GDP.

The paper belongs to the literature on the economic convergence, spurred by the seminal theoretical contribution of Romer (1986) and Lucas (1988).

There is inconsistency on the empirical evidence on the economic growth convergence. The main reason relies on challenge to capture the steady state per capita GDP (Sala-i-Martin, 1996). On the neoclassical growth model (Solow, 1956; Swan, 1956), one economy converges to the steady state, i.e, long-run equilibrium, in which the capital stock per effective unit of labor is constant. By the diminishing return to scale of capital stock, an economy with initial lower capital stock has a higher growth rate than the economy with initial huger capital stock. But this mechanism only works when different economies share the same steady state. Thus, the empirical analysis needs to hold the steady state to be constant. As Sala-i-Martin (1996) discusses, there are two approachs to overcome this challenge, by adding the variables that proxy for the steady state or alternatively by analyzing sets of similar economies.

We follow both the first strategy by using the sovereign debts rating as proxy for the steady state per capita GDP and the second strategy by separating the group of advanced economies with the group of emerging and developing economies. Thus, our main approach is similar to Aghion et al (2005) who use a cross-section regression to show that the financial development amplifies the likelihood of an economy to converge to the growth rate of the world frontier. Our evidence records a similar mechanism but with the sovereign debts rating: the rating raises the likelyhood of economic growth convergence. And for the

economies which exhibits the economic convergence, the sovereign debts rating has a positive impact on the steady state level of per capita GDP.

While Aghion et al (2005) focuses on the cross-section analysis, we extend the cross-section to the panel data regression. Technically, the panel data captures the intra-country distribution of per capita GDP that is absent on the cross-section analysis (Quah, 1996). Our panel evidence records that the convergence of economic growth only happens for the economies with a high enough value of sovereign debts rating.

Furthermore, by both of the cross-section and panel evidence, we uncover the mechanism for the impact of sovereign debts rating on the convergence of economic growth. A higher rating raises the domestic investment, then, the domestic capital stock. Thus, the sovereign debts rating also contributes on the capital accumulation process along the convergence pathway toward the steady state. This evidence provides an addition new result on the previous literature by stressing that the reputation of government is important for the convergence of economic growth.

The current paper is closely related to a recently dynamic literature on the safe assets. The safe assets can be defined as the uncertainty-insensitive assets with a constant rate of return even on the economic downturn period (Caballero et al, 2014) or alternatively as the information-insensitive assets with a rate of return unaffected by the assymetric information (Gorton, 2011). When there exists the excess demand for the safe assets as a store of wealth, an increase of safe assets supply can reduce the interest rate, then, stimulating the aggregate demand and associated economic growth rate (Caballero and Farhi, 2018). An increase of safe assets supply can also reduce the pressure of primary deficit on the inflation rate (Brunnermeier et al, 2020) or the appreciation of domestic currency (Gopinath and Stein, 2021).

Our paper sheds a refresh light on the macroeconomic impact of safe assets. In particular, the safe assets can contribute on the catching-up process of

poor to the rich economies. This effect works through the role of the safety of assets on the economic growth, instead of the supply of assets as the aforementioned papers. Therefore, our evidence complements to the previous results by charactering one additional role of the safe assets on the macroeconomy.

The paper is structured as following. After the first section on the introduction, the second section on Analysis Framework with the data sample and associated empirical model. Then, the third section shows the empirical evidence on both cross-section and panel regression, and their robustness checks. Finally, the paper closes with the fourth section on the conclusion.

2. Analysis Framework

2.1. Data

The data set is a cross-section sample of 180 economies over the 1990-2019 period. Each variable takes its average value over time. This approach is useful to focus on the long-run pattern of economic growth since a long time period of about 30 years is enough to absorb the short-run fluctuation over time.

The economic growth rate, denoted by ($aGDPpcgrowth$), is the dependent variable on our analysis. This variable captures the change of living standard of households within an economy. Moreover, it also serves as a proxy for the change of technology level, since on the neoclassical growth model (Solow, 1956; Swan, 1956) implies that the GDP per capita grows with the technology progress.

This variable is measured by the growth rate of real gross domestic product (GDP) per capita, on percentage. In particular, the real GDP is the GDP at constant national 2011 price on USD, which is from Penn World Tabke 10.0 (2020). And the population is from World Development Indicators updated to 2019, relased by the World Bank. Then, the real GDP per capita is the ratio of real GDP per population, on USD. Based on this data, the initial GDP per capita, denoted by ($LnGDPpc1990$), is the value of GDP per capita in 1990.

The sovereign debts rating, denoted by ($aSovrate$), plays a central role on our analysis. This variable captures the safety of sovereign debts issued in each

economy. It is an index ranged from 1 to 21, with a higher index meaning a greater safety level. This index is constructed and released by the World Bank Fiscal Space Database, updated to 2019. The inputs include the ratings of sovereign debts by well-known international agency such as the Standard & Poor, and Moody.

