

SEEJE

South-Eastern Europe Journal of Economics

THE OFFICIAL JOURNAL OF THE ASSOCIATION OF ECONOMIC UNIVERSITIES
OF SOUTH AND EASTERN EUROPE AND THE BLACK SEA REGION

Vol 18 | No 2 | FALL 2020

web site: <http://www.asecu.gr>
ISSN 1109-8597
ISSN On line: 1792-3115



FUNDING INSTITUTION
UNIVERSITY OF MACEDONIA
THESSALONIKI, GREECE

SEEJE

Editorial Office:

ASECU, University of Macedonia

156 Egnatia Str., 546 36 Thessaloniki, Greece

tel: +30 2310 891 793, fax: +30 2310 891 748

e-mail: asecu@uom.edu.gr

web site: <http://www.asecu.gr>

© ASECU

ISSN 1109-8597

ISSN On line: 1792-3115

Thessaloniki, Fall 2020

contents

Articles

- Are "Twin Deficits" an Illusion?
International Evidence on Fiscal Policy and the Current Account**
GEORGIOS KARRAS 139
- Determinants of Firm Investment:
Evidence from Slovenian Firm-Level Data**
ČRT LENARČIČ, GEORGIOS PAPADOPOULOS 159
- China - Cee Relations, In-Depth Analyses of 16+1 Mechanism
Within Obor Initiative**
LEONID NAKOV, VLADO DIMOVSKI, IGOR IVANOVSKI 181
- Growth, Wealth Accumulation and Environmental Change
in Portfolio Choice and Trade**
WEI-BIN ZHANG 197
- The Global Financial Crisis (GFC) and Remittances Received in Africa:
Any Lessons for Covid-19?**
EMEKA OKORO AKPA, SEGUN SUBAIR AWODE,
ANDY TITUS OKWU, ISIAQ OLASUNKANMI OSENI 217

aim and scope of

ASECU was founded in 1996 as Association of South-Eastern Europe Economic Universities with the general aim of promoting the interests of those economic universities in South-Eastern Europe which are public, recognized or financed by the state of origin.

By decision taken in General Assembly of 2007, it was modified *in Association of Economic Universities of South and Eastern Europe and the Black Sea Region*. Presently, Universities and Research Centers are included to the active Full members of ASECU from Albania, Armenia, Bosnia-Herzegovina, Bulgaria, Greece, Montenegro, North Macedonia, Poland, Romania, Russia, Serbia, Slovakia, Turkey and Ukraine. Also, as Associated members, Universities form Egypt, China, Hungary, Kazakhstan, Lebanon and Palestine.

The specific aims of the Association are:

To promote cooperation between Economic Universities, Faculties, Departments; i.e., especially: a) to exchange views and information about syllabi, b) to exchange undergraduate and postgraduate students and c) to exchange teaching and research staff.

To provide members with the opportunity exchange information, opinions etc. by publishing a relevant scientific journal or by cooperation in elaborating scientific studies in relation to the future development of higher education and research as well as to improve their quality in the field of economic studies and business administration.

To undertake initiatives for the protection of the interests of members and their institutions, so as to be supported by international organizations and in particular by the higher education institutions of the European Union.

To encourage cooperation between universities inside and outside the countries referred to in the Association.

To pursue cooperation in the field of higher education with the consolidation of close relations with other organisations having similar aims, e.g. E.U.A.;

To provide opportunities for harmonising the degrees of faculties and departments of the universities participating in the Association;

To promote cooperation between economic universities, faculties, departments in the field of research for the benefit of the economy, the society, peace and the cultural development of the countries referred to the Association.

Presidency and Board Members

The following Board was elected for a four years period, during the 7th General Assembly of ASECU, on the 30th of March 2019.

Grigorios Zarotiadis, President

Aristotle University of Thessaloniki, Thessaloniki, Greece

Oleg Bodyagin, Vice President

Rostov State University of Economics, Rostov-on-Don, Russia

Leonid Nakov, General Secretary

“Ss Cyril and Methodious” University, Skopje, North Macedonia

Fatmir Memaj, Member

University of Tirana, Tirana, Albania

Dejan Mikerević, Member

University of Banja Luka, Bosnia - Herzegovina

Paskal Zhelev, Member

University of National and World Economy, Sofia, Bulgaria

Vesna Karadžić, Member

University of Montenegro, Podgorica, Montenegro

Bogdan Wierzbinski, Member

University of Rzeszów, Rzeszów, Poland

Zaklina Stojanović, Member,

University of Belgrade, SERBIA

ARE "TWIN DEFICITS" AN ILLUSION? INTERNATIONAL EVIDENCE ON FISCAL POLICY AND THE CURRENT ACCOUNT

GEORGIOS KARRAS*
University of Illinois at Chicago

Abstract

The “Twin Deficits” hypothesis predicts that the current account responds to changes in the budget deficit, whether these are coming from changes in government spending or taxes. On the contrary, the “Fundamental Current Account Equation” of the intertemporal approach predicts that the current account responds only to (temporary) changes in government spending but not to taxes. Using annual data from 1870 to 2013 for a panel of seven OECD economies, the paper finds that (i) budget and current account deficits move together, which is necessary but not sufficient for the Twin Deficits hypothesis to hold; (ii) temporary increases in government spending deteriorate the current account balance, as predicted by the Fundamental Equation hypothesis; and (iii) changes in the budget deficit, other than temporary changes in government spending, also reduce the current account balance, suggesting that Twin Deficits are not an illusion. Quantitatively, an increase in temporary government spending by 1% of GDP deteriorates the current account by a maximum of 0.20% of GDP, whereas an increase in temporary taxes by 1% of GDP improves the current account by a maximum of 0.50% of GDP.

JEL Classification: E62, F41

Keywords: Budget Deficit, Current Account Balance, Twin Deficits, Fundamental Current Account Equation

I wish to thank participants at the 15th International WEAI Conference in Tokyo, and seminar participants at the Department of Economics, University of Wisconsin-Milwaukee for helpful comments and suggestions. Errors and omissions remain mine.

Corresponding Address:* **Georgios KARRAS, Professor of Economics, University of Illinois at Chicago, Department of Economics, 601 S. Morgan St., Chicago, IL 606077121.
E-mail: gkarras@uic.edu.

1. Introduction

The Covid-19 public health emergency has reinforced the trend begun with the global financial crisis towards extraordinary fiscal intervention combined with near-zero interest rates¹. This macroeconomic policy mix has revitalized interest in the relationship between the government budget and the current account. There is widespread consensus that the two should move together, often characterized as the “twin deficits” hypothesis. The popularity of the hypothesis is explained by evidence such as the recent US experience, where an unprecedented peacetime fiscal stimulus worth 12% of GDP has coincided with the largest trade deficit in 14 years².

Theoretically, however, the precise nature of the relationship between the two balances is less straightforward. The strongest version of “twin deficits”, suggested by simple open-economy national income accounting, is that the deficits in the government budget and the current account have an exact one-to-one relationship; however, this rests on unrealistic assumptions about the behavior of private saving and investment. When these assumptions are relaxed, as in the Mundell-Fleming model or the “fundamental current account equation” intertemporal approach, the budget deficit is shown to influence the current account in more complex and varying ways. As shown in section 2 below, the theoretical consensus is quite fragile.

Therefore, the precise nature of the relationship between the two balances needs to be resolved empirically, and a very large literature has developed on the subject, utilizing different data sets and econometric techniques. Recent examples include Corsetti and Müller (2006), Kim and Roubini (2008), Bluedorn and Leigh (2011), IMF (2011), Forte and Magazzino (2013), Eldemerdash, Metcalf, and Maioli (2014), Auerbach and Gorodnichenko (2016), Forni and Gambetti (2016), and Karras (2019). While results differ widely, a broad consensus appears to be that increases in budget deficits do worsen the current account balance, but less than one-to-one. Focusing on the influential IMF (2011) study, for example, a fiscal consolidation of 1% of GDP is found to improve the current account balance by a little more than 0.5% of GDP, and the effect is found to be permanent.

The goal of the present paper is to revisit this relationship, aiming at distinguishing between the “twin deficit” and “fundamental current account equation” approaches. The paper also relies on a unique data set of seven countries over the period 1870-2013. The main advantage of using such a long data set is that it includes a variety of government budget and current account experiences that are not typically (or not at all) found in more commonly used post-World War II data sets.

1. See IMF (2020), OECD (2020), World Bank (2020).

2. The Economist (October 20, 2020).

Our first finding is that a version of the “twin deficits” hypothesis is indeed supported by the data. A change in the budget deficit moves the current account in the opposite direction, though by less than one-to-one (about a quarter-to-one). The effect is shown to be persistent but temporary, peaking about three years after the shock, and dying out after a maximum of ten years. However, we find a similar result if the budget deficit is replaced by temporary changes in government spending, as predicted by the “fundamental current account equation”. Because the budget deficit is highly positively correlated with temporary increases in government spending, empirical models such as these cannot distinguish between the two theories.

Next, we move to the paper’s central contribution, which is to develop models that identify the current account effects of temporary government spending separately from those of other components of the budget deficit (including temporary taxes). The results are instructive. While, as predicted by the “fundamental current account equation”, temporary government spending clearly affects the current account, so does the rest of the budget deficit (including temporary taxes) as well, implying that “twin deficits” are not an illusion. The estimated models can be used to quantify these effects and how they evolve over time.

The rest of the paper is organized as follows. Section 2 discusses the conceptual framework, presents the data, and defines the variables to be used in the estimation. Section 3 outlines the estimation methodology, derives the main empirical results, and implements a number of robustness checks. Section 4 discusses the findings and concludes.

2. Conceptual Framework

This section discusses three of the most widely used theoretical approaches which have clear, though differing, implications about the relationship between the balances of the current account and the government budget.

The first, and probably the simplest, is the open-economy national accounting identity, $CA \equiv S - I$, which says that the current account balance (CA) equals the difference between national saving (S) and domestic investment (I). National saving is the sum of private saving (S_p) and government saving (S_G): $S = S_p + S_G$. Defining government saving as the difference between net tax revenue (T) and government spending (G), we have $S_G = T - G$, which is just the government budget surplus. Substituting in the current account identity, we get $CA \equiv S_p - I - (G - T)$, which is the origin of the “twin” deficits hypothesis: *given private saving and investment*, there should be an exact one-to-one relationship between the budget deficit and the current account deficit. In other words, $\frac{\partial(-CA)}{\partial(G-T)} = 1$. An increase in $(G - T)$ by $\$x$ will be accompanied by a decrease in CA by exactly $\$x$. Moreover, it makes no difference whether the increase in $(G - T)$ comes from a higher G or a lower T : under the assumptions stated above, the CA effects would be the same. Under these assumptions, the two deficits are “twins”. Of course, what makes the “twin deficits” hypothesis a very special case is that, realistically, neither private saving nor investment are likely to be unaffected

by fiscal policy changes. The next two theoretical frameworks address this in two very different ways.

The second approach we consider is a simple version of the Mundell-Fleming model, based on standard Keynesian consumption and import functions. As is well known, this implies $\frac{\partial CA}{\partial G} < 0$ and $\frac{\partial CA}{\partial T} > 0$, so that $\frac{\partial(-CA)}{\partial(G-T)} > 0$. Once again, the budget and current-account deficits are (almost) twins: they move in the same direction, though not necessarily one-to-one. Note again that the relationship applies both to changes in G and changes in T .

The third and final framework we consider is the simplest version of the “intertemporal approach” to the current account. The representative individual’s objective at time t is to maximize $\sum_{j=0}^{\infty} (1 + \rho)^{-j} u(C_{t+j})$, where C is consumption, ρ is the subjective rate of time preference, and the utility function satisfies $u' > 0$ and $u'' < 0$. Using B for beginning-of-period net foreign assets, Y for GDP, and r for the real interest rate, the open economy’s budget constraint is $B_{t+1} - B_t = Y_t + rB_t - C_t - G_t - I_t$.³ Obstfeld and Rogoff (1996) show that the first-order conditions imply consumption smoothing and, under the simplifying assumption $\rho = r$, the exact “fundamental current account equation”: $CA_t = (Y_t - \tilde{Y}_t) - (I_t - \tilde{I}_t) - (G_t - \tilde{G}_t)$, where \tilde{X}_t denotes the permanent component of variable X_t .⁴

The “fundamental current account equation” above implies that increases in G will affect the current account only to the extent they are temporary: optimizing consumers will try to reduce consumption by a smaller amount (or leave it unaffected if \tilde{G}_t is not altered at all), necessitating more borrowing from abroad and thus a deterioration in the current account: $\frac{\partial(-CA)}{\partial(G_t - \tilde{G}_t)} > 0$. Permanent changes in G , however, will cause consumption to move in the opposite direction by exactly the same amount, so the current account will be unaffected: $\frac{\partial(-CA)}{\partial \tilde{G}_t} = 0$. In addition, and most importantly for our purposes here, changes in taxes are completely irrelevant for the determination of the current account: *given the “fundamentals”* in the right-hand side of the equation, changing taxes has no effect on the current account balance (consumers are subject to Ricardian Equivalence)⁵.

3. Note that $Y_t + rB_t = GNP_t$, so $Y_t + rB_t - C_t - G_t - I_t = S_t - I_t$, and because $B_{t+1} - B_t = CA_t$, the budget constraint is equivalent to $CA = S - I$.

4. Specifically, $\tilde{X}_t = \frac{r}{1+r} \sum_{j=0}^{\infty} (1+r)^{-j} X_{t+j}$.

5. Of course, just like the strict “twin deficits” hypothesis, the simple “fundamental equation” is also a special case. Obstfeld and Rogoff (1996) show that in more realistic theoretical settings, where consumers are not necessarily Ricardian, government budget deficits will induce current account deficits, so the two will continue to move together, though their relationship will not necessarily be one-to-one. The related theoretical literature is vast, and the theoretical predictions vary considerably. For example, Erceg, Guerrieri, and Gust (2005) develop a dynamic general equilibrium model which predicts that a rise in the fiscal deficit by 1% of GDP would deteriorate the trade balance by 0.2% of GDP or less. On the other hand, Roubini (1988) shows that if both consumption smoothing and tax smoothing apply, the theoretical relationship between the budget and current account deficits should be one-to-one (the strong version of the “twin” result).

This raises the possibility that “twin deficit” empirical findings are an illusion, in the following sense. Suppose the “fundamental current account equation” is correct and fiscal policy affects the current account only when government spending goes up temporarily. Because temporary increases in G tend to coincide with budget deficits (as we will see in the next section, the two variables are highly positively correlated), one would (correctly) conclude that such deficits deteriorate the current account, but then (erroneously) decide that this confirms the “twin deficits” hypothesis and (again erroneously) infer that changes in both G and T influence CA .

The implication is that establishing an empirical relationship between the budget deficit, $G - T$, and the current account balance, CA , is necessary but not sufficient evidence in favor of the “twin deficits” hypothesis. The reason is that such a relationship would obtain even if the “twin deficits” hypothesis was false, but other economic conditions, such as the “fundamental equation”, applied.

Therefore, to convincingly test the “twin deficits” hypothesis, one needs to show that elements of the budget deficit *other than the temporary component of government spending*, can also affect the current account balance in the predicted direction. This is the task of the empirical part of this paper.

3. Data

All data are from the Jordà-Schularick-Taylor Macrohistory Database (see Jordà, Schularick, and Taylor, 2017). Using i to index over countries and t over time, the current account balance as percent of GDP is simply defined as $ca_{i,t} = \frac{CA_{i,t}}{GDP_{i,t}} \cdot 100$, where $CA_{i,t}$ is the reported current account balance (nominal, local currency), and $GDP_{i,t}$ is Gross Domestic Product (nominal, local currency). Similarly, the government budget deficit as percent of GDP is defined as $d_{i,t} = \frac{G_{i,t} - T_{i,t}}{GDP_{i,t}} \cdot 100$, where $G_{i,t}$ is government expenditure (nominal, local currency), and $T_{i,t}$ is government revenues (nominal, local currency).

The data set consists of annual observations covering the period 1870 – 2013 for each of the following seven countries, for which complete time series are available: Canada, Switzerland, Great Britain, Italy, Portugal, Sweden, and the US.

To incorporate the predictions of the intertemporal approach, we rewrite the budget deficit as $d_{i,t} = g_{i,t} - \tau_{i,t}$, where $g_{i,t} = \frac{G_{i,t}}{GDP_{i,t}} \cdot 100$ and $\tau_{i,t} = \frac{T_{i,t}}{GDP_{i,t}} \cdot 100$. We then use the Hodrick-Prescott (HP) filter, proposed by Hodrick and Prescott (1997), to decompose g and τ into permanent (\tilde{g} and $\tilde{\tau}$) and transitory (\hat{g} and $\hat{\tau}$) components⁶.

6. In particular, for a series x_t , the HP filter defines the permanent component, \tilde{x}_t , as the one that minimizes $\sum_{t=1}^T (x_t - \tilde{x}_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tilde{x}_{t+1} - \tilde{x}_t) - (\tilde{x}_t - \tilde{x}_{t-1})]^2$ for $\lambda > 0$. In the empirical section below we report results for $\lambda = 100$, the value suggested by Hodrick and Prescott for annual data, but we have also tried $\lambda = 6.25$, as recommended by Ravn and Uhlig (2002). The temporary component is then $\hat{x}_t = x_t - \tilde{x}_t$.

Figures A1 and A2 in the Appendix illustrate the decompositions⁷.

Figure 1 plots the budget deficit, $d_{i,t}$, and the current account balance, $ca_{i,t}$, for each of the seven countries over the entire period. Figure 2 repeats the exercise for temporary government spending ($\hat{g}_{i,t}$) and $ca_{i,t}$. Figures 1 and 2 clearly show the generally inverse relationship between the current account and both of the other variables: increasing budget deficits or temporary government expansions tend to coincide with deteriorating current account balances, while diminishing budget deficits or reductions in temporary government spending tend to overlap with improving current account balances.

Visually, therefore, the majority of episodes appear to be qualitatively consistent with both the “twin deficits” and the “fundamental equation” hypotheses. The most striking examples include the sizable World War I and World War II fiscal expansions which were accompanied by current account deteriorations in most countries. Even peace-time current account balances, however, usually move *in the opposite* direction from budget deficits or temporary government increases (such as in Italy and Portugal in the 1970s, or Sweden and the US in the 1980s), as dictated by the “twin deficits” and “fundamental equation” hypotheses⁸.

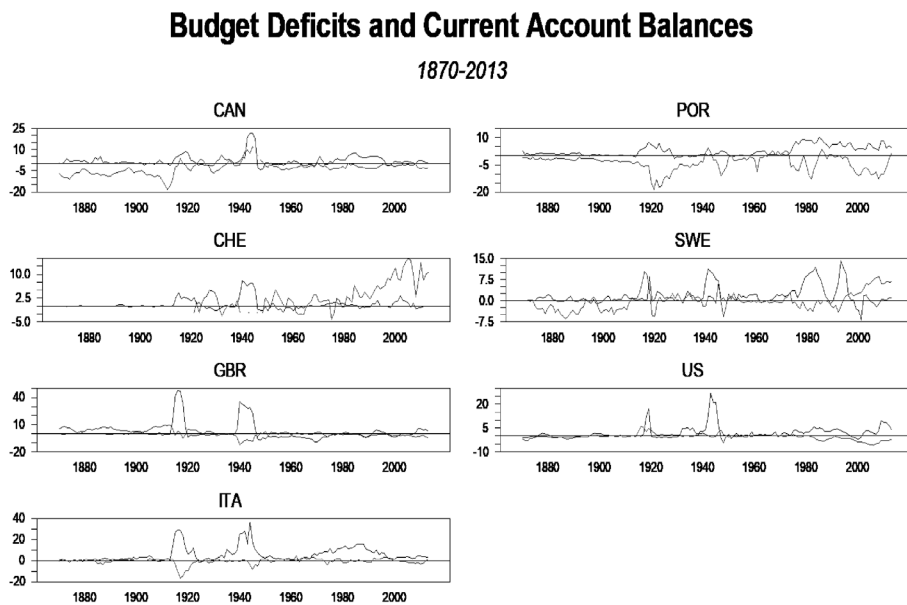


Figure 1. Government Budget Deficits (black lines) and Current Account Balances (blue lines) as percent of GDP.

-
7. The filters proposed by Baxter and King (1999) and Christiano and Fitzgerald (2003) were also used for the decomposition, with very similar results.
8. Nevertheless, exceptions are also easy to identify (as in Switzerland in the 1990s and Portugal in the 2000s), when budget deficits (or temporary government expansions) and current account balances moved *in the same* direction, contrary to the “twin deficit” and “fundamental equation” hypothesis. This is another reason why the formal testing of the next section is necessary.

Temporary G and Current Account Balances

1870-2013

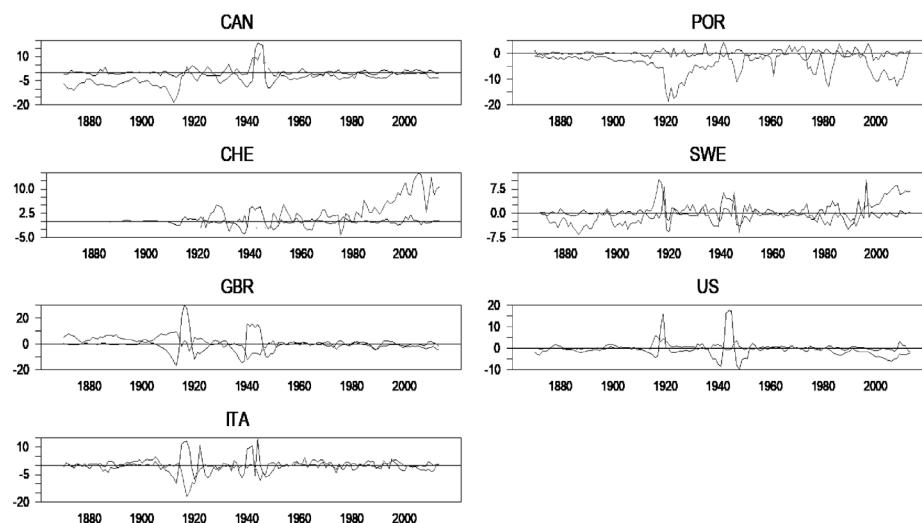


Figure 2. Temporary Government Spending (black lines) and Current Account Balances (blue lines) as percent of GDP.

Summing up, the visual evidence is potentially consistent with both the “twin deficits” and the “fundamental equation” hypotheses – as a result, it is unable to distinguish between the two.

The first objective of the next section is to show that the same ambiguity obtains if we formally test these relationships separately (as in most of the literature). The second objective is to go beyond the ambiguous evidence by estimating nested models that can be used to unambiguously distinguish between the two competing explanations.

3. Empirical Evidence

This section presents the paper’s empirical evidence. Section 3.1 tests the relationship between the budget deficit and the current account balance. Section 3.2 investigates the relationship between temporary government spending and the current account. Section 3.3 presents a nested model, and section 3.4 an additional extension for robustness.

3.1 *The Two Deficits*

We start with a simple dynamic relationship that estimates the responses of the

current account balance to changes in the government budget deficit. Using the local projection method of Jordà (2005), the basic specification is:

$$ca_{i,t+h} = w_i^h + v_t^h + \theta^h \Delta d_{i,t} + \sum_{j=1}^J \theta_j^h \Delta d_{i,t-j} + \sum_{j=1}^J \alpha_j^h ca_{i,t-j} + u_{i,t} \quad (1)$$

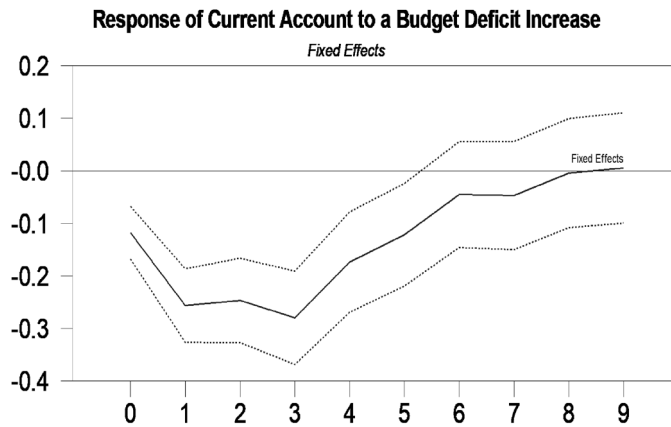
where i is indexing over countries and t over time; h indicates the horizon (years after time t) considered; the w s and v s are, respectively, country- and time-specific fixed (or random) effects; and the α s and θ s are parameters to be estimated. The desired impulse response function consists of the estimated θ^h s, which capture the dynamic responses of the current account balance to a change in the budget deficit.

Table 1 and Figures 3 and 4 present the impulse response functions estimated with fixed or random effects. Beginning with the fixed-effects estimates (Figure 3 and top row of Table 1), an increase in the budget deficit by 1% of GDP is found to reduce the current account balance contemporaneously (i.e., within the year) by 0.12% of GDP. This impact is modest, but statistically significant. One year later, however, the deterioration in the current account is much larger, at 0.26% of GDP (and statistically significant). The current account effect then gradually declines in (absolute) size, but remains statistically significantly negative even for the sixth year after the shock. By the tenth year after the increase in the budget deficit, however, the current account response has effectively died out – both economically and statistically. The random effect estimates (Figure 4 and second row of Table 1) paint a very similar picture, so the results appear to be robust to the modeling of the country-specific and time-specific effects.

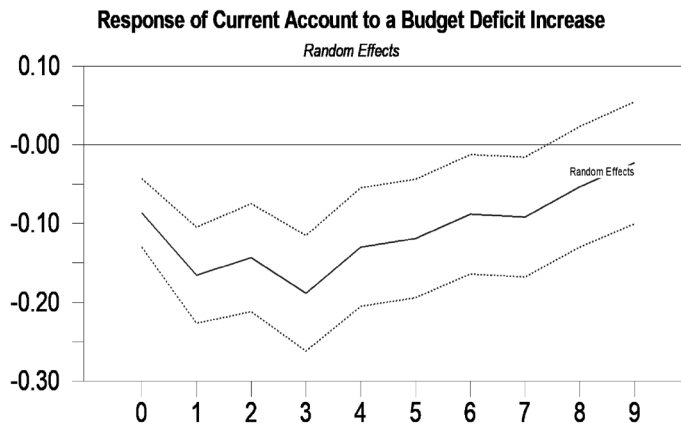
Table 1. Responses of the Current Account to the Budget Deficit

	Horizons (in years)				maximum response	year
	0	1	5	10		
Fixed Effects	-0.118** (0.025)	-0.256** (0.035)	-0.121* (0.049)	-0.036 (0.053)	-0.279** (0.044)	3
Random Effects	-0.086** (0.022)	-0.166** (0.030)	-0.119** (0.038)	-0.000 (0.039)	-0.189** (0.037)	3

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Budget Deficit by 1% of GDP. Estimated standard errors in parentheses. ‘***’ and ‘*’ denote statistical significance at the 1% and 5% significance levels.

**Figure 3**

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Budget Deficit by 1% of GDP. Model estimated over 1870-2013 with country and time fixed effects. Dashed lines are two-standard-error confidence intervals.

**Figure 4**

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Budget Deficit by 1% of GDP. Model estimated over 1870-2013 with country and time random effects. Dashed lines are two-standard-error confidence intervals.

Overall, the evidence suggests that the response of the current account balance to the budget deficit is inverse-hump-shaped: an increase in the budget deficit results in a current account deterioration that is sizeable though less than one-to-one, and persistent but temporary.

We now turn to an investigation of the mechanisms that are generating this relationship.

3.2 Temporary Government Spending

Pursuing now the “fundamental current account equation” perspective, the next model allows the current account to respond only to temporary changes in government spending. Using again the local projection method (Jordà, 2005), the specification becomes:

$$ca_{i,t+h} = w_i^h + v_t^h + \beta^h \Delta \hat{g}_{i,t} + \sum_{j=1}^J \beta_j^h \Delta \hat{g}_{i,t-j} + \sum_{j=1}^J \alpha_j^h ca_{i,t-j} + u_{i,t} \quad (2)$$

where notation is as in (1), and now the α s and β s are parameters to be estimated. The desired impulse response function consists of the estimated β^h s, which capture the dynamic responses of the current account balance to a change in the temporary component of government spending, \hat{g} .

Table 2 and Figures 5 and 6 present the estimated impulse response functions. The most remarkable thing about these estimates is how similar they are to the ones from model (1). Looking at the fixed-effects estimates for example (Figure 5 and top row of Table 2), an increase in temporary government spending by 1% of GDP reduces the current account balance by 0.11% of GDP contemporaneously (i.e., within the year), and by 0.19% of GDP one year later (both statistically significant). The effect then gradually declines, eventually becoming economically and statistically insignificant. The random effect estimates (Figure 6 and second row of Table 2) tell the same story, with minor quantitative differences (such as the maximum effect occurring three years out), so the results are again robust across the specifications.

Table 2. Responses of the Current Account to Temporary Government Spending

	Horizons (in years)				maximum response	year
	0	1	5	10		
Fixed Effects	-0.110** (0.027)	-0.189** (0.038)	-0.028 (0.051)	-0.001 (0.055)	-0.189** (0.038)	1
Random Effects	-0.084** (0.023)	-0.108** (0.032)	-0.084* (0.040)	0.040 (0.041)	-0.148** (0.039)	3

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Temporary component of Government Spending by 1% of GDP. Estimated standard errors in parentheses. ‘**’ and ‘*’ denote statistical significance at the 1% and 5% significance levels.

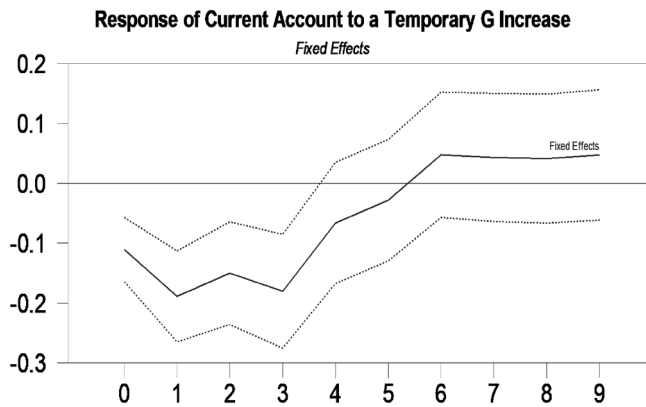


Figure 5

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Temporary component of Government Spending by 1% of GDP. Model estimated over 1870-2013 with country and time fixed effects. Dashed lines are two-standard-error confidence intervals.

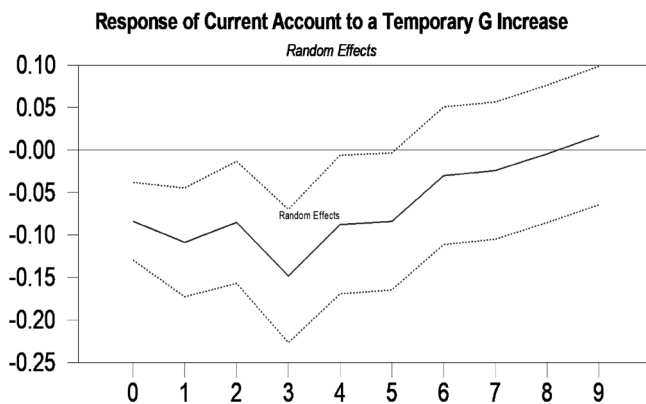


Figure 6

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the Temporary component of Government Spending by 1% of GDP. Model estimated over 1870-2013 with country and time random effects. Dashed lines are two-standard-error confidence intervals.

This evidence is obviously consistent with the predictions of the “fundamental current account equation”. In addition, however, it casts doubt on the “twin deficits” interpretation of the observed relationship between the two balances. We will return to this in the next section, but it is worthwhile first to ask: Why are the results of models (1) and (2) so similar? The answer is simple: the overall budget deficit and the temporary component of government spending are strongly positively correlated. Table A1 in the Appendix shows this to be the case both for the levels

and first differences of the two series, and for all of the countries in our sample. This is not surprising of course: periods of temporarily high government spending are naturally periods of deficit financing, as implied by the “tax smoothing” hypothesis (Barro, 1979). The implication for our empirical strategy is obvious. Models (1) and (2) do not suffice to distinguish between the “twin deficit” and “fundamental current account equation” explanations of the observed relationship. To achieve this, we next turn to a richer model.

3.3 A Nested Model

To shed light on the validity of the two competing frameworks, we estimate a model that allows the current account to be affected differently by temporary government spending than by other components of the budget deficit. Specifically, let $nd_{i,t} = d_{i,t} - \hat{g}_{i,t}$ denote the *net deficit* (deficit net of temporary government spending), and consider the local projection model:

$$ca_{i,t+h} = w_i^h + v_t^h + \beta^h \Delta \hat{g}_{i,t} + \sum_{j=1}^J \beta_j^h \Delta \hat{g}_{i,t-j} + \delta^h \Delta nd_{i,t} + \sum_{j=1}^J \delta_j^h \Delta nd_{i,t-j} + \sum_{j=1}^J \alpha_j^h ca_{i,t-j} + u_{i,t} \quad (3)$$

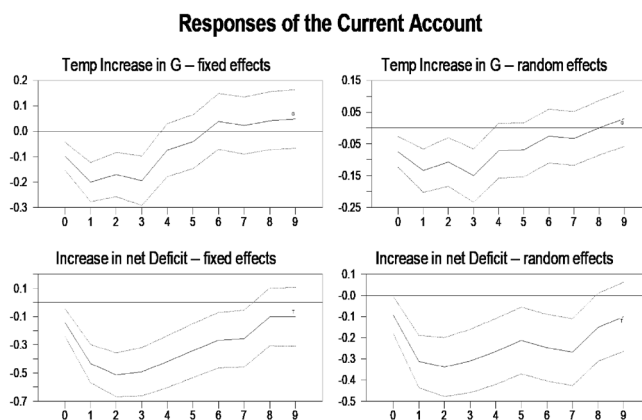
where notation is standard, and now the α s, β s, and δ s are parameters to be estimated. There are now two impulse response functions that are of interest: (i) the estimated β^h s, which capture the dynamic responses of the current account balance to a change in the temporary component of government spending, \hat{g} , and (ii) the estimated δ^h s, which capture the responses to a change in the net deficit, i.e., any component of the budget deficit other than temporary government spending, \hat{g} . In simple terms, the “fundamental current account equation” predicts $\beta^h < 0$ and $\delta^h = 0$, whereas the two deficits can be characterized as “twins” if $\delta^h < 0$, so that the relationship holds even when the change in the budget balance does not come from the temporary component of government spending.

Table 3 and Figure 7 report the results from model (3). The most crucial finding for your purposes is that *both* temporary government spending and the net deficit are shown to deteriorate the current account balance. In fact, the two responses are qualitatively similar to each other, and to the results of the previous two Tables. For example, the fixed-effects estimates (the two left panels of Figure 7, and the two top rows of Table 3), estimate that an increase in temporary government spending (net deficit) by 1% of GDP reduces the current account balance by 0.1% (0.14%) of GDP within the year, and by 0.2% (0.43%) of GDP one year later (both statistically significant). Both effects then gradually decay, eventually becoming economically and statistically insignificant. The random effect estimates (in the two right panels of Figure 7, and the bottom two rows of Table 3) demonstrate robustness.

Table 3. Responses of the Current Account to Temporary Government Spending and the Net Deficit

	Horizons (in years)				maximum response	year
	0	1	5	10		
Fixed Effects						
Temporary G	-0.098** (0.028)	-0.200** (0.038)	-0.042 (0.053)	-0.018 (0.058)	-0.200** (0.038)	1
Net Deficit	-0.142** (0.049)	-0.433** (0.068)	-0.341** (0.096)	-0.151 (0.105)	-0.513** (0.078)	2
Random Effects						
Temporary G	-0.075** (0.024)	-0.134** (0.034)	-0.069 (0.043)	0.043 (0.044)	-0.150** (0.042)	3
Net Deficit	-0.093* (0.044)	-0.312** (0.062)	-0.213** (0.079)	-0.112 (0.082)	-0.338** (0.070)	2

Notes: Response of the Current Account Balance (as a percent of GDP) to increases in the Temporary component of Government Spending and the Net Deficit, each by 1% of GDP. Estimated standard errors in parentheses. ‘***’ and ‘*’ denote statistical significance at the 1% and 5% significance levels.

**Figure 7**

Notes: Response of the Current Account Balance (as a percent of GDP) to increases in the Temporary component of Government Spending and the Net Deficit, each by 1% of GDP. Model estimated over 1870-2013 with country and time fixed or random effects, as indicated. Dashed lines are two-standard-error confidence intervals.

These results suggest that the “twin deficit” hypothesis does not look like an illusion. The “fundamental current account equation’s” prediction that the current account deteriorates when government expenditure increases temporarily is clearly supported by the data. However, the evidence also suggests that increases in the budget deficit that do *not* originate in temporary government spending also deteriorate the current account balance. While the effect is less than one-to-one, it is (qualitatively, at least) in line with the traditional “twin deficits” idea.

3.4 Another Nested Model

An additional way to compare the “twin deficits” and the “fundamental current account equation” approaches, would be to look separately at the effects of government spending and taxes, by allowing their temporary components to have different effects on the current account. Using the local projection technique once more, we finally estimate:

$$ca_{i,t+h} = w_t^h + v_t^h + \beta^h \Delta \hat{g}_{i,t} + \sum_{j=1}^J \beta_j^h \Delta \hat{g}_{i,t-j} + \gamma^h \Delta \hat{t}_{i,t} + \sum_{j=1}^J \gamma_j^h \Delta \hat{t}_{i,t-j} + \sum_{j=1}^J \alpha_j^h ca_{i,t-j} + u_{i,t} \quad (4)$$

where notation is as before, and now the α s, β s, and γ s are parameters to be estimated. The two impulse response functions of interest are now: (i) the estimated β^h s, which capture the responses to \hat{g} , and (ii) the estimated γ^h s, which capture the responses to temporary taxes, \hat{t} . Following our earlier discussion above, the “fundamental current account equation” predicts $\beta^h < 0$ and $\gamma^h = 0$, whereas the two deficits can be characterized as “twins” if $\gamma^h > 0$, so that the relationship holds even when the change in the budget balance comes from temporary changes in taxes.

The results from model (4) are in Table 4 and Figure 8. Perhaps not surprisingly by now, the estimates imply that *both* temporary government spending and taxes affect the current account balance, and both responses are in the direction predicted by the “twin deficit” hypothesis. Specifically, using the fixed-effects estimates first (the two left panels of Figure 8, and the two top rows of Table 4), an increase in temporary government spending (temporary taxes) by 1% of GDP reduces (improves) the current account balance by 0.12% (0.20%) of GDP within the year, and by 0.24% (0.49%) of GDP one year later (both statistically significant). Once again, both effects gradually decay over time, eventually becoming economically and statistically insignificant. The results are robust to using random effect estimation (see the two right panels of Figure 8, and the bottom two rows of Table 4).

These findings reinforce the conclusion that the “twin deficit” hypothesis is not an illusion. While the current account deteriorates when government expenditure increases temporarily (as predicted by the “fundamental current account equation”)

it also improves when taxes increase temporarily (which is inconsistent with the “fundamental current account equation” but as predicted by “twin deficits”).

Table 4. Responses of the Current Account to Temporary Government Spending and Temporary Taxes

	Horizons (in years)				maximum response	year
	0	1	5	10		
Fixed Effects						
Temporary G	-0.123** (0.028)	-0.242** (0.039)	-0.043 (0.053)	-0.014 (0.058)	-0.242** (0.039)	1
Temporary T	0.204** (0.057)	0.493** (0.080)	0.013 (0.112)	0.102 (0.123)	0.493** (0.080)	2
Random Effects						
Temporary G	-0.093** (0.024)	-0.161** (0.034)	-0.090* (0.043)	0.039 (0.044)	-0.174** (0.042)	3
Temporary T	0.147** (0.053)	0.370** (0.074)	0.060 (0.098)	0.000 (0.101)	0.370** (0.074)	1

Notes: Response of the Current Account Balance (as a percent of GDP) to increases in the Temporary component of Government Spending and the Net Deficit, each by 1% of GDP. Estimated standard errors in parentheses. ‘**’ and ‘*’ denote statistical significance at the 1% and 5% significance levels.

Responses of the Current Account

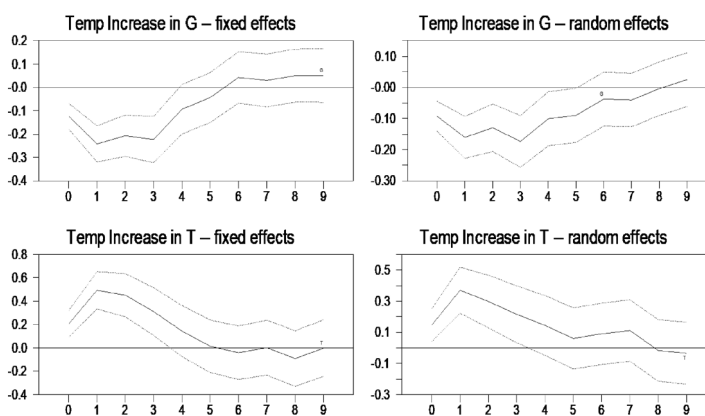


Figure 8

Notes: Response of the Current Account Balance (as a percent of GDP) to an increase in the temporary components of Government Spending or Taxes by 1% of GDP. Models estimated over 1970-2013, and with fixed or random effects, as indicated. Dashed lines are two-standard-error confidence intervals.

4. Discussion and Conclusions

This paper revisited the relationship between the balances of the government budget and the current account, a subject of extensive theoretical and empirical investigation.

One class of theoretical frameworks deliver the “Twin Deficits” hypothesis which implies that the current account deficit widens when there is an increase in the budget deficit, whether this is coming from changes in government spending or taxes. On the contrary, the “Fundamental Current Account Equation” of the intertemporal approach predicts that the current account responds only to (temporary) changes in government spending but not to taxes. Because temporary government spending is very strongly and positively correlated with the government budget deficit, showing that there is a relationship between the two deficits is consistent with both the “twin deficits” and the “fundamental current account equation”, and thus incapable of assessing their relative merits. To achieve that, the present study develops a methodology that can distinguish between the two competing views.

Using annual data from 1870 to 2013 for a panel of seven OECD economies, the paper first shows that budget and current account deficits have been moving together, a finding that is consistent with the “Twin Deficits” hypothesis. Next, however, the paper shows that temporary increases in government spending deteriorate the current account balance, as predicted by the “Fundamental Equation” hypothesis.

To move beyond these results, the paper then estimates models that separate the effects of temporary government spending from those of other components of the budget deficit (including temporary taxes). The results indicate that changes in the budget deficit *other than temporary changes in government spending* also reduce the current account balance, suggesting that Twin Deficits are not an illusion.

Summing up, the evidence supports the “fundamental equation’s” prediction that temporary government expansions deteriorate the current account balance—however, so do other factors that raise the budget deficit, including temporary tax cuts. This is consistent with “twin deficits”.

Quantitatively, an increase in temporary government spending by 1% of GDP deteriorates the current account by a maximum of 0.20% of GDP, whereas an increase in temporary taxes by 1% of GDP improves the current account by a maximum of 0.50% of GDP.

References

- Auerbach, Alan J. and Yuri Gorodnichenko. “Effects of Fiscal Shocks in a Globalized World.” *IMF Economic Review*, 64, 2016, 177-215.
- Barro, Robert J. “On the Determination of the Public Debt.” *Journal of Political Economy*, 87, 1979, 940-971.
- Baxter, Marianne and Robert G. King. “Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series.” *Review of Economics and Statistics*, 81, 1999, 575-593.

- Bluedorn, John and Daniel Leigh. "Revisiting the Twin Deficits Hypothesis: the effect of fiscal consolidation on the Current Account." *IMF Economic Review*, 59, 2011, 582-602.
- Christiano, Lawrence J. and Terry J. Fitzgerald. "The Band Pass Filter." *International Economic Review*, 44, 2003, 435-465.
- Corsetti, Giancarlo and Gernot J. Müller. "Twin Deficits: Squaring Theory, Evidence, and Common Sense." *Economic Policy*, 2006, 599-638.
- Eldemerdash, Hany, Hugh Metcalf, and Sara Maioli. "Twin Deficits: New Evidence from a Developing (oil vs. non-oil) Countries' Perspective." *Empirical Economics*, 47, 2014, 825-851.
- Erceg, Christopher J., Luca Guerrieri, and Christopher Gust. "Expansionary Fiscal Shocks and the US Trade Deficit." *International Finance*, 8, 2005, 363-397.
- Forni, Mario and Luca Gambetti. "Government Spending Shocks in Open Economy VARs." *Journal of International Economics*, 99, 2016, 68-84.
- Forte, Francesco, and Cosimo Magazzino. "Twin Deficits in the European Countries." *International Advances in Economic Research*, 19, 2013, 289-310.
- Hodrick, Robert J. and Edward C. Prescott. "Postwar U.S. Business Cycles: An Empirical Investigation." *Journal of Money, Credit, and Banking*, 29-1997, 1-16.
- International Monetary Fund. *Fiscal Monitor*, April 2020.
- International Monetary Fund. "Separated at Birth? The Twin Budget and Trade Balances." *World Economic Outlook*, chapter 4, September 2001.
- Karras, Georgios. "Are 'Twin Deficits' Asymmetric? Evidence on Government Budget and Current Account Balances, 1870-2013." *International Economics*, 158, 2019, 12-24.
- Kim, Soyoung, and Nouriel Roubini. "Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S." *Journal of International Economics*, 74, 2008, 362-383.
- Obstfeld, Maurice and Kenneth Rogoff. *Foundations of International Macroeconomics*. MIT Press, 1996.
- OECD. *Economic Outlook*, June 2020.
- Òscar Jordà, Moritz Schularick, and Alan M. Taylor. "Macrofinancial History and the New Business Cycle Facts" in *NBER Macroeconomics Annual 2016*, volume 31, edited by Martin Eichenbaum and Jonathan A. Parker, University of Chicago Press, 2017.
- Òscar Jordà. "Estimation and Inference of Impulse Responses by Local Projections." *American Economic Review*, 95, 2005, 161-182.
- Roubini, Nouriel. "Current Account and Budget Deficits in an Intertemporal Model of Consumption and Taxation Smoothing." NBER working paper No. 2772, November 1988.
- World Bank. *Global Economic Prospects*, June 2020.

Appendix

Table A1

<i>i</i>	Correlations	
	$Corr_i(d_{i,t}, \hat{g}_{i,t})$	$Corr_i(\Delta d_{i,t}, \Delta \hat{g}_{i,t})$
CAN Canada	0.802	0.911
CHE Switzerland	0.760	0.720
GBR Great Britain	0.800	0.949
ITA Italy	0.655	0.908
POR Portugal	0.372	0.637
SWE Sweden	0.556	0.488
USA U.S.	0.777	0.933

Notes: Estimated correlations of the budget deficit ($d_{i,t}$) and the temporary component of government spending ($\hat{g}_{i,t}$) in levels and differences, by country, over the 1870-2013 period.