Other variables are explored from various resources. The trade openness, denoted by (*aEopen*), the ratio of exports summing imports over nominal GDP on percentage. The exports, imports and nominal GDP at current price on USD are all taken from the World Development Indicators, updated to 2019. And the government effectiveness, denoted by (*aGovern*), reflects the institutional quality, and is extracted from the World Government Index, constructed and released by the World Bank.

Next, the distance to world frontier, denoted by (*aDistance*), is the ratio of domestic productivity level over the United States one. This data is constructed and released by the Penn World Table 10.0 (2020). And the end-of-period capital stock, denoted by (*LnK2019*), is the logarithm value of the 2019 capital stock in current USD. The investment per GDP, denoted by (*aI2y*), is the ratio of domestic investment per GDP on percentage. And the net total capital inflows are the ratio of negative value of current account over the GDP on percentage. All of these three variables are from the World Development Indicators.

Table 1: Descriptive Statistics

Variables	Observations	Mean	Std.Dev	Min	Max
Economic Growth (<i>aGDPpcgrowth</i> ,%)	178	2.04	1.72	-2.38	8.25
Sovereign Debts Rating (<i>aSovrate</i>)	151	11.86	4.91	4.72	21
Initial GDP per capita (<i>LnGDPpc1990</i>)	177	8.88	1.20	6.00	11.53

Trade Openness (<i>aEopen</i> ,%)	191	87.29	45.90	13.34	354.8 9
Government Effectiveness (<i>aGovernment</i>)	198	-0.04	0.97	-2.15	2.15
Distance to World Frontier (<i>aDistance</i>)	117	0.65	0.25	0.19	1.57
End-of-Period Capital stock (<i>LnK2019</i>)	176	12.86	2.16	7.94	18.43
Investment per GDP (<i>aI2y</i>)	182	23.68	6.51	9.20	50.76
Net Total Capital Inflows (<i>anegCA2y</i>)	177	3.93	10.22	-38.54	60.08

Table 1 reports the descriptive statistics of the data sample. The economic growth rate has a mean at 2.04% with a standard deviation at 1.72%. Compared with this variable, the trade openness, investment per GDP and net total capital inflows have both a higher mean and greater standard deviation. Moreover, the sovereign debts rating has a mean at 11.86 and a large standard deviation at 4.91. Other variables, including the initial GDP per capita, government effectiveness, distance to world frontier and end-of-period capital stock, also have a quite large standard deviation. Therefore, the data sample offers a great variation to explore the convergence of economic growth on accounting for the sovereign debts rating.

2.2. Model

The empirical model is as following:

$$\begin{aligned}
aGDPpcgrowth^j = & \alpha + \beta^{GDPpc1990} LnGDPpc1990^j \\
& + \beta^{Sovrate} aSovrate^j + \beta^{Inter} LnGDPpc1990^j * aSovrate^j \\
& + \beta^{Eopen} aEopen^j + \beta^{Govern} aGovernment^j + \beta^{Distance} aDistance^j + u^j \quad (1)
\end{aligned}$$

The focal point is the coefficients of ($\beta^{GDPpc1990}$), (β^{Inter}), and ($\beta^{Sovrate}$).

First, the coefficient of initial per capita GDP ($\beta^{GDPpc1990}$) captures the dependence of the economic growth on the initial GDP per capita. When this coefficient is significantly negative, i.e., $\beta^{GDPpc1990} < 0$, there exists the convergence of economic growth. Accordingly, an economy with a higher initial per capita GDP has a higher average growth rate of per capita GDP over the time period of 1990-2019.

Second, the coefficient of the interaction term between the initial per capita GDP with the sovereign debts rating (β^{Inter}) illustrates the impact of the sovereign debts rating on the convergence of economic growth rate. When this coefficient is significant, the sovereign debts rating determines the convergence rate, captured by the first derivative of the economic growth rate with respect to the initial per capita GDP.

$$\beta^{convergence} = \frac{\partial aGDPpcgrowth}{\partial LnGDPpc1990} = \beta^{GDPpc1990} + \beta^{Inter} aSovrate^j \quad (2)$$

On accounting for the sovereign debts rating, an economy can converge to the growth rate of world leading economy when its growth rate of per capita GDP depends negatively on the initial per capita GDP. This requires that ($\beta^{convergence} < 0$). In this case, the speed of convergence is amplified by the sovereign debts rating: for a higher sovereign debts rating, the tendency of economic growth convergence is stronger. Given that ($\beta^{GDPpc1990} < 0$), this results will hold only if:

$$\beta^{Inter} < 0 \quad (3)$$

Third, the coefficient ($\beta^{Sovrate}$) illustrates the impact of the sovereign debts rating on the long-run equilibrium or the steady state value of per capita GDP. When this coefficient is significantly positive, the sovereign debts rating exerts a positive effect on the steady state level of per capita GDP relative to that level of world leading economy.

In order to uncover this third implication, we can define variable with upper bar as the value of the leading economy, which is at the world frontier,

then, is the objective for other economies to converge toward in the long run. By the equation (1), we have the value of the world leading economy as:

$$\begin{aligned} \overline{aGDPpcgrowth} = & \alpha + \beta^{GDPpc1990} \overline{LnGDPpc1990} \\ & + \beta^{Sovrate} \overline{aSovrate} + \beta^{Inter} \overline{LnGDPpc1990} * \overline{aSovrate} \\ & + \beta^X \bar{X} + \bar{u} \quad (4) \end{aligned}$$

Whereby, for simlicity, we denote X as the vector containing three variables including the economic openness, government effectiveness and distance to world frontier.

By taking the difference between the equation (1) and (4), we have:

$$\begin{aligned} aGDPpcgrowth^j - \overline{aGDPpcgrowth} = & \beta^{GDPpc1990} (LnGDPpc1990^j - \overline{LnGDPpc1990}) + \beta^{Sovrate} (aSovrate^j - \overline{aSovrate}) + \\ & \beta^{Inter} (LnGDPpc1990^j * aSovrate^j - \overline{LnGDPpc1990} * \overline{aSovrate}) + \beta^X (X - \bar{X}) + (u^j - \bar{u}) \quad (5) \end{aligned}$$

By defining $(LnGDPpc1990^j = LnGDPpc1990^j - \overline{LnGDPpc1990})$ and $(\Delta aSovrate^j = \overline{aSovrate} - aSovrate^j; \Delta X = \bar{X} - X^j; \Delta u = \bar{u} - u^j)$, we rewrite this equation as:

$$\begin{aligned} aGDPpcgrowth^j - \overline{aGDPpcgrowth} = & \beta^{GDPpc1990} LnGDPpc1990^j - \beta^{Sovrate} \Delta aSovrate^j + \beta^{Inter} aSovrate^j * LnGDPpc1990^j - \\ & \beta^{Inter} \Delta aSovrate^j * \overline{LnGDPpc1990} + \beta^X \Delta X + \Delta u \quad (6) \end{aligned}$$

We assume that the convergence of economic growth rate happens at the long run equilibrium, i.e, the steady state:

$$aGDPpcgrowth^j - \overline{aGDPpcgrowth} = 0$$

Then, we denote the steady state per capita GDP gap of an economy with the world leading economy as $LnGDPpc1990^{j,*}$. Then, solving the equation (6), i.e, $aGDPpcgrowth^j - \overline{aGDPpcgrowth} = 0$, we have:

$$LnGDPpc1990^{j,*} = \frac{\Delta aSovrate^j (\beta^{Sovrate} + \beta^{Inter} \overline{LnGDPpc1990}) + \beta^X \Delta X + \Delta u}{\beta^{GDPpc1990} + \beta^{Inter} aSovrate^j} \quad (7)$$

Then, the first derivative of the steady state per capita GDP gap with respect to the sovereign debts rating is:

$$\frac{\partial \widehat{\text{LnGDPpc}}_{1990}^{j,*}}{\partial a\text{Sovrate}^j} = - \frac{\beta^{\text{Sovrate}} + \beta^{\text{Inter}} (\widehat{\text{LnGDPpc}}_{1990}^{j,*} + \overline{\text{LnGDPpc}}_{1990})}{\beta^{\text{GDPpc}}_{1990} + \beta^{\text{Inter}} a\text{Sovrate}^j} \quad (8)$$

When an economy converges to the growth rate of world leading economy, i.e, there exists the economic growth convergence, we have a negative term: $(\beta^{\text{GDPpc}}_{1990} + \beta^{\text{Inter}} a\text{Sovrate}^j) \leq 0$. And we also assume that all countries lag the world leading economy in the steady state with a large distance: $(\widehat{\text{LnGDPpc}}_{1990}^{j,*} + \overline{\text{LnGDPpc}}_{1990} < 0)$. Thus, only when the coefficient of sovereign debts rating is positive i.e, $(\beta^{\text{Sovrate}} > 0)$, the value of first derivative is positive:

$$\frac{\partial \widehat{\text{LnGDPpc}}_{1990}^{j,*}}{\partial a\text{Sovrate}^j} > 0 \quad (9)$$

Other coefficients control for the role of other variables. In details, the economic openess (β^{Eopen}) and government effectiveness $(\beta^{\text{Government}})$ can have a positive impact on the growth since these variable captures the institutional quality. The distance to world frontier $(\beta^{\text{Distance}})$ can also exert a positive impact on the economic growth for the backwardness advantage (Gerchenskon, 1956): an economy further from the world frontier can enjoy a higher economic growth by exploring the benefit from the advanced technology.