Gov: Permanent and Temporary components

1870-2013

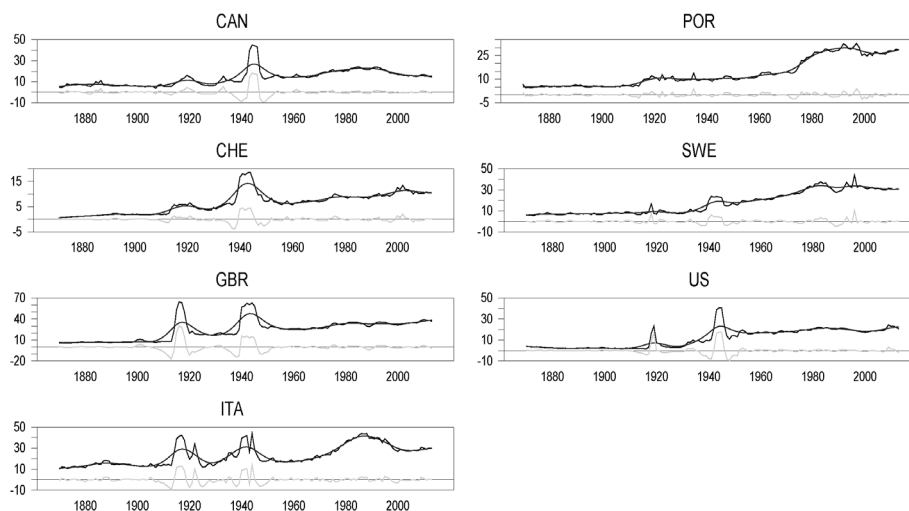


Figure A1

Notes: Decomposing Government Spending (as a percent of GDP, back lines) to Permanent (blue lines) and Temporary (green lines) Components.

Tax: Permanent and Temporary components

1870-2013

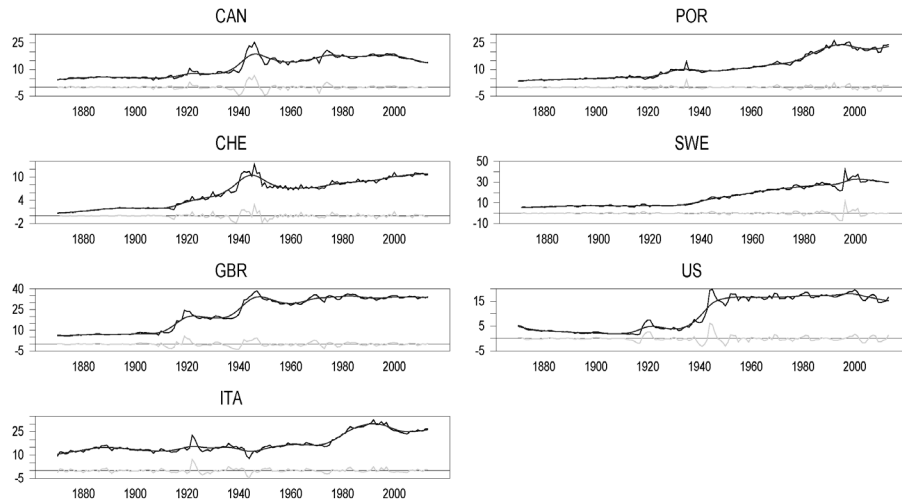


Figure A2

Notes: Decomposing Tax Revenue (as a percent of GDP, back lines) to Permanent (blue lines) and Temporary (green lines) Components.

DETERMINANTS OF FIRM INVESTMENT: EVIDENCE FROM SLOVENIAN FIRM-LEVEL DATA

ČRT LENARČIČ^a
GEORGIOS PAPADOPOULOS^b

^aBank of Slovenia

^bEconomics Research Centre, University of Cyprus

Abstract

This paper examines the role of corporate balance sheet positions in determining Slovenian firms' investment behaviour. The analysis is based on the theoretical framework of the financial accelerator, which suggests that firms' financial positions influence their real behaviour. The underlying hypotheses of the financial accelerator are tested, namely its asymmetric effect during crises and in respect to firms' size. In addition, the existence of differences in the relationship between the balance sheet variables and investment across various sectors is examined. The results indicate that balance sheet strength is an important determinant of Slovenian firms' investment behaviour. Moreover, this relationship is affected by a firm's size but the effect of the crisis or its sectoral specialization does not seem to materially affect it.

JEL Classification: C33, D22, E22

Keywords: Firm Investment, Financial Accelerator, Firm-Level Data

The views presented herein are those of the authors and do not necessarily represent the official views of Bank of Slovenia or of the Eurosystem.

Corresponding Author: Črt LENARČIČ, Financial Stability and Macprudential Policy Department, Bank of Slovenia, Slovenska cesta 35, 1000 Ljubljana, Slovenia. E-mail: crt.lenaric@bsi.si

Georgios PAPADOPOULOS, Economics Research Centre, University of Cyprus, P.O. Box 20537, CY-1678 Nicosia, Cyprus. E-mail: papadopoulos.i.georgios@ucy.ac.cy

1. Introduction

Private-sector investment remained depressed in many countries even several years after the outbreak of the global financial crisis (henceforth, GFC) in 2008. The reasons behind this are multiple and identifying them is not a trivial issue. In the euro area, private-sector investment has only recently approached its pre-crisis levels. Comparing the growth of private-sector investment to the aggregate economic activity at the euro area level, the dynamics of the former only slightly lag behind output. At the country level, however, the picture is different and very heterogeneous. Despite the fact that, in most countries, private-sector investment is broadly in line with the overall economic activity, some countries display substantial gaps between the two.

In Slovenia, which also suffered a severe domestic banking crisis in 2012-2013, private-sector investment displayed a sluggish performance in the aftermath of the GFC, reaching only 16.6 percent of GDP in 2016. This compares unfavourably to its average figure, which was 22 percent of GDP over the 1996-2004 period, when the Slovenian economy was performing more-or-less at its potential. Given that non-financial corporations (henceforth, NFC or firms) undertook the bulk of private-sector investment, this paper aims to uncover firm-specific factors that have affected NFC investment in Slovenia from the mid-nineties until recently.

The identification of firm investment determinants and the analysis of the relationship between a firm's investment decisions and its financial standing are particularly important for the assessment of an economy's outlook. It is reasonable to assume that such relationship is not constant over the business cycle and might be heterogeneous among firms with different characteristics, such as their size or sectoral specialization. The financial accelerator theory, developed and described by Bernanke, Gertler and Gilchrist (1996), is a theoretical framework that can facilitate the investigation of this underlying relationship.

In the context of the financial accelerator theory, it is argued that a firm's financial position influences its real decisions. In particular, due to asymmetric information, a firm's access to financing depends on its balance sheet strength, which acts as a proxy of its health and viability. Thus, an initial shock, combined with a weak balance sheet, will impair a firm's credit access and, as a consequence, affect its investment decisions. An important feature of the financial accelerator is the so-called double asymmetry, namely, that the balance sheet effects are expected to be stronger during downturns than booms and more severe for small than large firms (Gertler and Gilchrist, 1993; Oliner, Rudebusch and Sichel, 1995).

A number of studies using Slovenian firm-level data have found a link between a firm's financing structure and size as well as financial performance, including investment spending. Ralyea (2016) and Damijan (2017) found that the investment activity of Slovenian firms became more sensitive to their level of indebtedness after

the GFC. Similarly, Gabrijelčič, Herman and Lenarčič (2017) found a significant negative effect of leverage on Slovenian firm performance. In all these studies, a fixed-effects regression technique was applied to a standard model of firm investment to estimate the pre- and post-GFC effect of indebtedness on firm performance/investment. IMAD (2014) has also analysed the impact of corporate indebtedness on gross capital formation and GDP growth using firm-level data within a smooth-transition structural vector autoregression framework.

A substantial part of the early literature on the subject focused either on the study of aggregate data on representative or large firms. However, both approaches can result in biased results by averaging out and, thus, obscuring the underlying processes. In particular, large firms are less likely to be affected by informational asymmetries and, therefore, enjoy better access to financial markets and, ultimately, maintain a stable investment behaviour compared to the small and medium sized ones (SME).

Our paper analyses investment behaviour of Slovenian NFCs in order to investigate its association with weak balance sheets, something that has become to be known as the financial accelerator theory (Bernanke, Gertler and Gilchrist, 1996) on firm investment decision. In addition to the examination of the doubly asymmetric nature of the financial accelerator, we complement the paper by testing the hypothesis that the strength of the latter differs by industry/sector. For the purpose of this study, we use a comprehensive dataset on balance sheet and income statement information. It covers more than 20 years of annual data (from 1995 to 2016), thus, including parts of both the upward and downward part of the business cycle. Moreover, almost 85% of the sample consists of SMEs, a figure that is more representative for the actual business environment in Slovenia. In terms of value added, this figure represents over 62%, while over 72% of employment is generated by SMEs (European Commission, 2016).

The rest of the paper is organised as follows: Section 2 provides a selective review of the literature on firm investment determinants. Section 3 describes the data used and elaborates on the method and model specification used for the analysis. Section 4 presents the empirical results and Section 5 concludes.

2. Literature

Several studies have tried to empirically investigate the determinants of firm investment. Despite the heterogeneity in country and time coverage, a set of common variables seems to emerge, augmented with additional, study-specific indicators. For an early summary of the main models, the work of Kopcke (1985) provides accessible reference. The author reviews five statistical models of business investment spending (accelerator, neo-classical, Q model, cash flow, and autoregression) and assesses them using quarterly investment data from 1956-79 for large U.S. firms. Kopcke

(1985) concludes that no model consistently outperforms its competitors. Each model enjoys periods when it best approximates the course of aggregate investment spending; highlighting the reasons of a vast variety of investment models.

In an often-cited paper on firm financing constraints, Fazzari *et al.* (1988) provide a solid theoretical underpinning of the rationale behind the impact of a firm's financial structure on its investment. Consistent with the firm financing hierarchy theory, Fazzari *et al.* (1988) argue that asymmetric information between a firm's managers and potential creditors induces potential providers of external finance to demand a premium for supplying funds relative to the cost of internal financing (cash flow and retained earnings). The authors test for the existence of firm financial constraints using three different empirical specifications of firm investment demand: the Q, accelerator and neo-classical models over a sample of large, publicly-traded U.S. firms that is split into different groups depending on their retention policies. The authors provide evidence that a firm's financial position affects its investment spending.

Vermeulen (2002) uses a sample of 112 'representative' firms (from AMADEUS database¹) from 4 European countries to test the hypotheses underlying the financial accelerator theory, namely, that balance sheet positions are significant determinants of firm investment and its double asymmetry aspect. Vermeulen (2002) finds the financial accelerator to be stronger in downturns and affecting small firms more in comparison to larger firms. He provides evidence in favour of the asymmetric working of the financial accelerator both regarding its differential impact over the business cycle and in respect to firm size. However, direct evidence of the effect of balance sheet strength is weak. The author recognises that this could be due to the use of data on representative firms, which could result in downwardly biased results.

Bond *et al.* (2003) use panel data on manufacturing firms in four European countries from 1979-89 and two different investment equations, a reduced-form error-correction model and an Euler-equation specification to explore and compare the effects of financial constraints on firm investment. Their approach relies on sample splitting (separate regressions run for each country) to tease out whether investment sensitivity to cash flow reflects expectations about future profitability or financing constraints.

In two related studies Aivazian, Ge and Qiu (2005a), Aivazian, Ge and Qiu (2005b) study the impact of leverage and debt maturity structure on firm investment. They evaluate the Q model on a sample of US and Canadian firms and show that firms' leverage has a significant impact on firms' investment decisions. They find that firms with high growth opportunities are less severely affected but they exhibit higher dependence on debt maturity structure, with high percentage of long-term debt in total debt significantly reducing their investment.

1. <https://www.bvdinfo.com/en-us/our-products/company-information/international-products/amadeus>.

Using a large-scale company-level panel dataset on Spanish firms in the 1985-2001 period, Hernando and Martínez-Carrascal (2008) find strong evidence that financial position is important in explaining corporate investment spending decisions. In particular, debt service burden and a measure of profitability are found to have significant effects, displaying robustness compared to alternative model specifications. Martínez-Carrascal and Ferrando (2008) test firms' investment decisions based on panel data from a large sample of NFCs in six euro area countries (Belgium, Germany, France, Italy, the Netherlands, and Spain). The results indicate that profitability (cash flow), net indebtedness and interest burden play an important role in firms' investment dynamics. Martínez-Carrascal and Ferrando (2008) also summarise the relevant literature through 2008 that provides empirical evidence on the impact of leverage on investment.

In their study, Farinha and Prego (2013) examine the effect of Portuguese firms' financial standing on their investment decisions. Using panel data on a sample spanning from 2006 to 2011, Farinha and Prego (2013) find that balance sheet strength has, indeed, significant explanatory power in corporate investment behaviour. Debt burden, cost of capital, firm indebtedness and profitability affect firms' investment rates. Moreover, in line with other studies, these conclusions confirm the nature of the double asymmetry of the financial accelerator. Goretto and Souto (2013) find additional evidence of a negative relationship between firms' investment rates and their debt burden based on a sample of aggregated firm-level data for euro area countries in the 2000-2011 period. The authors' analysis also points to possibly asymmetric effects beyond certain levels of indebtedness.

Kalemli-Ozcan, Laeven and Moreno (2019) build on the works of Whited (1992), Bond and Meghir (1994) and Lang, Ofek and Stulz (1996). These authors show that modelling the relationship between firms' debt and investment improves standard investment models and adds to the discussion of the effect that debt has on investment. They also rely on more recent literature that adds additional explanatory variables of investment decisions, such as sovereign default risk proxied by sovereign credit risk ratings (Gennaioli, Martin and Rossi, 2014). Other linkages to firms' investment developments have been studied as well. The effect of guarantees or bank bailouts is an indirect linkage that can arise at times, when the government backstops the financial system. This was studied by Laeven and Valencia (2013), concluding that bailouts can significantly add to the increase of sovereign debt and sovereign risk. Acharya, Dreshler and Schnabl (2014) reach similar conclusions. Gennaioli, Martin and Rossi (2013) and Acharya and Steffen (2015) also find that weaknesses in the banking sector reinforce sovereign-bank linkages. The so-called moral suasion could represent another possible linkage and appears when governments force banks to hold risky government bonds (Ongena, Popov and Van Horen, 2016; Altavilla, Pagano and Simonelli, 2017; Becker and Ivashina, 2018).

The study of Kalemli-Ozcan, Laeven and Moreno (2019) highlights the importance of the role of firm leverage, debt maturity and weak bank balance sheets in determining firms' investment. These authors find that firms with higher leverage reduce investment more compared to their low-leverage peers. Moreover, this effect is stronger when these firms are linked to weak banks. Additionally, firms, which rely on short-term borrowing, suffer from rollover risk and, consequently, decrease their investment more. Again, this effect is stronger when these firms are linked to weak banks. Kalemli-Ozcan, Laeven and Moreno (2019) complement the existing literature by focusing on aggregate demand, banks' financial health, and sovereign-bank linkages explaining the dynamics of firm investment in the wake of the GFC. Kalemli-Ozcan, Laeven and Moreno (2019) find that the economic policies that target the financial conditions of firms more directly might be more suitable in reducing debt overhang and stimulating the real economy. Their results also point to possible dangers of over-reliance on short-term debt to finance investment during good times.

Overall, from this certainly non-exhaustive review of literature on firm investment, certain variables are repeatedly and robustly found to affect firm's investment behaviour. These primarily include the lagged value of investment, a variety of indicators proxying firms' general indebtedness or leverage, such as the ratio of debt over assets, sales growth rate or its ratio over capital and some measure of profitability, such as gross operational profits or income as a fraction of total assets. Additional indicators of balance sheet strength, which are frequently found to significantly affect firm investment decisions, are firm's debt maturity and interest burden. The former measure is proxied by short- or long-term debt as fractions of total debt obligations, while the latter by the ratio of interest payments over gross revenues. Finally, in line with the underlying hypotheses of the financial accelerator theory, several studies have identified statistically significant asymmetric behaviour during different phases of the business cycle, as well as in respect to firm size, the effect being larger during downturns and more severe for small firms.

Guided by the findings of the relevant literature, this study aims to further investigate the effect of 'weak balance sheets' using a detailed dataset of Slovenian firm-level data for from 1995 to 2016 period.

3. Data and methodology

Data

The analysis in this paper makes use of data from the balance sheets and profit and loss accounts of individual Slovenian companies, gathered by the Agency for Public Legal Records and Legal Services (AJ PES)². The dataset consists of annual observa-

2. The AJ PES database includes all Slovenian firms excluding those undergoing bankruptcy proceedings, which are no longer obliged to submit their annual reports, and, hence, are not included in the database as of the year when they filed for bankruptcy.

tions from 1995 until 2016, originally covering 118,100 firms and 19 sectors of the Slovenian economy³.

Before proceeding with the analysis, the original dataset is pre-processed and cleaned. Firms with fewer than five employees, those classified as other than non-financial corporations (financial firms, government-related, etc.), as well as those belonging to NtoS sector by NACE classification⁴ are dropped from the sample. Moreover, since size is considered an important variable, firms with no information about their size are also excluded from the analysis. It should be noted that for the classification of firms' size the Republic of Slovenia Companies Act (ZGD-1), Article 55 is observed (see Appendix for a detailed description).

In addition to the previous sector- and size-related conditions, problematic observations are discarded. Any negative asset (total, tangible and intangible), sales or debt component (total, short-term and long-term debt) are removed from the sample. The application of the aforementioned conditions reduce the size of the original sample from more than 100,000 to 21,665 individual firms.

Following Lang, Ofek and Stulz (1996) and Kalemli-Ozcan, Laeven and Moreno (2019), net investment rate is used⁵, computed as the annual change in capital stock (i.e., the sum of tangible and intangible assets minus depreciation), as a ratio of lagged capital stock ($IK_{i,t}$). The rationale of using net, instead of gross, investment is that the latter will be positive even if investment expenditure merely matches the depreciation of existing capital equipment. However, in this case, the former will be zero, thus making it a more relevant variable for firms' future productivity. Firms' balance sheet strength is proxied by the following variables, which are widely used by the literature⁶. Leverage is captured by the ratio of total debt to assets ($DA_{i,t}$), debt maturity is proxied by the fraction of long-term debt to total debt ($LTR_{i,t}$), and profitability is defined as the ratio of operating profits to total assets ($PA_{i,t}$). Annual percentage growth of net sales ($SG_{i,t}$) is used to control for growth opportunities since market-based proxies, such as Tobin's Q, can not be used. Finally, all variables are trimmed at the appropriate level in order to exhibit a sample kurtosis below 10 as in Kalemli-Ozcan, Laeven and Moreno (2019). Therefore, $IK_{i,t}$, $DA_{i,t}$, $PA_{i,t}$ and

3. The original dataset's sector coverage includes every NACE Revision 2 classification of economic activities from A to S sectors, the most populated ones being manufacturing (C), construction (F), wholesale and retail trade, repair of motor vehicles and motorcycles (G) and professional, scientific and technical activities (M), which account for more than 70% of the original sample observations.

4. Administrative and support service activities (N), public administration and defence, compulsory social security (O), education (P), human health and social work activities (Q), arts, entertainment and recreation (R), and other service activities (S).

5. Referred as *investment* for brevity for the remainder of the study.

6. Just to name a few: Lang, Ofek and Stulz (1996), Giannetti and Ongena (2012), Chodorow-Reich (2014), Kalemli-Ozcan, Laeven and Moreno (2019).

$SG_{i,t}$ are trimmed at 5%, 1%, 1% and 2%, respectively. For the case of $LTR_{i,t}$, no trimming is necessary because the *kurtosis* ≤ 10 condition already holds. It should be mentioned that capital and net sales series are deflated using the equipment-specific price deflator for gross fixed capital formation. Table 1 presents descriptive statistics of the sample over the whole period.

Table 1. Summary statistics of variables used

Variable	Mean	St. dev.	Median	Minimum	Maximum	N
$IK_{i,t}$	6.833	32.722	-1.988	-43.321	162.680	125,676
$SG_{i,t}$	7.569	25.888	4.248	-50.745	129.651	136,561
$DA_{i,t}$	59.870	27.489	60.898	5.376	186.813	163,700
$LTR_{i,t}$	31.740	24.502	27.058	0.001	100.000	108,006
$PA_{i,t}$	8.378	8.080	5.806	0.115	50.104	128,450

Source: AJPES.

While summary statistics in Table 1 provide an overall picture, a more revealing one is shown in Figures 1 to 3, where the evolution of variables through time is plotted. In addition to full-sample results, categorisation by firm size and sectoral specialisation are also considered, revealing some interesting patterns.

The charts in Figure 1 present, in an apparent way, the grim situation that firms faced after the onset of the GFC and their reactions in terms of investment and leverage. After a drop from its initially high levels, median investment⁷ dropped in 2002 and remained relatively stable until 2008, when it began to decline. Until 2012, investment remained depressed, while from 2013 started gradually increasing almost reaching its pre-crisis levels in 2016. Median profitability (more precisely, the ratio of profits to assets) exhibits a striking pattern. At the beginning of the GFC, it plummeted by almost 2 percentage points and stayed at this low level for 4 years until it began to rise again in 2013 coinciding with the economic recovery in Slovenia. This upward trend continued to 2016 resulting in the recovery of profitability to its pre-crisis figures. Debt-related indicators also exhibit interesting patterns. Total debt to assets ratio showed a sharp decrease starting in 2008, while the long-term component of debt (as a share of total debt) stopped increasing and stabilised during the same period. These patterns continue until the end of respective charts indicating the existence of a prolonged de-leveraging behaviour by firms, which, as of 2016, is still ongoing. In Figure 2 the same set of results is plotted by firm size.

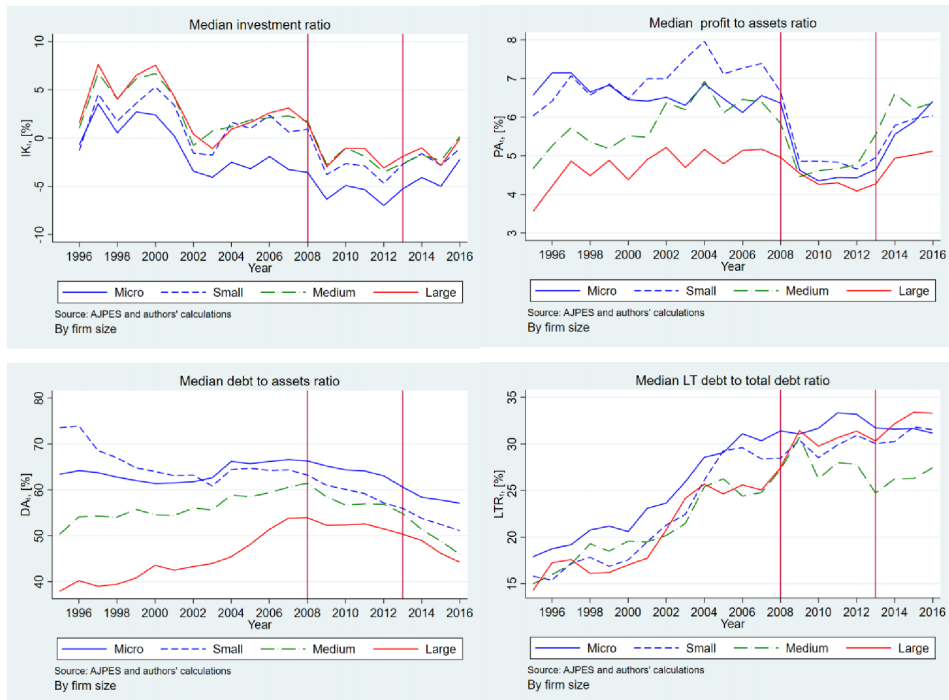
7. Average investment follows a similar pattern, only exhibiting an upward level shift of roughly 10 percentage points.