For the robustness analysis, we employ a fixed-effect panel regression. While the cross-section regression captures the cross-country distribution of per capita GDP across economies, the panel regression focuses on the intra-country distribution of per capita GDP (Sala-i-Martin, 1996; Quah, 1996). Moreover, the cross-section regression reflects the empirical approach based on the theoretical growth model with one unique steady state while the panel regression follows the approach based on the model with multiple steady states (Galor, 1996). Thus, each type of empirical model can reflect different aspect of economic growth convergence.

We carry out two subsequent regression equations. First, we try to detect the existence of non-linearity on the dependence pattern of economic growth on the per capita GDP. In details, the regression equation is as following:

$$GDPpcgrowth^{j,t} = \alpha^j + \beta^{GDPpc} LnGDPpc^{j,t} + \beta^{GDPpc,2} (LnGDPpc^{j,t})^2 + \beta^{Eopen} aEopen^{j,t} + \beta^{Govern} aGovernment^{j,t} + \beta^{Distance} aDistance^{j,t} + u^{j,t} \quad (10)$$

Next, we investigate whether the sovereign debts rating can explain the non-linearity on the pattern of economic growth rate. The regression equation is as following:

$$GDPpcgrowth^{j,t} = \alpha^j + \beta^{GDPpc} LnGDPpc^{j,t} + \beta^{Sovrate} aSovrate^{j,t} + \beta^{Inter} LnGDPpc^{j,t} * aSovrate^{j,t} + \beta^{Eopen} aEopen^{j,t} + \beta^{Govern} aGovernment^{j,t} + \beta^{Distance} aDistance^{j,t} + u^{j,t} \quad (11)$$

In brief, the combination of these two-step analysis can uncover the role of sovereign debts rating on the convergence of economic growth rate in the panel data sample.

3. Safe Assets and Economic Growth Convergence

3.1. Empirical Evidence

Table 1 shows the regression results of economic growth rate on the initial GDP per capita, sovereign debts rating and other independent variables. The evidence examines the impact of debts rating on the economic growth convergence, on controlling for the economic openness, government effectiveness and distance to world frontier.

The evidence records that there exists the convergence of economic growth across economies. In particular, in column 1, the coefficient of initial GDP per capita is negative. Thus, an economy with higher income per capita also has lower economic growth rate. The coefficient of the initial GDP per capita also measures the convergence rate:

$$\beta^{convergence} = \frac{\partial aGDPpcgrowth^j}{\partial LnGDPpc^j} = -0.381$$

The evidence also uncovers that the sovereign debts rating can affect the convergence of economic growth across countries. In particular, in column 2, the estimated coefficients can be captured by the following equation:

$$aGDPpcgrowth^j = 2.848 - 1.202 LnGDPpc^j + 0.264 aSovrate^j - 0.111LnGDPpc^j \cdot aSovrate^j$$

Then, the convergence rate is dependent on the sovereign debts rating as following:

$$\beta^{convergence} = -(1.202 + 0.111 aSovrate^j)$$

The estimated coefficient shows that an economy with a higher sovereign debts rating would have a faster convergence rate. To illustrate this finding, let's consider two economies: Singapore and Mexico. On average over 1990-2019, Singapore has an economic growth at 3.31% and associated sovereign debts rating at 20.46, while the corresponding parameters for Mexico are 1.05% and 12.23. By our empirical evidence, the convergence rate of Singapore is (-3.47) while that of Mexico is (-2,55). Thus, the difference on the convergence rate of Singapore compared with Mexico is 0.92 on its absolute value.

Table 1: Cross-Section Regression Results of Economic Growth Rate (*aGDPpcgrowth*) on Initial GDP per capita, Sovereign Debts Rating, Economic Openness, Government Effectiveness and Distance to World Technology Frontier