Figure 1. Median evolution of the variables over the entire firm sample



Note: Vertical lines are placed at 2008, at the beginning of the GFC, and at 2013, at the end of the GFC in Slovenia.

In Figure 2, one can see several similarities, but also notice differences, among firms of different sizes regarding their investment behaviour, debt dynamics and profitability. Firms behave in a largely similar way as regards their investment decisions irrespective of their size. Apart from a, generally expected, difference in the levels of micro firms' investment, the patterns (and even the levels of the rest) are similar for every firm size. Regarding profitability, firms exhibit some rather time-dependent similarity dynamics. After 2008 firms of every size experienced a drop in their profitability levels (although large firms were less affected compared to others, as shown by the red, solid line in Figure 2). This trend reversed after 4 years, at the start of the economic recovery period in 2013 and recovered back to 2008 levels in 2016. However, before the GFC, two different groupings are present in terms of profitability growth; the first group includes large and micro firms exhibiting relatively stable profitability, while the second group of small and medium firms shows an upward trend roughly until 2007. The results in Figure 2 suggest that debt accumulation and firms' de-leveraging are quite heterogeneous over different size classes.

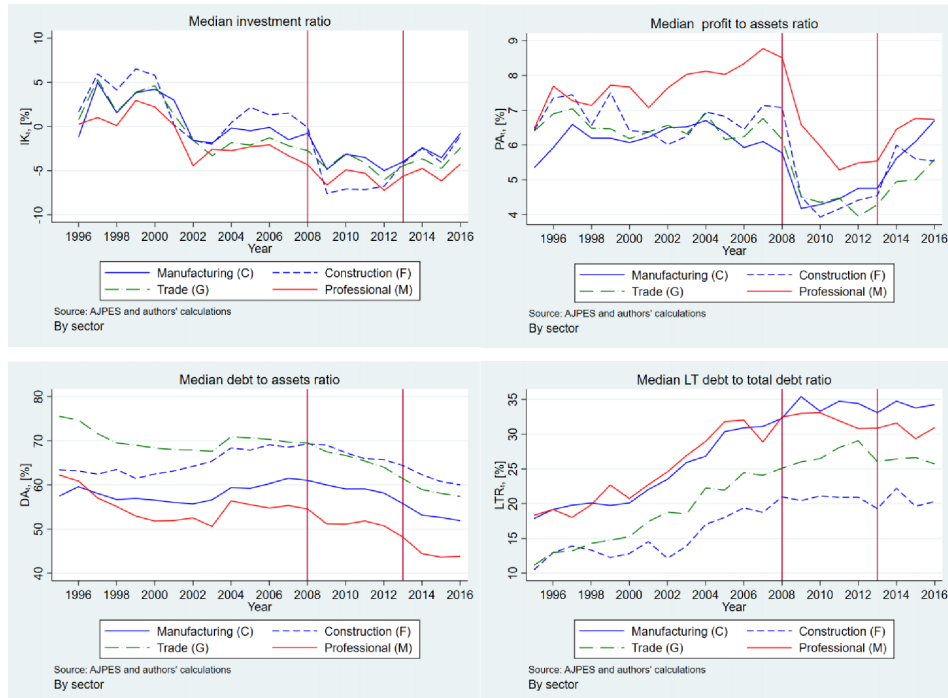
Figure 2. Median evolution of variables by firm size

Note: Vertical lines are placed at 2008, at the beginning of the GFC, and at 2013, at the end of the GFC in Slovenia.

As for the debt to assets variable, the highest growth of all size classes before the GFC is observed for large firms. They exhibit an increase of about 12 percentage points in the decade preceding 2008. On the contrary, small firms' leverage is declining practically over the last 20 years, perhaps with a small exception during the three-year period between 2004 and 2007. Nevertheless, that period is characterised by an excessive increase of debt across the board. Medium and micro sized firms fall between the former cases displaying mild growth in leverage (around 7 percentage points) during the pre-crisis period, followed by a decline in the post-crisis period. In fact, de-leveraging is most intense for medium-sized firms, which reduced their median debt to assets ratio by more than 15 percentage points from almost 61% in 2008 to about 45% in 2016, the steepest decline occurring in the last 3 years. Finally, long-term debt to total debt ratio shows a quite similar evolution before 2008 for every size category, a pattern that also holds after this time, except for medium sized firms. As seen in Figure 2, during the post-crisis period, long-term debt to total debt ratio remained relatively stable for every size class except for medium sized firms, as the long-term debt to total debt ratio was decreasing from 2009 until 2013. Data on

the second component of total debt⁸, i.e., short-term debt, indicate that, during this period, medium-sized firms slightly increased short-term debt, depicted as a share in the total debt. However, after 2013, the aforementioned increase halted resulting in stabilisation of long-term debt evolution.

Figure 3. Median evolution of variables by firm sectoral specialisation



Note: Vertical lines are placed at 2008, at the beginning of the GFC, and at 2013, at the end of the GFC in Slovenia.

In Figure 3 the evolution of (median) investment, debt and profitability dynamics by firm sectoral specialisation is plotted. From the 12 sectors considered in the study, only the 4 largest are shown, which, combined, account for more than 77% of the final-sample, non-missing, investment observations. It is evident that the largest impact of the crisis was on construction firms, which reduced their investment by around 7 percentage points immediately after 2008. However, in general, the dynamics are similar across sectors. Profitability evolution also exhibits a high degree of similarity among different sectors, as does the long-term debt ratio. Finally, firms' (de)leverage evolution shows some mild clustering between two groups: wholesale and retail

8. Not shown here but available upon request.

trade, repair of motor vehicles and motorcycles (G) and professional, scientific and technical activities (M), on the one hand, and manufacturing (C) and construction (F) on the other. Nevertheless, the differences between these two groups are small.

Methodology

For the quantitative analysis of the significance and the direction of correlation between firm investment, standard fixed-effects panel data regression is used. The reason of choosing the fixed-effects panel data regression model is straightforward, since we control for specific firm characteristics⁹. The specification of the baseline model is described in Equation 1.

$$IK_{i,t} = \alpha SG_{i,t-1} + \beta X_{i,t-1} + d_t + u_i + \epsilon_{i,t} \quad (1)$$

Where the term $IK_{i,t}$ denotes investment of firm i at time t , $SG_{i,t-1}$ denotes sales growth at time $t-1$, while the term $X_{i,t-1}$ represents the measure of firm's financial position (i.e., leverage defined as total debt to assets $DA_{i,t-1}$, debt maturity proxied by long-term debt to total debt $LTR_{i,t-1}$ or profitability defined as operating profits to total assets $PA_{i,t-1}$). The term d_t represents the time fixed effect, while the term u_i is the unobserved, firm fixed effect and $\epsilon_{i,t}$ represents the error term. It is assumed that the variation of user cost of capital is controlled by the inclusion of firm and time fixed effects. As previously mentioned, i is 1,2,...21665 and t is 1995, 1996,...2016.

Besides the baseline specification in Equation 1, two additional specifications are considered in order to examine the hypotheses underlying the financial accelerator, namely, its asymmetric working during financial crises and in respect to firms' size. The third specification aims at examining the existence of differences in the strength of the financial accelerator among various sectors. This is done by introducing interaction terms between balance sheet variables ($X_{i,t-1}$) and the crisis, size, and sector dummies, respectively. In particular, the crisis dummy variable takes the value of 1 from the year following the start of the GFC until the end of the banking crisis period in Slovenia, in 2013. Regarding the firm size, four classes are used, according to the criteria described in detail in Appendix, micro-sized firms being the reference group. Finally, the sector dummy variable includes 12 different sectors referring to agriculture, forestry, and fishing¹⁰. The estimation results of various specifications are presented in the following sections.

9. We also considered a dynamic panel data regression setup with the Arellano-Bond GMM estimator (Arellano and Bond, 1991), as a robustness check. However, the dynamic model diagnostics are weak, which has a negative impact on inference from that model.

10. The sectoral categories include the following NACE Revision 2 classification of economic activities: agriculture, forestry and fishing (A), mining and quarrying (B), manufacturing (C), electricity, gas, steam and air conditioning supply (D), water supply, sewerage, waste management and re-mediation activities (E), construction (F), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transporting and storage (H), accommodation and food service activities (I), information and communication (J), real estate activities (L) and professional, scientific and technical activities (M).

4. Results

This section is dedicated to the description of the empirical results of the fixed effect panel data regression model. First, we provide the results of the baseline model and, subsequently, of the alternative model specifications.

Baseline model

The results of the estimation of the baseline specification are reported in Table 2.

Table 2. Baseline regression results

Variable	Model 1	Model 2	Model 3
$SG_{i,t-1}$	0.077*** (0.005)	0.072*** (0.005)	0.053*** (0.005)
$DA_{i,t-1}$	-0.088*** (0.009)		
$LTR_{i,t-1}$		-0.134*** (0.008)	
$PA_{i,t-1}$			0.406*** (0.024)
Observations	104,128	74,733	84,988
R^2	0.036	0.042	0.040
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: Standard errors in parentheses are clustered at the firm level. *p<0.1, **p<0.05, ***p<0.01.

The estimated coefficients presented in Table 2 are statistically significant and their signs are broadly in line with findings from most of the literature. The estimation results show that increases in firm's leverage DA (Model 1), as well as increases in long-term debt to total debt ratio LTR (Model 2) are linked with a detrimental effect on investment. The latter result is in line with the findings of Kalemlı-Ozcan, Laeven and Moreno (2019), which indicate that having shorter debt maturity is considered beneficial. On the contrary, as expected, profitability PA (Model 3) is positively associated with investment. Overall, the results of the baseline model imply the existence of the financial accelerator mechanism, suggesting that firms' balance sheet positions are especially important determinants of their investment decisions. In the next subsections, we examine the asymmetrical nature of the financial accelerator given different states of the economy, firm size, and sector.

Significance of the crisis regime

Similar to the relevant literature (for instance Vermeulen, 2002), we hypothesize that the periods of economic downturns can impose asymmetries in the financial accelerator effects on firms. In order to study the asymmetric nature of the financial accelerator, namely the hypothesis that firms' balance sheets are more significant determinants of investment during financial crises, an interaction term is added in Equation 2.

$$IK_{i,t} = \alpha SG_{i,t-1} + \beta X_{i,t-1} + \gamma X_{i,t-1} \times Crisis_{t-1} + d_t + u_i + \epsilon_{i,t} \quad (2)$$

where the term $Crisis_{t-1}$ represents the crisis dummy variable assuming the value of 1 between 2009 and 2013 (both ends included) and 0 elsewhere. The estimation results are reported in Table 3.

Table 3. Financial accelerator and crisis regime

Variable	Model 1	Model 2	Model 3
$SG_{i,t-1}$	0.077*** (0.005)	0.072*** (0.005)	0.053*** (0.006)
$DA_{i,t-1}$	-0.071*** (0.009)		
$DA_{i,t-1} \times Crisis_{t-1}$	-0.057*** (0.009)		
$LTR_{i,t-1}$		-0.135*** (0.009)	
$LTR_{i,t-1} \times Crisis_{t-1}$		0.002 (0.010)	
$PA_{i,t-1} \times$			0.402*** (0.027)
$PA_{i,t-1} \times Crisis_{t-1}$			0.15 (0.042)
Observations	104,128	74,733	84,988
R^2	0.037	0.042	0.040
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: Standard errors in parentheses are clustered at the firm level. *p<0.1, **p<0.05, ***p<0.01. Crisis dummy takes the value 1 between 2009 and 2013 and 0 elsewhere.

As seen in Table 3, the results are mixed. The coefficient of firms' leverage DA is almost twice as large during financial crises, indicating a stronger (negative) relationship between investment and leverage in economic downturns. This is evident by the statistically significant coefficient of the multiplicative term $DA \times Crisis$, which adds to the negative effect of firms' leverage in non-crisis times. On the other hand, the results for the remaining variables have the expected signs but are not statistically significant. The positive sign of the debt maturity LTR interaction variable during the crisis period is in line with the results from Kalemli-Ozcan, Laeven and Moreno (2019), who associate it with higher debt roll-over risks during turbulent times. The authors' rationale is that having shorter debt maturity is considered beneficial during normal times; however, this reverses when the economy is in crisis period. Moreover, a positive sign of the profitability PA interaction variable indicates that its (positive) relationship with investment is even stronger during economic downturns. However, both coefficients of these two interaction variables (LTR and PA) are statistically insignificant and, therefore, the results should be treated with caution.

Significance of the firm's size

Another source of asymmetry in the working of the financial accelerator stems from firms' size. This is related to information asymmetries, which are more easily reduced by large compared to small firms. Thus, access to credit is limited to the latter impeding their investment growth. Moreover, large firms are expected to be more capable of accessing alternative sources of financing, hence, their balance sheet positions should have a smaller impact on their investment behaviour. In order to test this hypothesis, Equation 3 is augmented with the respective firm-size interaction terms

$$IK_{i,t} = \alpha SG_{i,t-1} + \beta X_{i,t-1} + \beta_{size} X_{i,t-1} \times Size_i + d_t + u_i + \epsilon_{i,t} \quad (3)$$

where $Size_i$ is the size category of firm i (micro, small, medium or large; see Appendix for details) and β_{size} the associated coefficients. The estimation results are reported in Table 4.

Table 4. Financial accelerator and firm size

Variable	Model 1	Model 2	Model 3
$SG_{i,t-1}$	0.077*** (0.005)	0.072*** (0.005)	0.053*** (0.006)
$DA_{i,t-1}$	-0.107*** (0.012)		
$DA_{i,t-1} \times Small_i$	0.032 (0.019)		
$DA_{i,t-1} \times Medium_i$	0.046* (0.025)		
$DA_{i,t-1} \times Large_i$	0.064** (0.031)		
$LTR_{i,t-1}$		-0.137*** (0.012)	
$LTR_{i,t-1} \times Small_i$		-0.011 (0.019)	
$LTR_{i,t-1} \times Medium_i$		0.013 (0.022)	
$LTR_{i,t-1} \times Large_i$		0.057** (0.025)	
$PA_{i,t-1}$			0.334*** (0.031)
$PA_{i,t-1} \times Small_i$			0.191*** (0.055)
$PA_{i,t-1} \times Medium_i$			0.119 (0.079)
$PA_{i,t-1} \times Large_i$			0.252** (0.112)
Observations	104,128	74,733	84,988
R^2	0.036	0.042	0.041
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: Standard errors in parentheses are clustered at the firm level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Micro-firms are the reference group.

The results presented in Table 4 speak in favour of firm-size related asymmetry of the financial accelerator. We set the micro-sized firms as the reference group. For every balance sheet variable, the respective size coefficient is positive and statistically significant for large firms. For debt-related variables, such as the *DA* and *LTR* interaction variables, this result suggests that their relationship with investment is less strong for large firms compared to micro-sized ones, while for profitability *PA* the (positive) link is even stronger. Interestingly, medium-sized firms' leverage interaction coefficient is also positive and statistically significant¹¹, indicating that leverage for this size class is also more weakly connected to their investment growth compared to that of the reference group of micro-sized firms. On the other hand, the small-sized firms' leverage *DA* interaction coefficient is small and statistically insignificant, meaning that the leverage effect of small-sized firms does not differ from the leverage effect on micro-sized firms. Another interesting finding is that, in addition to large firms, profitability seems to be a more important determinant of small firms' investment growth compared to micro and medium-sized ones. Finally, the next subsection investigates whether there are differences in the relationships between leverage, debt maturity and profitability and firms' investment behaviour across different sectors.

Significance of firm's sectoral specialisation

This subsection examines the possible existence of differences in the relationship between balance sheet variables and firm investment by sector. For this purpose, the balance sheet indicators $X_{i,t-1}$ in Equation 4 are made to interact with a sectoral dummy variable assuming 12 different values, one for each sector

$$IK_{i,t} = \alpha SG_{i,t-1} + \beta X_{i,t-1} + \beta_{sector} X_{i,t-1} \times Sector_i + d_t + u_i + \epsilon_{i,t} , \quad (4)$$

where $Sector_i$ is the NACE Revision 2 sector that firm i is classified into (letter classification A, B, C, D, E, F, G, H, I, J, L and M) and β_{sector} the associated interaction coefficient. Estimation results are reported in Table 5.

11. Albeit smaller in absolute terms compared to that for large firms.

Table 5. Financial accelerator and firm sector

Variable	Model 1	Model 2	Model 3
$SG_{i,t-1}$	0.077*** (0.005)	0.072*** (0.005)	0.053*** (0.006)
$DA_{i,t-1}$	-0.31 (0.054)		
$DA_{i,t-1} \times SectorH$	-0.186*** (0.067)		
$LTR_{i,t-1}$		-0.20 (0.060)	
$LTR_{i,t-1} \times SectorC$		-0.130** (0.061)	
$LTR_{i,t-1} \times SectorF$		-0.123* (0.069)	
$LTR_{i,t-1} \times SectorG$		-0.115* (0.062)	
$LTR_{i,t-1} \times SectorH$		-0.201*** (0.068)	
$LTR_{i,t-1} \times SectorJ$		-0.144*** (0.069)	
$PA_{i,t-1}$			0.396 (0.271)
Observations	104,128	74,733	84,988
R^2	0.036	0.042	0.041
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: Standard errors in parentheses are clustered at the firm level. *p<0.1, **p<0.05, ***p<0.01. NACE sector A are the reference group. In order to keep the table size small, only statistically significant interaction terms are presented.

The results presented in Table 5 suggest that, by and large, the relationship between firm investment and balance sheet position exhibits some heterogeneity across different sectors. For the case of profitability *PA* (Model 3) not even a single sector exhibits statistically significant differences from the reference group – sector A. In the case of Model 1, leverage *DA* seems to have a stronger (more negative) relationship with investment only for firms belonging to the transportation and storage sector (H), while other sectors do not exhibit significant differences from the reference group. The results from Model 2 indicate that the link between debt maturity *LTR* and investment shows the widest sectoral differentiation. In particular the relationship is stronger (and more negative) for manufacturing (C), construction (F), wholesale and retail trade, repair of motor vehicles and motorcycles (G), transporting and storage (H), and real estate activities (J) related firms, while for those from the remaining 6 sectors differences from the reference group are not statistically significant.

5. Conclusions

This paper examines the role of firm balance sheets and their relationship with investment behaviour. The findings of the analysis point in the direction of a financial accelerator mechanism underlying firm investment in Slovenia. The double asymmetry of this mechanism is less evident as regards to its working during financial turmoil, but it is clearer when examined in respect to firms' size. In particular, large firms exhibit a less strong connection between their debt-related balance sheet positions and investment compared to micro-sized ones. Finally, results from a sectoral analysis indicate that, in general, there are insignificant differences in the aforementioned relationship across different sectors. A possible exception is associated with the role of debt maturity, which it is found to be more strongly linked to firm investment for almost half of the sectors examined.

Understanding the effect of firm balance sheet positions in firm investment decisions can have interesting policy implications. To be more specific, promoting the strengthening of firms' financial positions during booms will help alleviate the impact of adverse events, should they occur. In addition, more directed policies could be devised for enhancing the resilience of those firms that are affected the most during downturns. These policies could focus either on specific, vulnerable sectors or, more broadly, on micro-sized firms. Finally, policies that promote alternative sources of financing instead of bank credit could be implemented with the additional benefit of decreasing risks related to the banking sector.

References

- Acharya, V., and Steffen, S., 2015, "The "Greatest" Carry Trade Ever: Understanding Eurozone Bank Risks", *Journal of Financial Economics*, 115(2), 215-236.
- Acharya, V., Dreshler, I., and Schnabl, P., 2014, "A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk", *Journal of Finance*, 69(6), 2689-2739.
- Aivazian, V.A., Ge, Y., and Qiu, J., 2005a, "Debt Maturity Structure and Firm Investment", *Financial Management*, 34(4), 107-119.
- Aivazian, V.A., Ge, Y., and Qiu, J., 2005b, "The Impact of Leverage on Firm Investment: Canadian Evidence", *Journal of Corporate Finance*, 11(1), 227-291.
- Altavilla, C., Pagano, M., and Simonelli, S., 2017, "Bank Exposures and Sovereign Stress Transmission", *Review of Finance*, 21(6), 2103-2139.
- Arellano, M., and Bond, S., 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, 58(2), 277-297.
- Becker, B., and Ivashina, V., 2018, "Financial Repression in the European Sovereign Debt Crisis", *Review of Finance*, 22(1), 83-115.
- Bernanke, B., Gertler, M., and Gilchrist, S., 1996, "The Financial Accelerator and the Flight to Quality", *Review of Economics and Statistics*, 78(1), 1-15.
- Bond, S., Elston, J.A., Mairesse, J., and Mulkay, B., 2003, "Financial Factors and Investment in Belgium, France, Germany, and the United Kingdom: A Comparison Using Company Panel Data", *Review of Economics and Statistics*, 85(1), 153-165.
- Bond, S., and Meghir, C., 1994, "Dynamic Investment Models and the Firm's Financial Policy", *Review of Economic Studies*, 61(2), 197-222.
- Chodorow-Reich, G., 2014, "The Employment Effects of Credit Market Disruptions: Firm-Level Evidence from the 2008-9 Financial Crisis", *Quarterly Journal of Economics*, 129(1), 1-59.
- Damijan, J., 2017, "Corporate Financial Soundness and its Impact on Firm Performance: Implications for Corporate Debt Restructuring in Slovenia", *Post Communist Economies*, 30(1), 1-37.
- European Commission, 2016, "Slovenia - 2016 SBA Fact Sheet", Tech. Rep. European Commission.
- Farinha, L., and Prego, P., 2013, "Investment Decisions and Financial Standing of Portuguese Firms-Recent Evidence", *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*, 2013.
- Fazzari, S.M., Hubbard, R.G., Petersen, B.C., Blinder, A.S., and Poterba, J.M., 2017, "Financing Constraints and Corporate Investment", *Brookings Papers on Economic Activity* 1988, 1, 141-206.
- Gabrijelčič, M., Herman, U., and Lenarčič, A., 2017, "Firm Performance and (Foreign) Debt Financing Before and During the Crisis: Evidence from Firm-Level Data", European Stability Mechanism Working Paper No. 15.
- Gennaioli, N., Martin, A., and Rossi, S., 2013, "Banks, Government Bonds, and Default: What Do the Data Say?", Mimeo, Bocconi University and Universitat Pompeu Fabra, 2013.
- Gennaioli, N., Martin, A., and Rossi, S., 2014, "Sovereign Default, Domestic Banks, and Financial Institutions", *Journal of Finance*, 69(2), 819-866.
- Gertler, M., and Gilchrist, S., 1993, "The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence", *Scandinavian Journal of Economics*, 95(1), 43-64.
- Giannetti, M., and Ongena, S., 2012, "Lending by Example": Direct and Indirect Effects of Foreign Banks in Emerging Markets", *Journal of International Economics*, 86(1), 167-180.
- Goretti, M., and Souto, M.R., 2013, "Macro-Financial Implications of Corporate (De)Leveraging in the Euro Area Periphery", IMF Working Papers No 13/154.
- Hernando, I., and Martínez-Carrascal, C., 2008, "The Impact of Financial Variables on Firms Real Decisions: Evidence from Spanish Firm-Level Data", *Journal of Macroeconomics*, 30(1), 543-561.

- IMAD, 2014, "Corporate Indebtedness and Deleveraging", Tech. Rep., Institute of Macroeconomic Analysis and Development, Ljubljana, Slovenia, 2014.
- Hernando, I., and Martínez-Carrascal, C., 2008, "The Impact of Financial Variables on Firms Real Decisions: Evidence from Spanish Firm-Level Data", *Journal of Macroeconomics*, 30(1), 543-561.
- Kalemli-Ozcan, S., Laeven, L., and Moreno, D., 2019, "Debt Overhang, Rollover Risk, and Corporate Investment: Evidence from the European Crisis", ECB Working Paper Series No. 2241.
- Kopcke, R.W., 1985, "The Determinants of Investment Spending", *New England Economic Review*, July/August, 19-35.
- Laeven, L., and Valencia, F., 2013, "Systemic Banking Crises Database", *IMF Economic Review*, 61(2), 225-270.
- Lang, L., Ofek, E., and Stulz, R.M., 1996, "Leverage, Investment, and Firm Growth", *Journal of Financial Economics*, 40(1), 3-29.
- Martínez-Carrascal, C., and Ferrando, A., 2008, "The Impact of Financial Position on Investment: An Analysis for Non-Financial Corporations in the Euro Area", ECB Working Paper Series No. 943.
- Oliner, I., Rudebusch, G., and Sichel, D., 1995, "New and Old Models of Business Investment: A Comparison of Forecasting Performance", *Journal of Money, Credit and Banking*, 27(3), 806-826.
- Ongena, S., Popov, A.A., and Van Horen, N., 2016, "The Invisible Hand of the Government: "Moral Suasion" during the European Sovereign Debt Crisis", ECB Working Paper Series No. 1937.
- Ralyea, J., 2016, "Corporate Financial Health and Investment", Tech. Rep., IMF, 2016.
- Vermeulen, P., 2002, "Business Fixed Investment: Evidence of a Financial Accelerator in Europe", *Oxford Bulletin of Economics and Statistics*, 64(3), 213-231.
- Whited, T.M., 1992, "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data", *Journal of Finance*, 47(4), 1425-1460.

Appendix

The following passage is an English translation of the Article 55 from the Republic of Slovenia's Official Gazette 65/2009 14.8.2009 Companies Act (ZGD-1) defining the criteria of each firm size class.

Article 55

(Micro, small, medium-sized, and large companies)

(1) For the purposes of implementing this Act, companies shall be classified as micro, small, medium-sized, and large on the annual balance sheet cut-off date, in accordance with the following criteria:

- average number employees in the financial year;
- net proceeds from sales; and
- value of assets.

(2) A company that satisfies any two of the following criteria shall be deemed a micro company:

- fewer than an average of 10 employees in a financial year;
- fewer than an average of 10 employees in a financial year;
- annual turnover under EUR 2,000,000; and
- asset value under EUR 2,000,000.

(3) A small company shall be a company other than a micro company, as defined in the preceding paragraph, and shall meet any two of the following criteria:

- fewer than an average of 50 employees in a financial year;
- annual turnover under EUR 8,800,000; and
- asset value under EUR 4,400,000.

(4) A medium-sized company shall be a company other than a micro company, as referred to in paragraph (2) of this Article, or a small company, as referred to in the preceding paragraph, and shall meet two of the following criteria:

- fewer than an average of 250 employees in a financial year;
- annual turnover under EUR 35,000,000; and
- asset value under EUR 17,500,000.

(5) A large company shall be a company, which is neither a micro company, in accordance with paragraph (2) of this Article, nor a small company, in accordance with paragraph (3) of this Article, nor a medium-sized company, in accordance with the preceding paragraph.

(6) Under the criteria referred to in the preceding paragraphs, companies shall be classified as micro, small, medium-sized, or large on the basis of data for two consecutive financial years at the annual balance sheet cut-off date.

(7) The provisions of this Act and other regulations relating to small companies shall also apply to micro companies, unless otherwise regulated by this act and other rules.

(8) For the purposes of this Chapter, large companies shall, at all times, be deemed to include the following:

- banks;
- insurance companies;
- stock exchanges;
- companies obliged to prepare a consolidated annual report in accordance with Article 56 of this Act.

CHINA - CEE RELATIONS, IN-DEPTH ANALYSES OF 16+1 MECHANISM WITHIN OBOR INITIATIVE

LEONID NAKOV^a
VLADO DIMOVSKI^b
IGOR IVANOVSKI^a

^aSs. Cyril and Methodius University in Skopje, North Macedonia

^bUniversity of Ljubljana, Slovenia

Abstract

Principally, the One Belt One Road (OBOR) Initiative was officially announced in October, 2013, in compliance with the strategy for sustainable development of the President of the P.R. of China, Xi Jinping, prescribing the potential to initially integrate and closely connect over 60 countries from continents such as Asia -and the Middle East, in particular- Europe and Africa, which currently, under the 17+1 mechanism, include 138 countries. The fundamental objective of OBOR is to pave the way for closer economic, infrastructural, environmental, as well as socio-economic cooperation and transfer of experiences in the context of the 16+1 mechanism between China and CEE countries, especially having in mind various economic and business environments, strategic developmental goals and advanced economic sectors of CEE countries. In increasing the capacity for harmonizing the main sustainability pillars, i.e. economic, social and environmental, aiming at circular economy, business modelling, ethical compliance, etc., the role of transferring the Chinese, and eastern experiences and practices in general, while solving sustainability challenges, should be perceived as being of increased importance in our days.

JEL Classification: F21, O12, O3

Keywords: Sustainable Changes, Developmental Model, 16+1 China - CEE Relations, OBOR Initiative

Corresponding Author: **Leonid NAKOV**, Faculty of Economics - Skopje, Ss. Cyril and Methodius University in Skopje, Blvd. Goce Delchev 9V, 1000 Skopje, North Macedonia.

E-mail: lnakov@eccf.ukim.edu.mk

Vlado DIMOVSKI, School of Economics and Business, University of Ljubljana, Kardeljeva ploščad 17, 1000 Ljubljana, Slovenia. E-mail: vlado.dimovski@ef.uni-lj.si

Igor IVANOVSKI, Faculty of Economics - Skopje, Ss. Cyril and Methodius University in Skopje, Blvd. Goce Delchev 9V, 1000 Skopje, North Macedonia.

E-mail: igor.ivanovski@eccf.ukim.edu.mk

Introduction

The thorough analyses of implementable aspects of knowledge, skills, abilities and expertise that derive from immense historical and cooperative influence among, initially, more than 60 national economies, currently under the 17+1 mechanism including 138 countries, that constitute the modern Maritime Silk Road, conceptualized as the OBOR initiative, in *creating and developing a managerial sustainability, while integrating and cooperating system* that, to a great extent, is focused on behavioural synergies and symbiosis of organizations and institutions involved from member countries. The core research theme of this paper refers to the *16+1 China - CEE member countries*, illustrated in Figure 1:

Figure 1. Member countries of the 16+1 Cooperating China – CEE mechanism¹



The necessity of sustainable national development is initially perceived as implementing the *key pillars of sustainability* (Schiehlé & Wallin, 2014):

- 1) *The United Nations Commission for Sustainable Development Theme Indicator Framework discerns four dimensions of sustainable development: economic, social, environmental, institutional in 15 themes and 38 sub-themes;*
- 2) *GRI Framework, which focuses on social, environmental and economic areas;*
- 3) *Wuppertal Sustainable Development Indicator Framework is based on four dimensions and integrating their connectivity;*
- 4) *Accountability Standards;*
- 5) *United Nations Global Compact Agreement (UNGC).*

1. European Council on Foreign Relations, 2015, at <http://ecfr.eu>.

The primary scientific-research focal point in this paper is unifying, in an integrative model, the key challenges and techniques for intensive and predictive development in China – CEE countries relations, through harmonizing the following *main section analyzes*:

1. *Identifying the best applicable environment for creating and managing current and future cooperative actions within the OBOR Initiative, aiming at eradicating national differences that could potentially obstruct the sustainable changes planned for China – CEE relations.* It is evident that each of the 3 levels of cooperation is linked to creatively increasing the expectations from a cooperative potential point of view, which by far exceeds economic one, and imposes future changes on the overall national development model of CEE countries;
2. *Introducing key complementary changes and further managing implications, predominantly focusing on nature and pillars for sustaining the complementary character underlying the joint cooperative perspective.* In this context, each and every change is linked to multi-functional implications related to the increased level of competitiveness of particular national industries, while, at the same time, enabling the attempt to reach an optimal level for the sustainability pillars referred to above, and,
3. *Benchmarking the most prominent best practices deriving from the effective readiness of mutual inter-disciplinary cooperation in China – CEE countries relations, as well as clearing up the potential of the 16+1 mechanism in the light of future structural changes in the majority of CEE countries.* It is a contemporary strive for each CEE country to increase its domestic capacity for intensive and efficient transfer of best practices, particularly in industries that are part of the national competitive environment, as an indicator of the national potential for broadening the scope and nature of cooperation with China, within the OBOR Initiative.

The prevalent contribution of the paper is fundamentally focused on the following methodological – empirical dimensions of importance:

Integrating methodological and expert oriented thought in the field of the potential and perspectives of the OBOR Initiative, from the view point of environmental, structural and multi-functional, especially economical, developmental implications. As such, it attempts to discuss that not all varieties of cooperative mechanisms are sustainable for all CEE countries' national development, particularly due to apparent diversities in their national models and priorities, as well as,

Clarifying current cooperative and sustainable prospects in China – CEE relations, predominantly by thoroughly linking existing cooperative modalities among various CEE countries, regarding their relations to quality changes crucial for increased and competitive cooperation. This contribution is particularly focused on the increasing expert challenge for proving that measuring and evaluating implications, rather than only nominal readiness, in regard to cooperation within the OBOR Initiative is crucial for the future cooperation prospects in all CEE countries.

Methodological Overview

Contemporary managerial analyses focused on relationships in economic, cultural, scientific, etc. fields related to the comprehensive social development, between regional economic, cultural and political groups, such as the CEE countries (comprising, in 16+1, of 11 EU member states and 5 Balkan non-EU member states, whereas, in 17+1, of 34 OBOR countries from Europe and Asia, including 18 EU member states). These groups include national economies of various structures, with a varying degree of current and potential prosperity -especially economic ones- and integrative capacity, particularly concerning the transfer of professional experiences from other economic regions, such as the Middle East, North Europe, etc. It is evident that their eager intention to strive and catch up with the pace of far more advanced economies from the European Union would not be entirely harmonized, if all long-term change management dimensions did not pay intensive attention to the following *CEE developmental challenges*:

- Each business or institutional change initiative is expected to have a place in *the overall framework of integration of complementary changes, especially due to*:
 - *the lack of sufficient resources in the majority of CEE countries, on the one hand, and,*
 - *diversified capabilities in the majority of the population for comprehensive and intensified social and environmental development, on the other.*
- The sustainability orientation of the internal CEE initiative should be entirely supported by *a broader external manifestation of regional and supra-regional cooperating initiatives, among which the OBOR -One Belt One Road Initiative- has intensive absorptive capacity, mostly in the fields of*:
 - *modality for economic changes and transformations, as cornerstone for a latter advancements in the fields of*
 - *education and science,*
 - *culture,*
 - *environmental challenges, etc.*

Within the global sustainability framework, known as *Agenda for sustainable development 2030* -articulated through the *Millennium development goals (MDG)* as the broadest developmental pathway for each modality of inter-regional, inter-national cooperation and integration- and with the application of the *Strategy for Education and Training of the European Union, known as Strategy 2020* -consisting of the prevailing indicators for crucial developmental approaches in the most advanced European economies for the most important success factor, i.e. their human capital- the tendency for increasing the significance and applicative effects within the OBOR – CEE countries should be recognised as a potential solution for the *CEE cooperative sustainability challenges*:

- Developmental models of countries involved in the OBOR Initiative, especially the economic one, may be altered by transferring management sustainability systems from the initiator of the OBOR Initiative, i.e. China, towards the CEE countries, especially the Western Balkan countries. As such, this is expected to produce *sustainable economic changes in the fields of*:
 - prevalent management model,
 - leadership development and team performances,
 - analysing success indicators, etc.
- There may be strategic shifts regarding educational, research and environmental aspects to implement *sustainable social practices* largely relying on *the cooperative model of higher benefits due to increased human capital value*, and
- There may be cultural attempts to validate the contemporary necessity of *increasing trust, respect and confidence among culturally diversified environments*, as well as to reshape cultural modalities for developing joint developmental programmes primarily on a supra-national basis.

Nevertheless, harmonised development of the integrative challenges presented above could be effectively implemented by:

- determining *the most applicable complementary changes*, on the one hand, and,
- *training and coaching for the abilities to behave like a sustainable, responsible organisation or institution within a rapidly changing environment*, not only nationally, but also regionally and internationally, on the other.

Sustainable management of crucial pre-conditions for intensive cooperation within the 16+1 mechanism – changes required, and outcomes expected

1. Creating a sustainable environment through the OBOR Initiative for an enhanced cooperative development model between China and CEE countries

Undoubtedly, every systematised and holistic management effort for stimulating and benefitting from the fundamental, inter-regional cooperative 16+1 mechanisms should follow *the fundamental Cooperative Development China – CEE expectations*, illustrated in the following Table 1.

The potential for more intensified and diverse cooperation in China – EU relationships in general, particularly with CEE countries, is of *multi-dimensional and inter-functional significance*, and, therefore, should be analysed through its *developmental and cooperative capacity*, using a holistic, analytical and research framework and respecting the main sustainability features distinctive of the OBOR Initiative.

Table 1. Levels of Cooperative Development China – CEE expectations²

<i>First level</i>	<i>Second level</i>	<i>Third level</i>
<ul style="list-style-type: none"> •Increasing the potential for acquiring and implementing new or renewed methods and techniques for determining and implementing most important economic, cultural, social and environmental segments for cooperation, in order to achieve sustainable joint interests through the cooperation 	<ul style="list-style-type: none"> •Incorporating in the framework key success factors to constitute the cooperative developmental model for planning and implementing joint projects in various fields of integrated development, i.e., additional to economic, social, and environmental segments educational, cultural, infrastructure and other potential cooperative segments 	<ul style="list-style-type: none"> •Attempting to integrate the prevailing developmental determination that the overall fulfillment of sustainability goals is not possible without sufficient and efficient regional, as well as supra-regional forms of cooperation, in which the potential of the mechanism for China – CEE countries enhances broader domestic, as well as international positions and perspectives for the majority of the developing countries involved

The process of creating a sustainable environment for business and institutional forms of cooperation should substantially relate to the prevalent *integrative potential for more intensified and sustained China – CEE relations*, predominantly determined through the following indicative features:

1. *The obvious Chinese tendency for behaving on a global basis, should be accompanied by enhanced regional cooperative mechanisms*; in other words, the cooperative model would not achieve its sustainability goals if it entails, in the majority of projects, only direct cooperative forms between China and specific developing countries, but would result in higher developmental influence if accompanied by several China regional country partners, mostly due to the mechanisms for balanced and adjusted transfer of skills and experiences leading to urgent and faster adoption of EU criteria through sustained and multi-dimensional Chinese practices. This leads to *more prosperous and sustained regional CEE development*,
2. *The precise spheres for cooperation would largely differ between the corpus of CEE countries*, in both intensity and depth for sustained cooperative modalities, indicating that CEE countries that are also EU member states should pay serious attention to regional and supra-regional developmental needs, especially considering that *the developmental experience is expected to spread faster among Balkan non – EU member states*, in order to establish a broader zone for increased regional cooperation and further EU integration,

2. Data-source: Authors' analytical framework of the 16+1 Cooperative mechanism.

3. Following the developmental approaches within the OBOR Initiative member countries, *it is perceived that national economies of CEE countries possessing more experience in project management models, particularly concerning infrastructure, energy, transportation, communication, finance, etc., as, for instance, China, which is actively present at the moment in the majority of Western Balkan countries and dominates infrastructure investments, would be the leaders of integrating cooperative tendencies, especially in regard to transfer of know-how, new business models, restructuring the portfolio of products or services, raising public awareness and enhancing responsibility in public-private sector cooperation, etc.*

While developing a sustainable environment for increased cooperative potential, when analysing individually and regionally all fundamental country members of the 16+1 Initiative, it is useful to emphasize *the most necessary business and institutional practices deriving from the China – CEE countries relationship, that serve as a pre-requisite condition for every aspect of sustainable development*; these practices are best illustrated by the *expected deliverables from the China – CEE cooperative developmental model proposed*:

- *Establishing a clear relationship between the cooperative objectives and the cooperative outcomes*: It is quite recommendable for each cooperating country to understand and apply such cooperative techniques, skills and experiences that would best enable and increase the level of their capacity for a multi-dimensional evaluation of all effects derived from cooperative activities between CEE countries and China;
- *Developing an experiential cooperative model*: Each advanced sustainability modality is expected to focus on several cooperative outcomes, which means that the combination of applied techniques and skills should incorporate not only transfer of contemporary methodologies, but also immense applicative business and institutional developmental concepts and models, realised through a separate cooperative approach between CEE countries and China, especially on a regional basis;
- *A systematic approach for analysing, creating and evaluating the effectiveness and efficiency of all sustainability programmes for cooperation*: as such, this enables all cooperating countries to develop improved change processes and behaviour for their existing activities in order to establish continuous implementation of complementary changes. The approach should possess multiple and inter-dependent sustained implications in at least 2 of the 3 sustainability pillars (2/3 success rule), i.e. economic, social or environmental;
- *Increasing mutual inter-sector developmental influence from advancements in distinctive investment fields*: The continuing character and implications of majority infrastructure, sector-based projects are aligned with potential advancement in the social and environmental spheres, particularly

because the enhanced cooperative OBOR mechanism between China and CEE countries influences the quality of life and the stability of systems in all partner countries involved;

- *Building sustained cooperative network partners*: One important success criterion for current and future implications from the OBOR Initiative, as a whole is related to enabling a sustainable cooperative network of specific businesses or institutions that undertake, on a continuous basis, managerial actions that encompass a long-term cooperative perspective, predominantly aiming at increasing the scope and quality of competitive economic sectors at all CEE partner countries involved;

- *Acquiring focused and competitive intra-sector skills and experience*: This is recommended and quite useful for the process of designing and developing long-term sustainable cooperative programmes within the China – CEE countries mechanism, as well as for advancing the leadership profiles of business and institutional managers; it also makes it possible to select and develop focused intra-sector competences, skills and analytical frameworks, particularly in complementary economic sectors, in order to support the value-chain system creation and further development, mostly in the sectors that constitute the essence of a country's national competitive economic infrastructure.

Principally, the Sustainable Development Goals UN Framework clearly stipulates that the process of trying to increase competitiveness and sustainability *will include mobilization of financial resources as well as capacity-building and transfer of environmentally sound technologies to developing countries on favourable terms, including concessional and preferential ones, as mutually agreed. Public finance, both domestic and international, will play a vital role in providing essential services and public goods and in catalysing other sources of finance (UN, 2015).*

In this concept, while managing developmental national challenges, it is inevitable that, *by relying greatly on the might of its growing economy, the entrepreneurial spirit of Chinese business people and the attractiveness of its adjustable and scalable development model, China is now ready to offer the developing world a new kind of unit based on the new rules for political and economic globalization it is currently seeking to set (Mikhalev, M., 2017).*

The prevalent model for advancing the development of CEE countries using the Chinese experience has been predominantly determined as harmonized on a regional and international basis. Therefore, it is widely perceived that *economic studies have attested the importance of infrastructure investment in reducing poverty, as infrastructure investment can improve economic productivity, boost economic growth, and accelerate mobility of labour from low-productive sector to high-productive sectors, leading to increase in employment and earnings to the poor. Infrastructure investment*

can also improve the opportunity of the poor to have access to health and education, thus enhancing human development (Hong, P., 2016).

It should be emphasised that regardless of the framework for enabling intensified partnership within the 16+1 mechanism, internal national change capabilities of CEE countries still remain as one of the limiting factors for intensive and cooperative development, especially on a short term basis. This prevalent opinion is manifested through the fundamental developmental premise that *national regulations or self-regulatory measures will improve environmental performance to some extent, but, in the absence of significant change of expectations from the initiative, the thrust and pull under the governance arrangements framework remain weak, and there is still room for strengthening the small-scale 'green' norms supported by institutional norms and incentive* (Solmecke U., 2016).

Nevertheless, the potential for stimulating cooperation between CEE partner countries and China lies, to a great extent, in *creating and sustaining a developmental model for managing complementary changes*, in order to unify, as much as possible, the developmental cooperative implications in sustainable sectors and the employees involved.

2. Managerial implications from complementary changes in China-CEE countries relations

In order to enable a sustainable basis for developing a model of *complementary business and institutional changes*, the initial prerequisite condition is, in fact, *managerial determination to introduce an organic, rather than mechanistic relationship between CEE countries and China*, aimed at *identifying and analysing the potential of the real-not only nominal- sources for the competitive capacities and advantages aspired by CEE countries*.

In accordance with the established practice of organising an annual summit of China – CEE countries, at the one organised in Budapest, Hungary, in November 2017, the implementation of 16+1 cooperative mechanism was evaluated as follows: *5 Years have passed and together we have made great achievements in policy consultation, economic cooperation, cultural exchanges, and in many other fields* (Jielong Duan, 2017).

Therefore, the nature of necessary complementary changes would best be illustrated through the *complementary character of changes* needed in the majority of CEE countries:

- *Complementary processes and behaviour originate from the constitution and application of complementary teams of expert individuals*, i.e., a composition of individuals who can have different functional and professional expertise and bring added value to the overall process of determining cooperative challenges, designing the most easily applicable solution, implementing it, all the way to the level of

assessing and evaluating the overall impact, from a regional, national, organisational/ institutional or individual point of view;

- *Complementing the tendencies for external adaptation with ones focused on internal integration*, in accordance with the Adizes change management methodology, which illustrates that each sustainable form of cooperation between China and CEE countries is expected to further orient and accommodate future changes in the legislative framework in a direction that is crucial for sustainable planned and continuous modalities of changes, as a pre-requisite condition for cooperative development between China and CEE countries;

- *Complementary changes in CEE countries should support the cooperative mechanism and they are fundamentally perceived as a managerial attempt to integrate inclusive and sustainable change management techniques, on the one hand, with the imperative of achieving the institutional stability and policy predictive features, on the other*, provided that the actual cooperation within the China–CEE countries relationships adds value to the economic perspectives of all sub-regions within CEE countries, while also overcoming the majority of institutional obstacles to ensure enhanced and supportive sustainable cooperation;

- *Complementary managerial implications of the intended cooperative development lie in the core economic outcomes woven in the overall cooperative capacity of China – CEE countries*; these are illustrated below (Haggai, 2016):

- *Promotion of local manufacturing and nationally distinctive industries, as well as expanding markets* – entailing efficient integration of resources, especially natural and renewable, recycling, and horizontal, vertical and diagonal integration of markets, whether national or, and in particular, newly created regional ones within CEE member countries;

- *Increased economic performance and productivity* – this is closely connected with policy coordination, increased economic dependence, liberation of economic factors, a transparent model for measuring efficiency, especially, productivity of joint cooperative projects between China and CEE partner countries, etc.,

- *Lowered transactional costs, increased employment, particularly of high-skilled employees and enabling the concept of welfare states* - linked to increased application of total quality management techniques, 6 Sigma, lean management, integrated business models of quality of work and life, rebalancing the growth and developmental model in accordance with sectors of the highest degree of cooperative outcomes, in quantity and quality terms, etc.,

- *Increased regional cooperation and connectivity, integrated joint projects, as well as trade facilitation* – i.e., an open, inclusive and balanced management cooperative model, which considers that the majority of MNC's perceive the CEE region as a single market with distinctive national economic features expected to be of a regionally supportive, rather than exclusive, character.