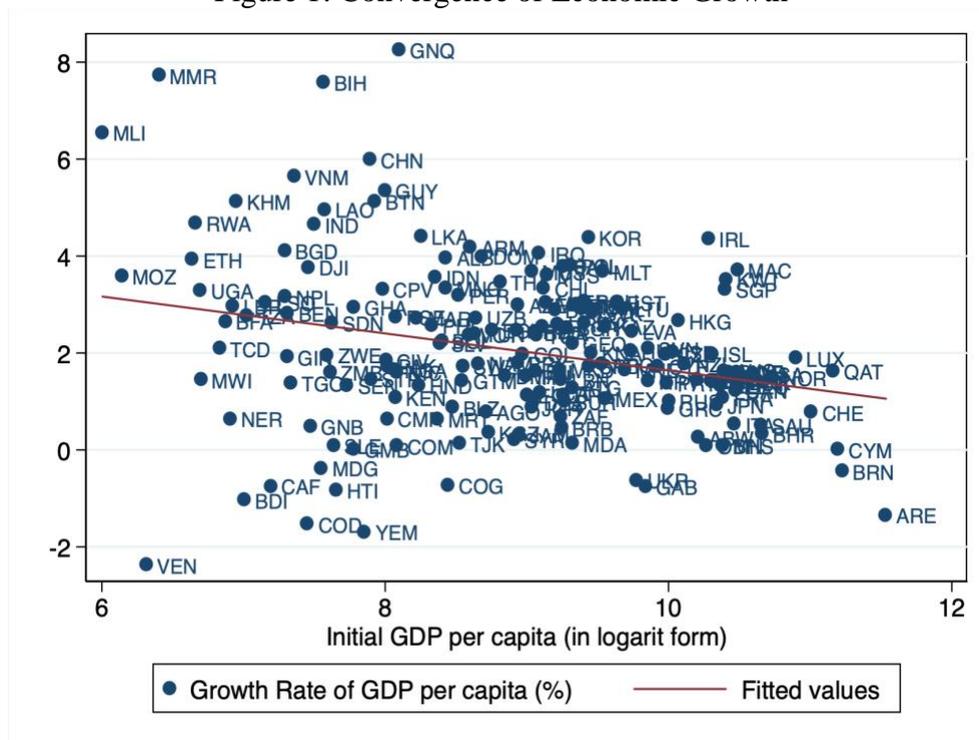
VARIABLES	(1)	(2)	(3)
	aGDPpcgrowth	aGDPpcgrowth	aGDPpcgrowth
Initial GDP per capita (<i>LnGDPpc1990</i>)	-0.381*** (0.103)	-1.202*** (0.163)	-1.188*** (0.179)
Sovereign Debts Rating (<i>aSovrate</i>)		0.264*** (0.0458)	0.246*** (0.0665)
LnGDPpc* aSovrate (<i>Interaction</i>)		-0.111*** (0.0268)	-0.127*** (0.0272)
Economic Openness (<i>aEopen</i>)			0.00455** (0.00214)
Government Effectiveness			-0.0324

(aGovernment)			(0.308)
Distance to World Frontier			1.625**
(aDistance)			(0.649)
Constant	2.067***	2.848***	1.357***
	(0.124)	(0.175)	(0.463)
Observations	177	143	104
R-squared	0.073	0.285	0.355

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Another important finding is the significantly positive coefficient of sovereign debts rating. In the third column, we have: ($\beta^{Sovrate} = 0.246 > 0$). As the equation (7) records, this positive coefficient proves that the sovereign debts rating exerts a positive effect on the steady state level of per capita GDP relative to that of world leading economy.

Figure 1: Convergence of Economic Growth



Source: Economic growth rate is the growth rate of GDP per capita on %. Initial GDP per capita is the GDP in 1990 at constant national 2011 price divided by population, in USD. Data are from Penn World Table 10.1 (2020).

Figure 1 illustrates the convergence of economic growth. With the GDP growth rate on the y-axis and the initial GDP per capita on the x-axis, the

correlation line is a downward sloping line. Thus, the figure is consistent with the empirical evidence recored in Table 1 that an economy with low initial GDP per capita also has a high economic growth rate. On other words, the convergence of economic growth exists.

Next, we investigate the mechanism for the convergence of economic growth. In the neoclassical growth model (Solow, 1956; Swan, 1956), the capital accumulation underlines the convergence of growth process toward the long-run equilibrium or the steady state. Based on this principle, the impact of sovereign debts rating on the capital accumulation can also underlines its role on the econonmic growth convergence. In particular, we collect three variables, including (i) the domestic capital stock at the end of time period, denoted by (LnK2019); (ii) the domestic investment per GDP flow, denoted by ($aI2y$); and (iii) the net total capital inflows per GDP, denoted by ($anegCA2y$). These variables are related to each other on the sense that the domestic capital stock is built up by the flows of domestic investment and foreign capital.

Table 2: Cross-Section Regression Results of Capital Stock (LnK2019), Investment per GDP ($aI2y$), Net Total Capital Inflows per GDP ($anegCA2y$) on Sovereign Debts Rating, Economic Openness, Government Effectiveness, Distance to World Frontier

VARIABLES	(1) LnK2019	(2) aI2y	(3) anegCA2y
Sovereign Debts Rating ($aSovrate$)	0.412*** (0.0732)	0.503** (0.231)	-1.367*** (0.260)
Economic Openness ($aEopen$)	-0.0121*** (0.00272)	0.0164* (0.00858)	-0.0299*** (0.00966)
Government Effectiveness ($aGovernment$)	-1.021** (0.392)	-1.642 (1.236)	6.955*** (1.391)
Distance to World Frontier ($aDistance$)	-0.901 (0.779)	-7.816*** (2.456)	-12.08*** (2.765)
Constant	10.69*** (0.913)	22.09*** (2.880)	26.47*** (3.241)
Observations	104	104	104
R-squared	0.416	0.143	0.451

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2 shows the cross-section regression results of capital stock, investment per GDP and net total capital inflows per GDP on the sovereign debts rating. The analysis also controls for the role of economic openness, government effectiveness and distance to world frontier. In column 1, the coefficient of sovereign debts rating is significantly positive at 0.412. Thus, an increase of average sovereign debts rating by 1 point, the capital stock at the end of time period raises by 1,5 billion USD. In column 2, the coefficient of debts rating is also significantly positive at 0.503 for the domestic investment per GDP, while it is significantly negative at (-1.367) for the net total capital inflows per GDP. Thus, for an increase of sovereign debts rating by 1 point, the domestic investment per GDP goes up by 0.5% while the foreign capital inflows per GDP goes down by 1.3%. Therefore, the evidence records that the sovereign debts rating exerts a positive impact on the domestic capital accumulation, by stimulating the domestic investment rather than the foreign capital inflows.

Next, we also analyze the potential change of economic growth convergence pattern by accounting for the global financial crisis in 2008, and for the development stage.

Table 3: Cross-Section Regression Results of Economic Growth Rate (*aGDPpcgrowth*) on Initial GDP per Capita, Sovereign Debts Rating, Economic Openness, Government Effectiveness, Distance to World Frontier on Two Sub-Samples: Before Global Crisis (1990-2007) in Column 1-3, After Global Crisis (2009-2019) in Column 4-6

VARIABLES	(1) aGDPpc growth	(2) aGDPpc growth	(3) aGDPpc growth	(4) aGDPpc growth	(5) aGDPpc growth	(6) aGDPpc growth
Initial GDP per capita (<i>LnGDPpc1990</i>)	-0.248* (0.144)	-1.321*** (0.206)	-1.199*** (0.197)	-0.415*** (0.152)	-1.320*** (0.285)	-1.693*** (0.384)
Sovereign Debts Rating (<i>aSovrate</i>)		0.290*** (0.0579)	0.240*** (0.0789)		0.270*** (0.0730)	0.259*** (0.0898)
LnGDPpc*aSovrate (<i>Interaction</i>)		-0.0865** (0.0338)	-0.113*** (0.0320)		-0.160*** (0.0415)	-0.218*** (0.0437)
Economic Openness			0.00428*			0.00795**

<i>(aEopen)</i>			(0.00247)			(0.00310)
Government Effectiveness			0.245			0.363
<i>(aGovernment)</i>			(0.396)			(0.437)
Distance to World Frontier			1.073			2.080*
<i>(aDistance)</i>			(0.681)			(1.136)
Constant	2.286***	3.195***	1.945***	1.956***	3.088***	1.239
	(0.173)	(0.229)	(0.494)	(0.181)	(0.280)	(0.782)
Observations	175	130	97	178	142	103
R-squared	0.017	0.252	0.333	0.041	0.159	0.262

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3 records the regression results of economic growth convergence with the financial crisis. From column 1 to 3, the data sample covers the time period before the global crisis (1990-2007), while from column 4 to 6, the data sample covers the time period after the global crisis (2008-2019). The evidence shows that there exists the convergence of economic growth on both the time period before, in column 1, and after the crisis, in column 4. And the convergence rate tends to increase from the value at (-0.248) for the time period before the crisis to the value at (-0.415) for the time period after the crisis. Moreover, the result in column 2 and 5 shows that the sovereign debts rating also affects the convergence growth process. And the magnitude of this effect raises after the crisis, captured by the increase of the coefficient of the interaction term from (-0.086) in column 2 to (-0.16) in column 5. This result holds on controlling for other independent variables in column 3 for the before-crisis period and in column 6 for the after-crisis period. In brief, the convergence of economic growth exists both before and after the global financial crisis and tends to be stronger after the crisis.

Table 4: Cross-Section Regression Results of Economic Growth Rate (*aGDPpcgrowth*) on Initial GDP per Capita, Sovereign Debts Rating, Economic Openness, Government Effectiveness, Distance to World Frontier on Two Sub-Samples: Advanced Economies in Column 1-3, Emerging and Developing