In order to acquire and utilise as many of *complementary change management concepts* above as possible, it is quite recommendable to integrate the *fundamental pillars that are an integral part of the sustainable development model*, as illustrated in Table 2 below:

Table 2. Fundamental pillars of the sustainable developmental model³

<i>Inclusive development</i>	<ul style="list-style-type: none"> • Indicating that all cooperative initiatives should focus on collaborative partnerships for better planned and better focused initiatives
<i>Universal development</i>	<ul style="list-style-type: none"> • Having in mind that technological and financial cooperative benchmarking modalities are critical for more prosperous economic results of developing countries; besides, a universal character of development relates to harmonising national policies and programmes with those included in the Sustainable Development Goals (SDG)
<i>Integrated development</i>	<ul style="list-style-type: none"> • Critically explains the managerial approach in balancing economic harmonisation, inclusive development and environmental sustainability, all of which aiming at advancing rural development, natural resource management and skills development
<i>Locally – focused development</i>	<ul style="list-style-type: none"> • If we respect the fact that, by 2050, 66% of the total population would be urban citizens, urban investments, innovations and social fields of interest acquire increasing developmental significance
<i>Technology – driven development</i>	<ul style="list-style-type: none"> • This refers to the potential for implementing advanced technologies, such as Chinese technology, especially in the manufacturing industries in CEE countries; on the other hand, this also leads to local exchange of technologies between developing countries in a rather resourceful manner

The integration of these key sustainable development pillars creates a *stimulating environment for managing complementary changes in a distinctive cooperative model, nationally and regionally*, through persistent and consistent integration of factors crucial for sustainable cooperation success.

II. Developing an applicative pathway for qualitative enhancement of the cooperative potential within the OBOR Initiative in China–CEE countries

3. Benchmarking current successful cooperating developmental practices within the OBOR Initiative

The managerial concept of proper selection and integration of the most influential external and internal factors pre-determining potential success of the fundamental,

3. Data source: Adapted according to the Sustainable Development Solution Network, 2015, at <http://unsdsn.org>.

cooperative mechanism 16+1 between China and CEE countries, crucially relies on the *cooperative sustainability pathways achieved*:

- Having in mind that the initial OBOR Initiative included around 60 countries -it currently numbers 138- and a total of 63% of the world population, as opposed to the initial OBOR contribution amounting to 29% of the world GDP value (Wang, 2014), *each one of the participating CEE partner countries expects that this cooperative mechanism will have a clearly positive impact on raising their overall GDP, while it will also contribute to transferring professional expertise, predominantly in the fields of infrastructure, transport, logistics and investment management*;
- In order for the number and quality of the sectors involved to rise within the cooperating China–CEE countries mechanism, *various types of development channels towards a more sustainable direction will be obviously needed but not easy (Shu, 2016)*; far more is dependent on identifying and applying, as much as possible, *measurable and sustainable economic, social and environmental incentives, especially combining a set of regulations, on national, regional and local levels, within the period spanning from the initial to the lasting effects arising from the joint cooperative projects implemented*;
- In accordance with the strong determination of the Chinese creator of the OBOR Initiative, namely, President Xi Jinping, *the principle of the desirable inclusive development is often applied in the form of joint contribution, broad developmental consultation and shared benefits*, particularly referring to the necessity for clear sustainable determination of cooperative objectives, implementing methodologies, as well success indicators;
- While developing the concept of the OBOR initiative, one of the crucial changes has been placed in the Chinese paradigm of *'going global'*. In-depth analyses of the content of this modern economic and business approach identifies that *'going global' was first proposed in 1996; the broader notion of "going global" includes the export of labour services, goods and services, international finance as well as foreign investment and other business. The narrow sense of "going global" refers to enterprises entering global markets through investment and participating in international competition and cooperation (Yang, K. & Tang, L., 2016)*;
- In order to identify future prospects for China–CEE countries, it is highly recommendable to pay particular attention to the *4 Pillars of the EU–China Strategic Agenda 2020 presented below*:
 - Foreign and security policy,
 - Cooperation in trade and investments,
 - Connectivity, ICT and innovation,
 - Visa facilitation and increased flows of tourism; student mobility, academia and cultural cooperation (Schweisgut, H. in EU-CHINA, Relations: new directions, new priorities, 2016).

- Establishment of fundamentally new and sustainable financial institutions, such as the *New China-led financial institutions established – the New Development Bank (US \$50-100 bill.), the Contingent Reserve Facility (US \$ 100 bill.), the Asian Infrastructure and Investment Bank (US \$ 100 bill.) and the New Silk Road Fund (US \$ 40 bill.)*, (Chibber, A., 2017);
- If we conceptually *inter-combine the 5 sustainable pillars of the OBOR Initiative, i.e., policy communication, road connectivity, unimpeded trade, money circulation and cultural understanding, with the 6 sustainability pillars of the 16+1 China–CEE countries mechanisms, i.e. infrastructure, transport, investments, education, science and culture*, we can clearly identify that *in various EU member states of the OBOR initiative, the domestic country potential in the cooperative segments described above varies mainly due to the focal developmental policy tendencies, as well as to the objective obstacles to more intensive project developments that can generate higher added value, predominantly related to human resources potential*;
- If each and every category of the Sustainable Development Goals (SDG) is analysed from the view point of its national implication, we can identify that *their fundamental influence is in the segment of policy development -from institutional point of view- as well as in the modalities for financing new and advanced technology transfer*; this clearly attracts attention to *the need for higher and more intensive transfer of modern management, marketing, technology, research, and similar techniques, skills, abilities and expertise from China to CEE countries*, in order for the latter to achieve sustainability following the implementation of each particular joint project.

All of the above cooperative sustainability pathways have been taken into consideration in detailing the OBOR Initiative mechanism, which would be best illustrated through *current best practices for sustainable development*:

- *Of the 6 economic corridors which form an integral part of the OBOR Initiative, as well as of the contemporary Maritime Silk Road, 2 are related to Europe as a continent, namely the New Eurasia Land Bridge and the 21st Century Maritime Silk Road, of which the latter featured in the OBOR Initiative as concerning the inclusion of developing Balkan countries*;
- *Over the previous period of implementing the OBOR Initiative, Chinese enterprises, for instance in 2015, signed more than 4,000 project contracts in the 60 partner countries involved, the majority of which on a bilateral basis, amounting to 92.6 billion US\$ (Shah, 2016)*,
- *The Chinese strategy concerning the expanding processes throughout Europe coincided with European Union plans to stimulate economy lagging behind in the wake of the global economy and financial crisis; besides, it aspires to deepen the single market with a new investment plan (EU, 2015), which, in fact, is in line with Chinese investment activities within the cooperating mechanism between China and CEE partner countries.*

Finally, it is evident from the entire analysis that *the overall intention of the China-CEE countries mechanism is to create and develop a joint sustainable developmental model for overall closer cooperation, especially through determining sectors of joint economic, social, educational, scientific, cultural, as well as environmental interests.*

Conclusion

Every business or institutional change initiative is expected to be a piece in the overall framework of integration of complementary changes, especially given the lack of sufficient resources in the majority of CEE countries, on the one hand, and the diversified capabilities in all fields of the entire social and environmental development, on the other.

Within the global sustainability framework, known as the Agenda for sustainable development 2030, and specifically articulated, through the Millennium development goals, as the broadest developmental pathway for each modality of inter-regional cooperation and integration and the application of the European Union Strategy for education and training, known as Strategy 2020, and comprising the main indicators for crucial developmental approaches in the most advanced European economies for the most significant success factor, i.e. human capital, the tendency for reinforcing the importance and applicative effects within the OBOR-CEE countries encounters several cooperative sustainability challenges. Some of them are the altered developmental models of the OBOR Initiative countries, especially the economic one, which may strategically shift the educational, research and environmental focus to sustainable practices largely relying on the cooperative model. This model may be highly beneficial due to the increased human capital value and may attempt to culturally validate the current need for increasing trust, respect, and confidence among culturally diversified environments.

The integrative potential for more intensified and sustained China-CEE relations indicates that the apparent Chinese tendency to be an active player on a global basis should be accompanied by enhanced regional cooperative mechanisms; the precise spheres for cooperation would largely differ within the main body of CEE countries, where it is perceived that the national economies have richer experience in project management models, particularly concerning infrastructure, energy, transportation, communication, finance, etc. For example, China is currently actively present in developing countries, dominantly with infrastructure investments, which would lead to several integrating cooperative tendencies, especially in transferring know-how, new business models, restructuring the portfolio of products or services, raising higher public awareness and responsibility in public-private cooperation, etc.

The deliverables expected from the proposed China-CEE cooperative developmental model, principally relate to establishing a clear relationship between the cooperative objectives and the cooperative outcomes, developing an experi-

ential cooperative model, a system approach for analysing, solving and evaluating the effectiveness and efficiency of all sustainability programmes of cooperation, increasing mutual inter-sector developmental influence from advancements in distinctive investment fields, building sustained cooperative network partners, acquiring specific, competitive skills and experiences, etc. The overall cooperative capacity of the China–CEE countries mechanism lies in the promotion of local manufacturing industries and expanding markets, increased economic performance and productivity, lowered transactional costs, employment and welfare, regional connectivity, integration, trade facilitation, etc.

Finally, if we conceptually inter-combine the 5 sustainable pillars of the OBOR Initiative concerning policy communication, road connectivity, unimpeded trade, money circulation and cultural understanding, with the 6 sustainability pillars of the 16+1 China–CEE countries mechanism, i.e., infrastructure, transport, investments, education, science and culture, we can clearly identify that, in various EU member states of this initiative, domestic country potential in the cooperative segments described above varies mainly due to focused developmental policy tendencies, as well as to objective obstacles to more intensive project developments that can generate higher added value, predominantly due to human resources potential.

The Chinese strategy concerning the expanding processes throughout Europe coincided with the European Union plans to stimulate the economy lagging behind in the wake of the global economy and financial crisis, while it also aspires to deepen the single market with a new investment plan which, in fact, is in line with Chinese investment activities within the 16+1 mechanism between China and CEE partner countries.

References

- Chhibber, A., 2017, “China’s One Belt One Road Strategy: The New Financial Institutions and India’s Options”, Institute for International Economic Policy Working Paper Series Elliott School of International Affairs, The George Washington University.
- EU, 2015, “Regulation (EU) 2015/1017 of the European Parliament and of the Council of 25 June 2015 on the European Fund for Strategic Investments, the European Investment Advisory Hub and the European Investment Project Portal and amending Regulations (EU) No 1291/2013 and (EU) No 1316/2013 – the European Fund for Strategic Investments”, *Official Journal of the European Union*, L 169
- EU-CHINA, “Relations new directions, new priorities - discussion paper”, 2016, Friends of Europe, European Council on Foreign Relations, 2015, “One Belt, One Road”: China’s Great Leap Outward; *China Analysis*.
- Haggai, K., 2016, “One Belt One Road Strategy in China and Economic Development in the Concerning Countries”, *World Journal of Social Sciences and Humanities*, Vol. 2, pp. 10-14.
- Hong, P., 2016, “Jointly building the “Belt and Road” towards the Sustainable Development Goals”, Background Paper for Inclusive and Sustainable City Exhibition and Dialogue.
- Jielong, Duan, 2017, “China – CEEC think tanks gather in Hungary for 16+1 cooperation discussion”, at http://www.china-ceec.org/eng/ldrhw_1/2016lj_1/hdxw4/t1513300.htm, Retrieved 22 August, 2020.

- Mikhalev, M., 2017, "Dreams for the World, 'Made in China': 'One Belt, One Road' in the Context of the Interaction of Global Civilizations", Dialogue of Civilizations Research Institute.
- Shah, A., 2016, "Building a Sustainable 'Belt and Road'", <http://www.cirsd.org/horizons>, Retrieved 13 September, 2020.
- Schiehlé, T., & Wallin, J., 2014, "The reporting on sustainability performance indicators". Umea: Umea School of Business and Economics. Retrieved November 4, 2016, from <http://www.diva-portal.se/smash/get/diva2:732792/FULLTEXT01.pdf>, Retrieved 7 August, 2020.
- Shu, Jifu, 2016, "'Yi dai yi lu shi kechixu fazhan jiyu haishi dui huanjing de tiaozhan' (Is the One Belt, One Road an opportunity for sustainable development or a challenge for the environment)", Baidu Zhidao, 5 January, <http://zhidao.baidu.com/question/1990678099688972027.html>, Retrieved 13 May, 2020.
- Solmecke, Ulrike, 2016, "Multinational Enterprises and the 'One Belt, One Road' Initiative: Sustainable Development and Innovation in a Post Crisis Global Environment", *The Copenhagen Journal of Asian Studies* Vol.34(2).
- Sustainable Development Solution Network, 2015, at <http://unsdsn.org>, Retrieved 9 October, 2020.
- United Nations, 2015, "Transforming our world: the 2030 Agenda for Sustainable Development", http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E, Retrieved 12 October, 2020.
- Wang, Shuang, 2014, 'Xi Jinping ti zhanlüe gouxiang: "Yi dai yi lu"zhu meng kongjian' (Xi Jinping on the idea of the strategy: "One Belt One Road" opens up space to realize the dream). Zhongguo Jingji Wang, 11 August.
- Yang, K., Tang, L., 2016, "Corporate Social Responsibility of Chinese Enterprises Going Global From a Context of the One Belt and One Road Strategy", 3rd International Conference on Economics and Management (ICEM).

GROWTH, WEALTH ACCUMULATION AND ENVIRONMENTAL CHANGE IN PORTFOLIO CHOICE AND TRADE

Prof. WEI-BIN ZHANG*

Ritsumeikan Asia Pacific University, Japan

Abstract

The main purpose of this paper is to study global economic growth against national capital accumulation and environmental change in conditions of free international trade. The paper addresses issues related to changes in inequalities of income, wealth and economic structures between countries. Another unique contribution is to include portfolio equilibrium along with physical wealth and other assets (such as gold and diamond) in the multi-country growth model. We develop a multi-country model of wealth and environment as endogenous variables, along with government intervention in environmental protection. Governments collect taxes from different sources of producers' outputs and consumers' income. We apply Zhang's alternative concept of disposable income and utility function to model behaviour of households. We build the dynamics of J-country world economy, the behaviour of which is described by differential equations. We simulate the movement of the 3-country global economy and carry out comparative dynamic analysis with regard to certain parameters.

JEL Classification: O41

Keywords: Global Economic Growth, Trade, Transboundary Pollution, Gold, Portfolio Equilibrium, Inequalities Between Countries

Acknowledgements: I would like to thank the two anonymous referees for their valuable comments and suggestions. The usual caveat applies.

*Corresponding Address: **Wei-Bin ZHANG**, Professor, Ritsumeikan Asia Pacific University, 1-1 Jumonjibaru, Beppu-Shi, Oita-ken, 874-8577 Japan. E-mail: wbz1@apu.ac.jp

1. Introduction

The world is well-connected, both economically and environmentally. The current pandemic shows how one occurrence in some unknown part of the world has caused global social and economic changes. Changes in savings and improved productivity in one region, such as East Asia, have great impact on the global economic geography. As economy has been becoming increasingly more complex, households deal with portfolio choices. It is obvious that pollution is no more a local or national concern. Economies with large populations, such as China and India, have serious implications on the global environment if their economies are further expanded. Low costs of transportation, fast flow of information, globalised education, and widely spread, culture-independent, rational, and scientific knowledge have changed how basic economic laws function globally. Price equalisation theories have become more valid, after one excludes frictions, such as trade barriers, various taxes, and tariffs. The world economy is becoming a village due to these changes. As the world becomes more closely interdependent, it is important to develop a global growth model that takes account of interdependence between these variables across countries and over time.

The main purpose of this paper is to study global economic growth against national capital accumulation and environmental change in conditions of free international trade. The paper addresses issues related to changes in inequalities of income, and wealth, and economic structures between countries. Another unique contribution is to include portfolio equilibrium along with physical wealth and other assets (such as gold and diamond) in the multi-country growth model. We develop a multi-country model of wealth and environment as endogenous variables along with government intervention in environmental protection. Governments collect taxes from different sources of producers' outputs and consumers' income.

A main character of many contemporary economies is that households hold many assets, such as housing, land, stocks, precious metals, gold, cash in different currencies, in their portfolios. The complexity of a portfolio is increased in many parts of the world (e.g., Uhler and Gragg, 1971; Agell and Edin, 1990; Cobb-Clark and Hilderbrand, 2009; Gaudecker, 2015). What was described by Guiso *et al.* (2002) is applicable to the current state of relevant literature on analysis of portfolio equilibrium: "Until recently, researchers in economics and finance paid relatively little attention to household portfolios. Reasons included the tendency of most households to hold simple portfolios, the inability of the dominant asset pricing models to account for household portfolio incompleteness, and the lack of detailed databases on household portfolios in many countries until the late 1980s or 1990s. Now, however, the analysis of household portfolios is emerging as a field of vigorous study." Although household portfolios are frequently modelled on microeconomic grounds, there are only a few theoretical growth models that explicitly take

account of multiple assets and portfolio equilibrium. An original contribution of this paper is to introduce portfolio choice equilibrium into the neoclassical growth theory into the endogenous environment. For the purpose of modelling simplicity, portfolio choice refers to the decision on holding physical wealth and gold. It can be shown that we can easily generalise gold to include other assets, such as land, stocks, diamond, and the like (e.g., Zhang, 2020).

Economic growth and environmental changes have increasingly drawn attention in public debates and academic literature papers. Global warming is a main concern of many governments. It is easy, nowadays, to see that economic and environmental systems have a close interactional relationship. Rigorous economic theory still lacks a deep analysis of the significance of the environment in economic growth. It is crucial to study the economic system as an integrated whole rather than an unconnected subsystem. This study introduces endogenous environment into a multi-country growth model along with endogenous wealth and portfolio equilibrium. The environment is affected by production and consumption. Many studies have been conducted to examine the interdependence among economic growth, consumption, and the environment (for instance, Ploude, 1972; Forster, 1973; John and Pecchenino, 1994; Lamla, 2009; Prieur, 2009; Tsurumi and Managi, 2010; Gassebner *et al.* 2011; and Lin and Liscow, 2012). As pointed out by Fullerton and Kim (2008), existing research has proposed different models for analysing different questions in a non-integrated way. We make a contribution to the literature of interdependence between growth and the environment by examining growth, trade, and environmental change within an integrated framework.

We model capital mobility and trade on the basis of neoclassical growth theory. National economies are composed of Uzawa's two-sectors plus one environmental sector. We model the trade pattern on the Oniki-Uzawa trade model. We synthesise these approaches within an integrated framework by applying an alternative approach to consumer behaviour according to Zhang (1993, 2005). The model is a synthesis of two models recently proposed by Zhang. Zhang (2014) developed a global growth model on the basis of neoclassical growth theory. Zhang (2016) examined the value of gold and portfolio equilibrium conditions in the global market within a global growth equilibrium framework. This paper makes a synthesis of the main ideas in the two models. This paper is organised as follows. Section 2 defines the global growth model of portfolio equilibrium with endogenous changes in capital and the environment. Section 3 shows that the J-country global economy is described by 2J differential equations. Section 3 also simulates the model and depicts the movement of the global economy. Section 4 conducts a comparative dynamics analysis with regard to certain parameters. Section 5 concludes the study.

2. The global growth model based on wealth, the environment, and gold

This study is concerned with a global economic system composed of J national economies, indexed by $j = 1, \dots, J$. Each national economy consists of three sectors: the capital goods sector, the consumer goods sector, and the environmental sector. National economies produce globally homogenous capital goods. We model the environment sector according to Zhang (2014). Each country's environment sector is financially supported by the national government. The national government collects taxes from producers and consumers. We model capital goods and consumer goods sectors on the Uzawa two-sector model (Uzawa, 1961; Burmeister and Dobell, 1970; Azariadis, 1993; Barro and Sala-i-Martin, 1995). Trade is described according to the Oniki-Uzawa model (Oniki and Uzawa, 1965). We add the environment sector to the Oniki-Uzawa trade model. The consumer goods sector is not globally tradable. Assets are owned by households. Saving is undertaken only by households. Households distribute disposable income proposed by Zhang (2005) to consume and save. All input factors are fully employed. It is assumed that there is a fixed amount of gold in the world. Gold is owned and used by households. Gold can be sold in free markets without any friction and transaction costs (Barro, 1979; Barsky and Summers, 1988; and Chappell and Dowd, 1997). The price of capital goods is a unit. We measure prices in terms of capital goods. The wage and interest rates are determined by their marginal values in perfectly competitive markets. We assume that trade is free. We omit possible transaction costs. This implies the interest rate is identical throughout the world economy. Capital goods and labour are used as input factors in the three sectors. We introduce:

N_j — country j 's fixed population;

$K(t)$ — capital stocks of the world economy;

$K_j(t)$ and $\bar{K}_j(t)$ — total capital stock employed by country j and value of physical wealth owned by country j ;

$E_j(t)$ — level of pollution in country;

i, s and e — subscript index standing for capital goods sector, consumer goods sector, and environment sector;

$N_{jm}(t)$ and $K_{jm}(t)$ — labour force and capital stocks employed by sector m in country j ;
 $m = i, s, e$;

$F_{jm}(t)$ — output level of sector m in country j ;

$w_j(t)$ and $p_j(t)$ — wage rate and price of consumer goods in country j ;

$r(t)$ and $p_g(t)$ — (internationally equal) rate of interest and price of gold;

$\bar{k}_j(t)$ and $\bar{g}_j(t)$ — value of physical wealth and amount of gold owned by a-typical household in country j ;

$c_j(t)$ — consumption level of consumer goods by the typical household in country j ;

τ_{jm} and $\bar{\tau}_{jm}$ — fixed tax rate in sector m and $\bar{\tau}_{jm} \equiv 1 - \tau_{jm}$, $m = i, s$;

τ_{jw} and $\bar{\tau}_{jw}$ – tax rate on wage income in country j and $\bar{\tau}_{jw} \equiv 1 - \tau_{jw}$;
 τ_{jc} – tax rate on consumption; and
 δ_{kj} – fixed depreciation rate of capital in country j ;

Capital goods sectors

Production of capital goods sector in country j is specified as follows:

$$F_{ji}(t) = A_{ji} \Gamma_{ji}(E_j) K_{ji}^{\alpha_{ji}}(t) N_{ji}^{\beta_{ji}}(t), A_{ji}, \alpha_{ji}, \beta_{ji} > 0, \alpha_{ji} + \beta_{ji} = 1, \tag{1}$$

where A_{ji} , α_{ji} , and β_{ji} are positive parameters. We use $\Gamma_{ji}(E_j)$ to describe how the environment affects the productivity of the capital goods sector. We will specify this function when simulating the model. The marginal conditions imply that

$$r(t) + \delta_{kj} = \frac{\alpha_{ji} \bar{\tau}_{ji} F_{ji}(t)}{K_{ji}(t)}, w_j(t) = \frac{\beta_{ji} \bar{\tau}_{ji} F_{ji}(t)}{N_{ji}(t)} \tag{2}$$

Consumer goods sectors

Production in the consumer goods sector is modelled as:

$$F_{js}(t) = A_{js} \Gamma_{js}(E_j(t)) K_{js}^{\alpha_{js}}(t) N_{js}^{\beta_{js}}(t), \alpha_{js} + \beta_{js} = 1, \alpha_{js}, \beta_{js} > 0, \tag{3}$$

where A_{js} , α_{js} , and β_{js} are parameters and $\Gamma_{js}(E_j(t))$ is a function of the environment. The marginal conditions are given as:

$$r(t) + \delta_k = \frac{\alpha_{js} \bar{\tau}_{js} p_j(t) F_{js}(t)}{K_{js}(t)}, w_j(t) = \frac{\beta_{js} \bar{\tau}_{js} p_j(t) F_{js}(t)}{N_{js}(t)}. \tag{4}$$

Modelling change in the environment

Following Zhang (2014), we specify changes in the environment as follows:

$$\dot{E}_j(t) = \theta_{ji} F_{ji}(t) + \theta_{js} F_{js}(t) + \theta_j C_j(t) - F_{je}(t) - \bar{\theta}_j E_j(t) + \Omega_j \left(E_q(t) \right), \tag{5}$$

in which θ_{ji} , θ_{js} , θ_j , and $\bar{\theta}_j$ are positive parameters and

$$F_{je}(t) = A_{je} \Gamma_{je}(E_j(t)) K_{je}^{\alpha_{je}}(t) N_{je}^{\beta_{je}}(t), A_{je}, \alpha_{je}, \beta_{je} > 0, \tag{6}$$

where A_{je} , α_{je} , and β_{je} are positive parameters, and $\Gamma_{je}(E_j(t)) (\geq 0)$ is a function of $E_j(t)$. We use $\theta_{ji} F_{ji}$ to model pollutant emission during production processes. It is assumed that emission is linearly positively proportional to the output level (Gutiérrez, 2008). Parameter θ_{ji} implies that in consuming one unit of the goods quantity θ_{ji} is left as waste. We use $\theta_{jm} F_{jm}$ to measure pollutants emitted by sector θ_{jm} . Emission of pollutants by consumers is $\theta_j C_j$. We use parameter $\bar{\theta}_j$ to measure rate of natural pu-

rification. Term $\bar{\theta}_j E_j$ measures the rate at which nature purifies the environment. We use $K_{je}^{\alpha_e} N_{je}^{\beta_e}$ to reflect that the purification rate of the environment sector is positively related to capital and labour inputs. Term Γ_{je} means that purification efficiency is related to stock pollutants. We take account of possible pollution of country j for all countries with $\Omega_j((E_q))$. Transboundary pollution has been well-studied in literature on international pollution (e.g., Copeland and Taylor, 1994; Ono, 1998; Schweirger and Woodland, 2008; and Suhardiman and Giordano, 2012).