Economies in Column 4-6

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	aGDPpc growth	aGDPpc growth	aGDPpc growth	aGDPpc growth	aGDPpc growth	aGDPpc growth
Initial GDP per capita (<i>LnGDPpc1990</i>)	-1.365*** (0.372)	-1.842 (1.290)	-3.232*** (1.057)	-0.498*** (0.135)	-1.217*** (0.190)	-1.025*** (0.245)
Sovereign Debts Rating (<i>aSovrate</i>)		0.0522 (0.257)	-0.112 (0.203)		0.254*** (0.0580)	0.253*** (0.0836)
LnGDPpc*aSovrate (<i>Interaction</i>)		0.0148 (0.191)	0.112 (0.142)		-0.114*** (0.0365)	-0.0912* (0.0498)
Economic Openness (<i>aEopen</i>)			0.00514*** (0.00141)			-0.00174 (0.00537)
Government Effectiveness (<i>aGovernment</i>)			0.250 (0.439)			0.0874 (0.435)
Distance to World Frontier (<i>aDistance</i>)			2.818*** (0.706)			1.173 (0.951)
Constant	3.794*** (0.515)	3.969*** (1.414)	2.663** (1.027)	1.922*** (0.156)	2.802*** (0.217)	2.101*** (0.786)
Observations	36	36	36	141	107	68
R-squared	0.284	0.300	0.698	0.089	0.286	0.313

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4 shows the regression results of economic growth rate on two different groups of economies: the advanced economies in column 1-3 and the emerging and developing economies in column 4-6. First, there exist the convergence of economic growth in both two groups, as recorded in column 1 and 4. And the convergence rate is higher in the emerging and developing economies, which is (-0.498), than in the advanced economies, which is (-1.365). Second, the impact of sovereign debts rating on the convergence of economic growth only applies for the group of emerging and developing economies. In column 2 and 3, the coefficients of the interaction term between the initial GDP per capita and sovereign debts rating is insignificant for the group of advanced economies. And in column 5 and 6, the corresponding coefficients are significant

for the group of emerging and developing economies. In brief, the convergence of economic growth is stronger in the group of emerging and developing economies than in the group of advanced economies, and the effect of sovereign debts rating only holds on the former group of economies.

3.2. Robustness Analysis

We carry out the robustness analysis of the cross-section evidence on the relationship between the safe assets and economic growth convergence. In particular, we employ a fixed-effect panel regression of the data sample covering the 1990-2019 period. The panel regression captures the time-dimension of data sample while the fixed-effect controls for the unobserved country effect. Compared with the cross-section regression which employs the average value of each variable over the same 1990-2019 period, the fixed-effect panel regression can characterize the fluctuation over time of the impact of safe assets on the economic growth convergence.

Table 5: Panel Regression Results of Economic Growth Rate (*GDPpcgrowth*) on GDP per Capita, Economic Openness, Government Effectiveness, Distance to World Frontier

VARIABLES	(1) GDPpcgrowth	(2) GDPpcgrowth	(3) GDPpcgrowth
GDP per Capita (<i>LnGDPpc</i>)	2.177*** (0.308)	16.15*** (2.524)	17.14*** (4.396)
Squared Value of <i>LnGDPpc</i> (<i>LnGDPpc2</i>)		-0.794*** (0.142)	-0.932*** (0.241)
Economic Openness (<i>Eopen</i>)			0.0143** (0.00575)
Government Effectiveness (<i>Government</i>)			-1.116** (0.548)
Distance to World Frontier (<i>Distance</i>)			5.105*** (1.076)
Constant	-17.83*** (2.811)	-78.02*** (11.15)	-79.17*** (20.07)

Observations	5,147	5,147	2,170
R-squared	0.010	0.016	0.021
Number of Economies	178	178	115

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5 shows the evidence on the economic growth rate on the GDP per capita, on controlling for other independent variables. In column 1, the coefficient of GDP per capita is positive, which means that the current-period economic growth tends to be higher for a higher previous-period GDP per capita. In column 2, the coefficients of the quadratic term is also significant and negative. Thus, the pattern of economic growth follows a quadratic function: it is first increasing then decreasing on the previous GDP per capita. On other word, the pattern can be depicted as an inverted-U-shaped curve. As column 3 shows, this pattern holds on controlling for the economic openness, government effectiveness and distance to world frontier. In brief, the panel evidence records that the economic growth follows a quadratic pattern of initial GDP per capita.

The panel evidence differs the cross-section one on the economic growth convergence. In particular, on the panel analysis, the convergence, that a lower growth rate is associated with a higher GDP per capita, only happens when the GDP per capita is high enough. But the cross-section analysis records that the convergence happens without depending on the level of GDP per capita.

Next, we also carry out the robustness check on the role of sovereign debts rating on the economic growth convergence.

Table 6: Panel Regression Results of Economic Growth Rate (*GDPpcgrowth*) on GDP per Capita, Sovereign Detbs Rating, Economic Openness, Government Effectiveness, Distance to World Frontier

	(1)	(2)	(3)
VARIABLES	GDPpcgrowth	GDPpcgrowth	GDPpcgrowth
Sovereign Debts Rating	0.141***	3.921***	2.890***

<i>(Sovrate)</i>	(0.0405)	(0.350)	(0.591)
GDP per Capita		4.145***	1.754**
<i>(LnGDPpc)</i>		(0.540)	(0.854)
Sovrate*LnGDPpc		-0.383***	-0.283***
<i>(Interaction)</i>		(0.0354)	(0.0587)
Economic Openness			0.0293***
<i>(Eopen)</i>			(0.00514)
Government Effectiveness			-0.181
<i>(Government)</i>			(0.549)
Distance to World Frontier			6.080***
<i>(Distance)</i>			(0.955)
Constant	0.528	-38.96***	-22.19***
	(0.524)	(5.086)	(8.155)
Observations	3,061	3,061	1,766
R-squared	0.004	0.043	0.046
Number of Economies	144	144	104

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6 shows the panel regression results of economic growth on the sovereign debts rating and its interaction term with GDP per capita, on controlling for other independent variables. In column 1, a higher debts rating is associated with a greater economic growth rate. In column 2, the coefficient of GDP per capita is positive but that of the interaction term between the GDP per capita and the sovereign debts rating is negative. As column 3 records, this result holds on controlling for the economic openness, government effectiveness and distance to world frontier.

The empirical evidence establishes that the convergence of economic growth only happens for a high enough sovereign debts rating.

$$GDPpcgrowth = 3.921 Sovrate + 4.145 LnGDPpc - 0.383 Sovrate.LnGDPpc$$

$$\Rightarrow \frac{\partial GDPpcgrowth}{\partial LnGDPpc} < 0 \Leftrightarrow Sovrate > 10.8$$

This result can explain the inverted-U-shaped dependence pattern of current-period economic growth on the previous-period GDP per capita. In

particular, for the low sovereign debts rating, i.e, lower than 10.8, an increase of GDP per capita is associated with higher economic growth rate. And only for the high sovereign debts rating, i.e, higher than 10.8, an increase of GDP per capita is associated with lower economic growth. Therefore, the convergence of economic growth only applies when the sovereign debts rating is high.

Table 7 shows the robustness check on the role of sovereign debts rating on the accumulation of capital stock. In column 1, a higher sovereign debts rating is associated with a huger capital stock. This increase of sovereign debts rating is also associated with more investment per GDP ratio, as shown in column 2, and more net total capital inflows per GDP, as captured in column 3. Compared with the cross-section evidence, the panel evidence is different only on the impact of sovereign debts rating on the net total capital inflows. This difference can rely on the fact that the panel regression can capture the time dimension of cross-border capital flows while the cross-section regression accounts for their cross country dimension.

Table 7: Panel Regression Results of Capital Stock (LnK), Investment per GDP ($I2y$), Net Total Capital Inflows ($negCA2y$) on Sovereign Debts Rating, Economic Openness, Government Effectiveness, Distance to World Frontier

	(1)	(2)	(3)
VARIABLES	LnK	$I2y$	$negCA2y$
Sovereign Debts Rating (<i>Sovrate</i>)	0.0326*** (0.00369)	1.149*** (0.0609)	0.826*** (0.0805)
Economic Openness (<i>Eopen</i>)	0.00195*** (0.000329)	-0.00408 (0.00543)	-0.0559*** (0.00742)
Government Effectiveness (<i>Government</i>)	0.110*** (0.0362)	-3.361*** (0.598)	-2.876*** (0.797)
Distance to World Frontier (<i>Distance</i>)	-0.174*** (0.0627)	-4.236*** (1.036)	-12.97*** (1.430)
Constant	13.14*** (0.0654)	13.82*** (1.082)	5.047*** (1.490)

Observations	1,766	1,765	1,708
R-squared	0.086	0.177	0.110
Number of ifscodes	104	104	104

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In brief, the cross-section evidence and associated robustness analysis by the panel data evidence jointly establishes role of the sovereign debts rating as a determinant of the convergence of economic growth across economies. This role works through the accumulation of capital, by stimulating both the domestic investment and foreign capital inflows.

4. Conclusion

The paper investigates the convergence of economic growth under the impact of the sovereign debts rating. Based on a data sample of 178 economies over 1990-2019, the empirical evidence records that the convergence exists. And its pattern depends on the sovereign debts rating: a higher rating raises both the chance and speed of convergence. This dependence pattern works through a larger capital accumulation for a better sovereign debts rating.

For the policy implication, the results uncover that the sovereign debts rating can be a priority for the public policy to upgrade the convergence of economic growth. This opens a new channel for the debts issuance to affect the economic growth: it can not only provide an additional finance resource for the economy but also determine the speed of growth convergence to the leading economy.

For the future research avenue, the paper can be extended by various ways. The convergence of economic growth can depend on the context of global economy. Recently, the recovery during Covid-19 pandemic is different across economies, generating the income gap across economies. Thus, the future research can cover the impact of the pandemic on the convergence of economic growth, on accounting for the sovereign debts rating.

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