Portfolio choice equilibrium with physical wealth and gold

We model portfolio choice equilibrium against physical wealth and gold according to Zhang (2016). Gold is owned only by households. Gold is sold and bought in free markets. There is neither friction nor transaction cost in markets for gold. There is neither loss nor depreciation of gold. Households choose physical wealth and gold. To model equilibrium conditions for gold, we assume that households can 'rent' it in free markets for 'decoration' use. The representative household gold is used either for decoration or rented to other households. We represent rent of gold by $R_g(t)$ in global markets. Consider now an investor with one unit of money. S/he can either invest in capital goods, thereby, earning profit equal to the net own-rate of return or invest in gold, thereby, earning profit equal to the net own-rate of return $R_g(t)/p_g(t)$. As capital and gold markets are at portfolio equilibrium in free markets, two options must yield equal returns, i.e.

$$\frac{R_g(t)}{p_g(t)} = r(t). \quad (7)$$

Consumer behaviours

This study applies Zhang's utility function and concept of disposable income to analyse behaviour of households (Zhang, 1993; 2005). There are three variables for households to decide on consumption levels of goods and gold, and on how much to save. The total value of wealth owned by a household $a_j(t)$ is the sum of two assets' values:

$$a_j(t) = \bar{k}_j(t) + p_g(t) \bar{g}_j(t). \quad (8)$$

The household's current income from interest payments, wage payments, and gold interest income $R_g(t)\bar{g}_j(t)$ is:

$$y_j(t) = r(t) \bar{k}_j(t) + \bar{\tau}_{jw} w_j(t) + R_g(t) \bar{g}_j(t).$$

The per capita disposable income is the sum of the current disposable income and the value of wealth. We have:

$$\hat{y}_j(t) = y_j(t) + a_j(t). \quad (9)$$

The disposable income is distributed between saving and consumption. Saving $s_j(t)$ originates from disposable income. We have the budget constraint:

$$(1 + \tau_{jc}) p_j(t) c_j(t) + R_g(t) \hat{g}_j(t) + s_j(t) = \hat{y}_j(t). \tag{10}$$

The household decides on $s_j(t)$, $c_j(t)$, and $\hat{g}_j(t)$. Zhang's utility function is as follows:

$$U_j(t) = \Gamma_j(E_j(t)) c_j^{\xi_{0j}}(t) \hat{g}_j^{\gamma_{0j}}(t) s_j^{\lambda_{0j}}(t), \xi_{0j}, \gamma_{0j}, \lambda_{0j} > 0, \tag{11}$$

where $\Gamma_j(E_j(t))$ is a function related to the environment, ξ_{0j} is the propensity to consume goods, γ_{0j} is the propensity to use gold, and λ_{0j} the propensity to own wealth. It should be noted that some studies examine how the environment directly affects a household's decision (e.g., Selden and Song, 1995; Balcao, 2001; Nakada, 2004; and Munro, 2009).

Household maximises subject to budget constraint (10) yields

$$p_j(t) c_j(t) = \xi_j \hat{y}_j(t), R_g(t) \hat{g}_j(t) = \gamma_j \hat{y}_j(t), s_j(t) = \lambda_j \hat{y}_j(t), \tag{12}$$

where

$$\xi_j \equiv \frac{\rho_j \xi_{0j}}{1 + \tau_{jc}}, \gamma_j \equiv \rho_j \gamma_{0j}, \lambda_j \equiv \rho_j \lambda_{0j}, \rho_j \equiv \frac{1}{\xi_{0j} + \gamma_{0j} + \lambda_{0j}}.$$

Change in wealth

The change in a household's wealth is equal to savings minus dissaving, that is

$$\dot{a}_j(t) = s_j(t) - a_j(t). \tag{13}$$

Household own all gold

Globally, households own all the gold:

$$\sum_{j=1}^J \bar{g}_j(t) \bar{N}_j = G. \tag{14}$$

Gold is fully utilised

The total amount of gold used for 'decoration' equals the total gold in markets

$$\sum_{j=1}^J \hat{g}_j(t) \bar{N}_j = G. \tag{15}$$

The environment sector's input factors

The government uses up tax income on employing labour force and capital stock. The government combines taxes from producers and households. Government tax income is:

$$Y_{je}(t) = \tau_{ji} F_{ji}(t) + \tau_{js} F_{js}(t) + \tau_{jc} c_j(t) N_j + \tau_{jw} w_j(t) N_j. \quad (16)$$

The government budget means:

$$(r(t) + \delta_k) K_{je}(t) + w_j(t) N_{je}(t) = Y_{je}(t). \quad (17)$$

The government employs labour force and capital stocks to ensure that the purification rate is maximised under budget constraints. The government's problem is formulated as

$$\begin{aligned} & \text{Max}_{\{K_{je}(t), N_{je}(t)\}} F_e(t) \\ & \text{s.t.: (17).} \end{aligned}$$

Marginal conditions imply:

$$(r(t) + \delta_k) K_{je}(t) = \alpha_{je} Y_{je}(t), w_j(t) N_{je}(t) = \beta_{je} Y_{je}(t), \quad (18)$$

in which

$$\alpha_{je} \equiv \frac{\tilde{\alpha}_{je}}{\tilde{\alpha}_{je} + \tilde{\beta}_{je}}, \beta_{je} \equiv \frac{\tilde{\beta}_{je}}{\tilde{\alpha}_{je} + \tilde{\beta}_{je}}.$$

Demand and supply

The equilibrium condition for consumer goods implies:

$$c_j(t) N_j = F_{js}(t), j = 1, \dots, J. \quad (19)$$

National labour and capital are fully employed:

$$K_{ji}(t) + K_{js}(t) + K_{je}(t) = K_j(t), N_{ji}(t) + N_{js}(t) + N_{je}(t) = N_j. \quad (20)$$

The value of global capital stock equals the value of global physical wealth

$$K(t) = \sum_{j=1}^J K_j(t) = \sum_{j=1}^J \bar{k}_j(t) N_j. \quad (21)$$

The change in global capital equals total capital output minus global capital depreciation

$$\dot{K}(t) = F(t) - \sum_{j=1}^J \delta_{kj} K_j(t). \quad (22)$$

where

$$F(t) = \sum_{j=1}^J F_j(t).$$

The model is completed. From a structural point of view, the model is general in the sense that some well-known models in economic theory, such as the Solow growth model (Solow, 1956), Uzawa's two sector model (Uzawa, 1961), and Oniki-Uzawa trade model (Oniki and Uzawa, 1965), can be considered as its special cases.

3. Global dynamics

As the global economy is composed of any (finite) number of national economies and there is free trade between countries, the dynamic system is highly dimensional. We show properties of the system by simulation. The following lemma shows that the dimension of the dynamic system is twice the number of countries. We provide a computational procedure for calculating all variables at any point in time. We define a new variable $z_1(t)$:

$$z_1(t) \equiv \frac{r(t) + \delta_{1k}}{w_1(t)}.$$

Lemma

The dynamics of the world economy is determined by $2J$ differential equations with $z_1(t)$, $\{\alpha_j(t)\}$ and $(E_j(t))$ where $\{\alpha_j(t)\} = (\alpha_2(t), \dots, \alpha_j(t))$ and $(E_j(t)) = (E_1(t), \dots, E_j(t))$ as variables:

$$\begin{aligned} \dot{z}_1(t) &= \Phi_1 \left(z_1(t), (E_j(t)), \{a_j(t)\} \right), \\ \dot{a}_j(t) &= \Phi_j \left(z_1(t), (E_j(t)), \{a_j(t)\} \right), j = 2, \dots, J, \\ \dot{E}_j(t) &= \Omega_j \left(z_1(t), (E_j(t)), \{a_j(t)\} \right), j = 1, \dots, J, \end{aligned} \tag{23}$$

in which Φ_j and Ω_j are unique functions of the $2J$ variables. The functions are provided in the Appendix. Moreover, the other variables are uniquely determined as functions of the $2J$ variables through the following procedure: $r(t)$ and $w_j(t)$ with (A2) $\rightarrow p_j(t)$ from (A4) $\rightarrow a_1(t)$ by (A20) $\rightarrow K_j(t)$ by (A17) $\rightarrow N_{ji}(t)$ and $N_{je}(t)$ from (A11) $\rightarrow N_{js}(t)$ in (A7) $\rightarrow K_{je}(t)$, $K_{js}(t)$, and $K_{ji}(t)$ in (A1) $\rightarrow \hat{y}_j(t)$ from (A5) $\rightarrow F_{ji}(t)$, $F_{js}(t)$ and $F_{je}(t)$ by the definitions $\rightarrow c_j(t)$ and $s_j(t)$ from (12) $\rightarrow Y_{je}(t) = w_j(t) N_{je}(t) / \beta_{je} \rightarrow K(t) = \sum_j K_j(t) \rightarrow R_g(t)$ by (A21) $\rightarrow p_g(t)$ by (7) $\rightarrow \bar{g}_j(t)$ by (12).

We can follow the computational procedure to show the movement of the global economy with any number of countries. We now examine a -country global economy by simulation. As in Zhang (2014), the functions related to environmental quality are specified

$F_{jm}(E_j(t)) = E_j^{-b_{jm}}(t), \Gamma_j(E_j(t)) = E_j^{-b_j}(t), j = 1, 2, 3, m = i, s, e.$ boundary pollution functions are specified as:

$$\Omega_q(E_q(t)) = \sum_{j, j \neq q}^J \theta_{jq} E_j(t).$$

We require $\theta_{jq} \geq 0$. The transboundary pollution functions mean that any country's environment may be affected by all other countries. We consider the transboundary pollution rate is linearly related to pollutant source countries. We specify the parameters as follows:

$$\begin{aligned} \begin{pmatrix} N_1 \\ N_2 \\ N_3 \end{pmatrix} &= \begin{pmatrix} 3 \\ 10 \\ 30 \end{pmatrix}, \begin{pmatrix} A_{1i} \\ A_{2i} \\ A_{3i} \end{pmatrix} = \begin{pmatrix} 1.7 \\ 1 \\ 0.8 \end{pmatrix}, \begin{pmatrix} A_{1s} \\ A_{2s} \\ A_{3s} \end{pmatrix} = \begin{pmatrix} 1.5 \\ 0.9 \\ 0.7 \end{pmatrix}, \begin{pmatrix} A_{1e} \\ A_{2e} \\ A_{3e} \end{pmatrix} = \begin{pmatrix} 1.2 \\ 1 \\ 0.9 \end{pmatrix}, \begin{pmatrix} \lambda_{10} \\ \lambda_{20} \\ \lambda_{30} \end{pmatrix} = \begin{pmatrix} 0.6 \\ 0.55 \\ 0.5 \end{pmatrix}, \\ \begin{pmatrix} b_{1i} \\ b_{2i} \\ b_{3i} \end{pmatrix} &= \begin{pmatrix} b_{1s} \\ b_{2s} \\ b_{3s} \end{pmatrix} = \begin{pmatrix} b_{1e} \\ b_{2e} \\ b_{3e} \end{pmatrix} = \begin{pmatrix} 0.1 \\ 0.02 \\ 0.01 \end{pmatrix}, \begin{pmatrix} \bar{\theta}_1 \\ \bar{\theta}_2 \\ \bar{\theta}_3 \end{pmatrix} = \begin{pmatrix} 0.08 \\ 0.12 \\ 0.11 \end{pmatrix}, \begin{pmatrix} \tau_{1w} \\ \tau_{2w} \\ \tau_{3w} \end{pmatrix} = \begin{pmatrix} 0.01 \\ 0.02 \\ 0.02 \end{pmatrix}, \\ \begin{pmatrix} \xi_{0j} \\ \tau_{jc} \\ \tau_{ji} \end{pmatrix} &= \begin{pmatrix} 0.2 \\ 0.01 \\ 0.01 \end{pmatrix}, \begin{pmatrix} \tau_{js} \\ \tilde{\alpha}_{je} \\ \tilde{\beta}_{je} \end{pmatrix} = \begin{pmatrix} 0.01 \\ 0.4 \\ 0.2 \end{pmatrix}, \begin{pmatrix} b_j \\ \theta_{ji} \\ \theta_j \end{pmatrix} = \begin{pmatrix} 0.01 \\ 0.08 \\ 0.03 \end{pmatrix}, \begin{pmatrix} \delta_{1k} \\ \delta_{2k} \\ \delta_{3k} \end{pmatrix} = \begin{pmatrix} 0.05 \\ 0.04 \\ 0.04 \end{pmatrix}, \\ \alpha_{ji} &= 0.31, \alpha_{js} = 0.33, G = 1, \gamma_{0j} = 0.005, \theta_{js} = 0.1, \theta_{jq} = 0.01, j, q = 1, 2, 3. \end{aligned} \tag{24}$$

We fix the total amount of gold in the world as one unit. The populations are respectively 3, 3 and 30 in order. Country 3 has the largest population. The total productivity factor of the capital goods sectors is, respectively: 1.7, 1 and 0.8. The total productivity factor of the consumer goods sectors is, respectively 1.5, 0.9 and 0.7. The total productivity factor of the environment sectors is, respectively 1.2, 1 and 0.9. Country 1's propensity to save is the highest; country 2's comes next and country 3's is the lowest. Tax rates on consumption level are one percent. Tax rates on production sectors and interest income of wealth are one or two percent. We simulate the model with the following initial conditions:

$$z_1(0) = 0.12, \alpha_2(0) = 3, \alpha_3(0) = 2.3, E_1(0) = 10.5, E_2(0) = 10, E_3(0) = 55.$$

The motion of the variables is plotted in Figure 1. In Figure 1, the global output is:

$$Y(t) = \sum_j \{F_{ji}(t) + p_j(t) F_{js}(t)\}.$$

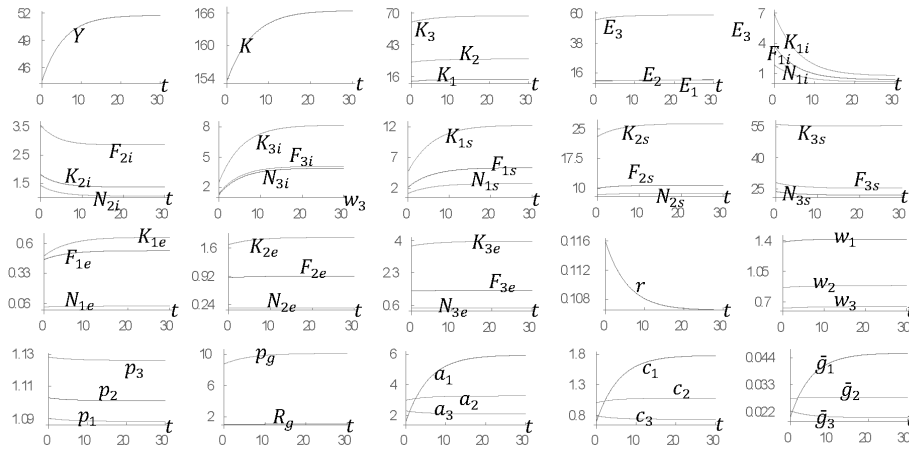


Figure 1. Motion of World Economy

The global output and capital stock are enhanced from the initial state. National economies employ more physical capital. Sectors in different countries experience different paths of economic development. The capital goods sectors of countries 1 and 2 produce less output and employ less the two input factors. The capital goods sector of country 3 produces more output and employs more the two input factors. The consumer goods sector of countries 1 and 2 produce more output and employ more the two input factors. The consumer goods sector of country 3 produces less output and employs less the two input factors. The three economies also experience different paths of environmental changes. Country 3's environment deteriorates. The other two countries' environmental conditions are slightly changed. The rate of interest falls. The price of gold rises and the rent of gold changes slightly. All the wage rates are increased. All service charges are lowered. Country 1's consumption levels of goods and gold and level of wealth are increased. Country 2's consumption levels of goods and gold and level of wealth per household change slightly. Country 3's consumption levels of goods and gold and level of wealth per household are reduced.

From Figure 1, we see that the system is approaching a stationary state over time. This implies the existence of an equilibrium point. We identify the values of an equilibrium point

$K = 166.5, Y = 51.8, r = 0.107, p_g = 10.08, R_g = 1.08, \bar{g}_1 = 0.046, \bar{g}_2 = 0.028, \bar{g}_3 = 0.02.$

$$\begin{pmatrix} E_1 \\ E_2 \\ E_3 \end{pmatrix} = \begin{pmatrix} 11.083 \\ 10.77 \\ 58.63 \end{pmatrix}, \begin{pmatrix} Y_{1e} \\ Y_{2e} \\ Y_{3e} \end{pmatrix} = \begin{pmatrix} 0.15 \\ 0.41 \\ 0.87 \end{pmatrix}, \begin{pmatrix} p_1 \\ p_2 \\ p_3 \end{pmatrix} = \begin{pmatrix} 1.1 \\ 1.09 \\ 1.13 \end{pmatrix}, \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} = \begin{pmatrix} 1.41 \\ 0.89 \\ 0.65 \end{pmatrix}, \begin{pmatrix} F_{1i} \\ F_{2i} \\ F_{3i} \end{pmatrix} = \begin{pmatrix} 0.41 \\ 1.37 \\ 3.9 \end{pmatrix}, \\ \begin{pmatrix} F_{1s} \\ F_{2s} \\ F_{3s} \end{pmatrix} = \begin{pmatrix} 5.33 \\ 10.83 \\ 22.13 \end{pmatrix}, \begin{pmatrix} F_{1e} \\ F_{2e} \\ F_{3e} \end{pmatrix} = \begin{pmatrix} 0.53 \\ 0.92 \\ 1.39 \end{pmatrix}, \begin{pmatrix} N_{1i} \\ N_{2i} \\ N_{3i} \end{pmatrix} = \begin{pmatrix} 0.2 \\ 1.06 \\ 4.11 \end{pmatrix}, \begin{pmatrix} N_{1s} \\ N_{2s} \\ N_{3s} \end{pmatrix} = \begin{pmatrix} 2.77 \\ 8.79 \\ 25.5 \end{pmatrix}, \\ \begin{pmatrix} N_{1e} \\ N_{2e} \\ N_{3e} \end{pmatrix} = \begin{pmatrix} 0.04 \\ 0.15 \\ 0.45 \end{pmatrix}, \begin{pmatrix} K_{1i} \\ K_{2i} \\ K_{3i} \end{pmatrix} = \begin{pmatrix} 0.8 \\ 2.88 \\ 8.18 \end{pmatrix}, \begin{pmatrix} K_{1s} \\ K_{2s} \\ K_{3s} \end{pmatrix} = \begin{pmatrix} 12.25 \\ 26.27 \\ 55.58 \end{pmatrix}, \begin{pmatrix} K_{1e} \\ K_{2e} \\ K_{3e} \end{pmatrix} = \begin{pmatrix} 0.65 \\ 1.86 \\ 3.97 \end{pmatrix}, \\ \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} = \begin{pmatrix} 5.93 \\ 3.27 \\ 2.1 \end{pmatrix}, \begin{pmatrix} c_1 \\ c_2 \\ c_3 \end{pmatrix} = \begin{pmatrix} 1.78 \\ 1.08 \\ 0.74 \end{pmatrix}.$$

We calculate the six eigenvalues at the equilibrium point:

$$-0.22, -0.2, -0.18, -0.13, -0.12, -0.08.$$

The equilibrium point is locally stable. This result is important as it confirms the validity of comparative dynamic analysis.

4. Comparative Dynamic Analysis

We followed the movement of the global economy. We now deal with how any exogenous changes affect global economy and national economies. We define a variable $\bar{\Delta}x(t)$, which represents the change rate of variable $x(t)$ in percentage due to changes in the specified parameter.

4.1. Country 1's propensity to use gold rises

We are first concerned with how the global economy is affected when country 1's propensity to use gold rises as follows: $\gamma_{01}: 0.005 \Rightarrow 0.007$. The simulation result is plotted in Figure 2. As country 1 increases its preference for gold for decoration, the price and rent of gold are enhanced. Country 1 uses more gold, while the other two economies use less. Prices of consumer goods fall. Country 1 consumes less and has less wealth, while the other two economies' consumption levels and levels of wealth are affected slightly. The Global output and physical capital are reduced in association with falling wage rates and rising rates of interest. Environmental qualities are improved in the three economies. All economies employ less capital. Economic structural changes are plotted in Figure 2.

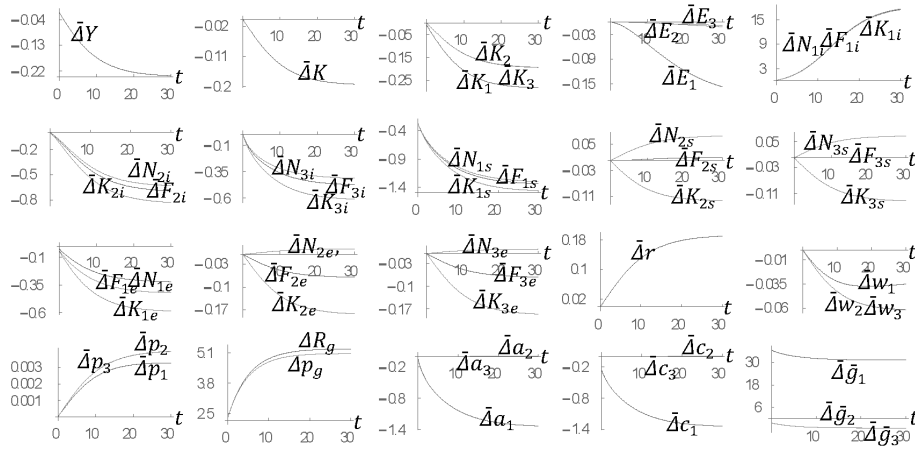


Figure 2. Country 1's Propensity to Use Gold Rises

4.3. Environmental tax rate in country 1's capital goods sector rises

We study impact of a rise in the environmental tax rate in country 1's capital goods sector as follows: $\tau_{1i}:0.01 \Rightarrow 0.02$. The simulation result is plotted in Figure 3. Country 1's environment sector expands. Environmental qualities are improved in all three economies. Country 1's capital goods sector shrinks. Global income and wealth rise initially and fall in the long term. Gold price and rent rise initially and fall in the long term. Country 1's household initially has more wealth, consumes more, and utilises more gold, but in the long term it has less wealth, consumes less, and utilises less gold. The behaviour of the other countries' households is slightly affected. The rate of interest falls initially and changes slightly in the long term. Country 1 has lower wage rates and lower prices of consumer goods.

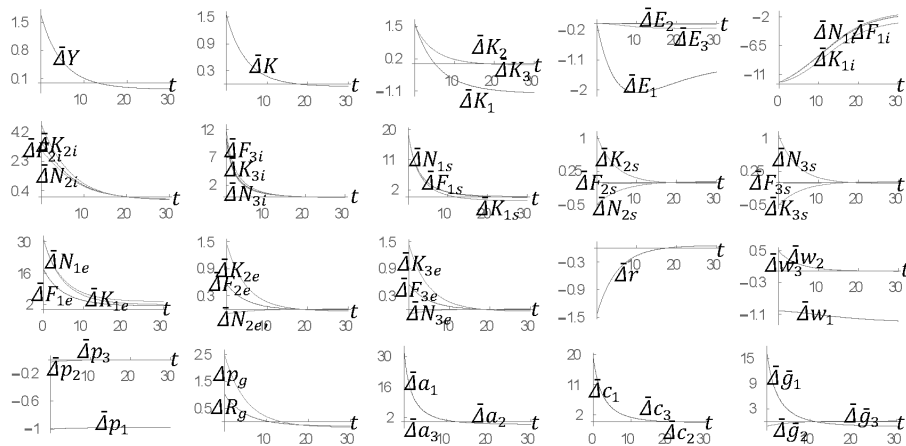


Figure 3. The Environmental Tax Rate in Country 1's Capital Goods Sector Rises

4.4. Country 3 increases consumption tax rate

We now study what happens in the global economy if the UE economy raises consumption tax rate as follows: $\tau_3c:0.01 \Rightarrow 0.03$. The simulation result is plotted in Figure 3. Country 3's consumption of consumer goods falls and country 3's consumer goods sector shrinks. All capital goods sectors expand. Global income rises, but global capital stock falls. All national economies have a better environment. Countries 1 and 2 employ more capital, while country 3 employs less capital. Gold price and gold rent initially fall, and prices of consumer goods fall in all economies. The rate of interest falls, and wage rates rise. In the long term environment sectors increase output levels.

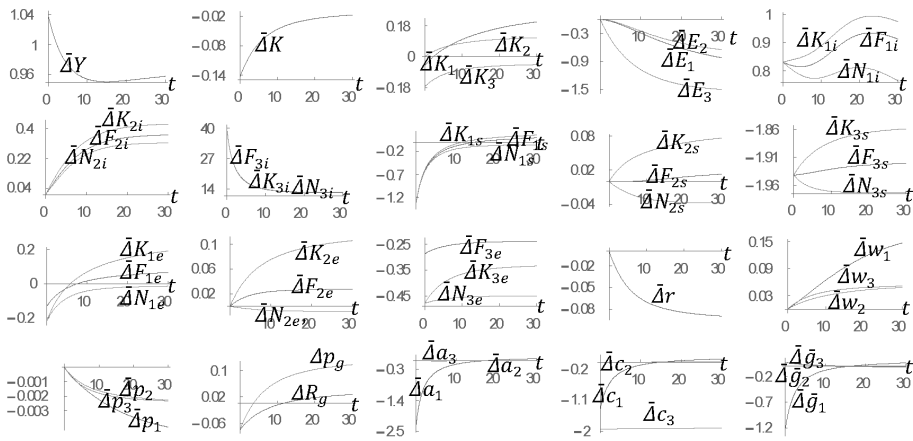


Figure 4. Country 3 increases Consumption Tax Rate

5. Concluding remarks

This paper studies global economic growth against national capital accumulation and environmental change in free international trade. It addresses issues related to changes in inequalities in income and wealth and economic structures between countries. Another unique contribution is made by introducing portfolio equilibrium between physical wealth and other assets (such as gold and diamond) in a multi-country growth model. The paper constructs a multi-country growth model with portfolio equilibrium between physical wealth and gold. The multi-country model treats wealth and the environment as endogenous variables along with government intervention in environmental protection. Governments collect taxes from different sources of producers' outputs and consumers' income. The study deals not only with issues related to changes in inequalities in income and wealth and economic structures between countries, but also differences in environmental changes between countries. We built the dynamics of a J -country world economy of which behaviour is described by $2J$ differential equations. We simulated the movement of the 3-country

global economy and carried out comparative dynamic analysis with regards to certain parameters. As the model is composed of dynamic interdependence among many variables, we get relations among these variables which cannot be obtained from partial analyses. In the paper, for instance, we show that an improvement in one country's environmental policy will improve all countries' environment quality but reduce the country's economic activities. The country also consumes less and has lower capital stock and lower wage rates. This might explain why some countries are reluctant to make contributions to environmental improvement through enhancing tax rates on firms. We also examine effects of changes in countries' preferences and technologies. As the analytical framework is robust, it can provide different insights into the complexity of modern economic issues.

We can examine some important issues related to the interdependence between growth and environmental change in a comprehensive manner, not only because our theory is built on the economic mechanisms, but also because we gave the computational procedure for plotting dynamic paths of the nonlinear dynamic system. Although our modelling framework is truly comprehensive, it is a simplified analytical framework and can be extended and generalised in different directions. For instance, other forms of production or utility functions may be applied to the economic system. Transboundary pollution may occur in other ways. There are different ways to tax firms and households (e.g., Zhang, 2020).

Appendix: Proving the Lemma

Equations (2), (4) and (18) imply:

$$z_j \equiv \frac{r + \delta_k}{w_j} = \frac{N_{jm}}{\bar{\beta}_{jm} K_{jm}}, j = 1, \dots, J, m = i, s, e, \tag{A1}$$

in which $\bar{\beta}_{jm} \equiv \beta_{jm}/\alpha_{jm}$. Inserting (A1) in (2) yields:

$$r = \alpha_{jr} \Gamma_{ji} z_j^{\beta_{ji}} - \delta_k, w_j = \alpha_j \Gamma_{ji} z_j^{-\alpha_{ji}}, \tag{A2}$$

in which

$$\alpha_{jr} = \alpha_{ji} \bar{\tau}_{ji} \bar{\beta}_{ji}^{\beta_{ji}} A_{ji}, \alpha_j = \frac{\beta_{ji} \bar{\tau}_{ji} A_{ji}}{\bar{\beta}_{ji}^{\alpha_{ji}}}.$$

Equation (A2) means:

$$r = \alpha_{jr} \Gamma_{ji} z_j^{\beta_{ji}} - \delta_{jk} = \alpha_{1r} \Gamma_{1i} z_1^{\beta_{1i}} - \delta_{1k}, j = 1, \dots, J.$$

We solve the above equations

$$z_j(z_1, (E_j)) = \left(\frac{\alpha_{1r} \Gamma_{1i} z_1^{\beta_{1i}} + \delta_{jk} - \delta_{1k}}{\alpha_{jr} \Gamma_{ji}} \right)^{1/\beta_{ji}}, j = 2, \dots, J. \tag{A3}$$

We, thus, solved r , w_j , and z_j as functions of z_1 and (E_j) . Equations (3) and (4) mean:

$$p_j(z_1, (E_j)) = \frac{\bar{\beta}_{js}^{\alpha_{js}} z_j^{\alpha_{js}} w_j}{\beta_{js} \bar{\tau}_{js} A_{js} \Gamma_{js}}. \quad (\text{A4})$$

By (7)-(9), we solve:

$$\hat{y}_j = (1 + r)a_j + \bar{\tau}_{jw} w_j. \quad (\text{A5})$$

Substitute $p_j c_j = \xi_j \hat{y}_j$ into (19):

$$\xi_j N_j \hat{y}_j = p_j F_{js}. \quad (\text{A6})$$

Insert (A5) in (A6):

$$N_{js} = \theta_j \bar{k}_j + \bar{\theta}_j, \quad (\text{A7})$$

in which we apply $w_j N_{js} = \beta_{js} \bar{\tau}_{js} p_j F_{js}$ and:

$$\theta_j(z, (E_j)) \equiv \left(\frac{1+r}{w_j} \right) \beta_{js} \bar{\tau}_{js} \xi_j N_j, \bar{\theta}_j \equiv \beta_{js} \bar{\tau}_{js} \bar{\tau}_{jw} \xi_j N_j.$$

By (A1) and (16) we solve:

$$\frac{N_{ji}}{\bar{\beta}_{ji}} + \frac{N_{js}}{\bar{\beta}_{js}} + \frac{N_{je}}{\bar{\beta}_{je}} = z_j K_j. \quad (\text{A8})$$

Substitute (A7) into (A8)

$$\frac{N_{ji}}{\bar{\beta}_{ji}} + \frac{N_{je}}{\bar{\beta}_{je}} = z_j K_j - \frac{\theta_j a_j}{\bar{\beta}_{js}} - \frac{\bar{\theta}_j}{\bar{\beta}_{js}}. \quad (\text{A9})$$

Substituting (A7) into $N_{ji} + N_{js} + N_{je} = N_j$ yields:

$$N_{ji} + N_{je} = N_j - \theta_j a_j - \bar{\theta}_j. \quad (\text{A10})$$

We solve (A9) and (A10) with N_{js} and N_{ji} as variables:

$$N_{ji} = a_{ji} + \tilde{b}_{ji} a_j - \tilde{\beta}_j z_j K_j, N_{je} = a_{je} + \tilde{b}_{je} a_j + \tilde{\beta}_j z_j K_j, \quad (\text{A11})$$

where

$$a_{ji} \equiv \left(\frac{N_j - \bar{\theta}_j}{\bar{\beta}_{je}} + \frac{\bar{\theta}_j}{\bar{\beta}_{js}} \right) \bar{\beta}_j, \tilde{b}_{ji}(z, (E_j)) \equiv \left(\frac{1}{\bar{\beta}_{js}} - \frac{1}{\bar{\beta}_{je}} \right) \bar{\beta}_j \theta_j,$$

$$a_{je} \equiv - \left(\frac{\bar{\theta}_j}{\bar{\beta}_{js}} + \frac{N_j - \bar{\theta}_j}{\bar{\beta}_{ji}} \right) \bar{\beta}_j, \tilde{b}_{je}(z, (E_j)) \equiv \left(\frac{1}{\bar{\beta}_{ji}} - \frac{1}{\bar{\beta}_{js}} \right) \bar{\beta}_j \theta_j, \tilde{\beta}_j \equiv \left(\frac{1}{\bar{\beta}_{je}} - \frac{1}{\bar{\beta}_{ji}} \right)^{-1}.$$

Insert (A1) in (2) and (5)

$$F_{ji} = \frac{A_{ji} \Gamma_{ji} N_{ji}}{\bar{\beta}_{ji}^{\alpha_{ji}} z_j^{\alpha_{ji}}}, F_{js} = \frac{A_{js} \Gamma_{js} N_{js}}{\bar{\beta}_s^{\alpha_s} z_j^{\alpha_{js}}}. \tag{A12}$$

From (A12) and (12) we get:

$$Y_{je} = \Lambda_{ji} N_{ji} + \Lambda_{js} N_{js} + \tau_{jc} c_j N_j + \tau_{jw} w_j N_j, \tag{A13}$$

where

$$\Lambda_{ji}(z_1, (E_j)) \equiv \frac{\tau_{ji} A_{ji} \Gamma_{ji}}{\bar{\beta}_{ji}^{\alpha_{ji}} z_j^{\alpha_{ji}}}, \Lambda_{js}(z_1, (E_j)) \equiv \frac{\tau_{js} A_{js} \Gamma_{js}}{\bar{\beta}_{js}^{\alpha_{js}} z_j^{\alpha_{js}}}.$$

By $p_j c_j = \xi_j \hat{y}_j$ and (A5), we solve:

$$c_j = \left(\frac{1+r}{p_j} \right) \xi_j a_j + \frac{\bar{\tau}_{jw} \xi_j w_j}{p_j}. \tag{A14}$$

From (A14) and (A13) we get:

$$Y_{je} = \bar{\Lambda}_j + \Lambda_{ji} N_{ji} + \Lambda_{js} N_{js} + \Lambda_j a_j, \tag{A15}$$

where

$$\Lambda_j(z_1, (E_j)) \equiv \left(\frac{1+r}{p_j} \right) \xi_j \tau_{jc} N_j, \bar{\Lambda}_j(z_1, (E_j)) \equiv \left(\frac{\bar{\tau}_{jw} \xi_j \tau_{jc}}{p_j} + \tau_{jw} \right) w_j N_j.$$

Substitute (A15) into $w_j N_{je} = \beta_{je} Y_{je}$

$$\frac{w_j N_{je}}{\beta_{je}} = \bar{\Lambda}_j + \Lambda_{ji} N_{ji} + \Lambda_{js} N_{js} + \Lambda_j a_j. \tag{A16}$$

Insert (A7) and (A11) in (A16)

$$K_j = \bar{\Delta}_j + \Delta_j a_j, \tag{A17}$$

where

$$\bar{\Delta}_j(z_1, (E_j)) \equiv \left(\bar{\Lambda}_j + \Lambda_{js} \bar{\theta}_j - \frac{w_j a_{je}}{\beta_{je}} + a_{ji} \Lambda_{ji} \right) \left(\frac{w_j}{\beta_{je}} + \Lambda_{ji} \right)^{-1} \frac{1}{\bar{\beta}_j z_j},$$

$$\Delta_j(z_1, (E_j)) \equiv \left(\tilde{b}_{ji} \Lambda_{ji} + \theta_j \Lambda_{js} + \Lambda_j - \frac{w_j \tilde{b}_{je}}{\beta_{je}} \right) \left(\frac{w_j}{\beta_{je}} + \Lambda_{ji} \right)^{-1} \frac{1}{\bar{\beta}_j z_j}.$$

Substitute (14) into (21)

$$\sum_{j=1}^J K_j = \sum_{j=2}^J a_j N_j - G. \tag{A18}$$

Substitute (A17) into (A18)

$$\sum_{j=1}^J \bar{\Delta}_j + \sum_{j=1}^J \Delta_j a_j = \sum_{j=2}^J (\Delta_j a_j - a_j N_j) - G. \quad (\text{A19})$$

From (A19) we determine α_1 as:

$$\alpha_1 = \phi(z_1, (E_j), \{a_j\}) \equiv \left(\sum_{j=1}^J \bar{\Delta}_j + G + \sum_{j=2}^J (\Delta_j - N_j) a_j \right) \frac{1}{N_1 - \Delta_1}. \quad (\text{A20})$$

From $R_g \hat{g}_j = \gamma_j \hat{y}_j$ in (12) and (15) we solve:

$$R_g = \frac{1}{G} \sum_{j=1}^J \gamma_j \hat{y}_j \bar{N}_j. \quad (\text{A21})$$

All other variables are solved as functions of and z_1 , (E_j) , and $\{a_j\}$ by: r and w_j with (A2) $\rightarrow p_j$ from (A4) $\rightarrow \alpha_1$ in (A20) $\rightarrow K_j$ in (A17) $\rightarrow N_{ji}$ and N_{je} from (A11) $\rightarrow N_{js}$ with (A7) $\rightarrow K_{je}$, K_{js} , and K_{ji} from (A1) $\rightarrow \hat{y}_j$ from (A5) $\rightarrow F_{ji}$, F_{js} and F_{je} with the definitions $\rightarrow c_j$ and s_j by (12) $\rightarrow Y_{je} = w_j N_{je} / \beta_{je} \rightarrow K = \sum_j K_j \rightarrow R_g$ in (A21) $\rightarrow p_g$ in (7) $\rightarrow \bar{g}_j$ in (12). From this procedure, (A19), (5) and (11), we have

$$\dot{\alpha}_1 = \bar{\Phi}_1(z_1, (E_j), \{a_j\}) \equiv \lambda_1 \hat{y}_1 - \phi, \quad (\text{A22})$$

$$\dot{\bar{k}}_j = \Phi_j(z_1, (E_j), \{a_j\}) \equiv \lambda_j \hat{y}_j - \bar{k}_j, j = 2, \dots, J.$$

$$\dot{E}_j = \Omega_j(z_1, (E_j), \{a_j\}) \equiv \theta_{ji} F_{ji} + \theta_{js} F_{js} + \theta_j C_j - F_{je} - \bar{\theta}_j E_j + \Omega_j((E_q)). \quad (\text{A23})$$

Taking derivatives of (A19), with respect to t and combining them with (A21), we have

$$\dot{\alpha}_1 = \frac{\partial \phi}{\partial z_1} \dot{z}_1 + \sum_{j=1}^J \Omega_j \frac{\partial \phi}{\partial E_j} + \sum_{j=2}^J \Phi_j \frac{\partial \phi}{\partial a_j}. \quad (\text{A24})$$

Equal the right-hand sizes of equations (A22) and (A24):

$$\dot{z}_1 = \Phi_1(z_1, (E_j), \{\bar{k}_j\}) \equiv \left[\bar{\Phi}_1 - \sum_{j=1}^J \Omega_j \frac{\partial \phi}{\partial E_j} - \sum_{j=2}^J \Phi_j \frac{\partial \phi}{\partial \bar{k}_j} \right] \left(\frac{\partial \phi}{\partial z_1} \right)^{-1}. \quad (\text{A25})$$

In summary, we have proved the lemma.

References

- Agell, J. and Edin, P.A., 1990, "Marginal Taxes and the Asset Portfolios of Swedish Households", *The Scandinavian Journal of Economics*, 92, 47-64.
- Azariadis, C., 1993, *Intertemporal Macroeconomics*, Oxford: Blackwell.
- Balcao, A., 2001, "Endogenous Growth and the Possibility of Eliminating Pollution", *Journal of Environmental Economics and Management*, 42, 360-73.
- Barro, R.J., 1979, "Money and the Price Level under the Classical Gold Standard", *Economic Journal*, 89, 13-33.
- Barro, R.J. and X. Sala-i-Martin, 1995, *Economic Growth*, New York: McGraw-Hill, Inc.
- Barsky, R.B. and Summers, L.H., 1988, "Gibson's Paradox and the Gold Standard", *Journal of Political Economy*, 96, 1161-6.
- Burmeister, E. and Dobell, A.R., 1970, *Mathematical Theories of Economic Growth*, London: Collier Macmillan Publishers.
- Chappell, D. and Dowd, K., 1997, "A Simple Model of the Gold Standard", *Journal of Money, Credit and Banking*, 29, 94-105.
- Cobb-Clark, D. and Hilderbrand, V.A., 2009, "The Asset Portfolios of Native-born and Foreign-born Australian Households", *Economic Record*, 85, 46-59.
- Copeland, B. R. and M. S. Taylor, 1994, "North-South Trade and the Environment", *Quarterly Journal of Economics*, 109, 755-787.
- Forster, B.A. 1973, "Optimal Consumption Planning in a Polluted Environment", *Economic Record*, 49, 534-45.
- Fullerton, D. and Kim, S.R. 2008, "Environmental Investment and Policy with Distortionary Taxes, and Endogenous Growth", *Journal of Environmental Economics and Management*, 56, 141-54.
- Gassebner, M., Lamlay, M.J., and Sturmz, J.E., 2011, "Determinants of Pollution: What Do We Really Know?", *Oxford Economic Papers*, 63, 568-95.
- Gaudecker, H. von., 2015, "How Does Household Portfolio Diversification Vary with Financial Literacy and Financial Advice?", *The Journal of Finance*, 70, 489-507.
- Guiso, L., Haliassos, M., and Jappelli, T., 2002, *Household Portfolios*, Mass., Boston: MIT Press.
- John, A. and Pecchenino, R. 1994, "An Overlapping Generation Model of Growth and the Environment", *The Economic Journal*, 104, 1393-410.
- Lamla, M.J., 2009, "Long-run Determinants of Pollution: A Robustness Analysis", *Ecological Economics*, 69, 135-44.
- Lin, C.Y.C. and Liscow, Z.D., 2012, "Endogeneity in the Environmental Kuznets Curve: An Instrumental Variables Approach", *American Journal of Agricultural Economics*, 95, 268-74.
- Munro, A. 2009, "Introduction to the Special Issue: Things We Do and Don't Understand About the Household and the Environment", *Environmental and Resources Economics*, 43, 1-10.
- Nakada, M. 2004, "Does Environmental Policy Necessarily Discourage Growth?", *Journal of Economics*, 81, 249-268.
- Oniki, H. and Uzawa, H., 1965, "Patterns of Trade and Investment in a Dynamic Model of International Trade", *Review of Economic Studies*, 32, 15-38.
- Ono, T., 1998, "Consumption Externalities and the Effects of International Income Transfer on the Global Environment", *Journal of Economics*, 68, 255-269.
- Plouder, G.C. 1972, "A Model of Waste Accumulation and Disposal", *Canadian Journal of Economics*, 5, 119-25.
- Priour, F. 2009, "The Environmental Kuznets Curve in a World of Irreversibility", *Economic Theory*, 40, 57-90.

- Schweinberger, A. G. and A. D. Woodland, 2008, "The Short and Long Run Effects of Tied Foreign Aid on Pollution Abatement, Pollution and Employment: A Pilot Model", *Journal of Environmental Economics and Management*, 55, 310–325.
- Selden, T.M. and Song, D. 1995, "Neoclassical Growth, the J Curve for Abatement and the Inverted U Curve for Pollution", *Journal of Environmental Economics and Management*, 29, 162-68.
- Solow, R., 1956, "A Contribution to the Theory of Growth", *Quarterly Journal of Economics*, 70, 65-94.
- Suhardiman, D. and Giordano, M., 2012, "Process-Focused Analysis in Transboundary Water Governance Research", *International Environmental Agreements: Politics, Law and Economics*, 3, 299-308.
- Tsurumi, T. and Managi, S. 2010. "Decomposition of the Environmental Kuznets Curve: Scale, Technique, and Composition Effects", *Environmental Economics and Policy Studies*, 11, 19-36.
- Uhler, R.S. and Gragg, J.G., 1971, "The Structure of the Asset Portfolios of Households", *The Review of Economic Studies*, 38, 341-57.
- Uzawa, H., 1961, "On a Two-Sector Model of Economic Growth", *Review of Economic Studies*, 29, 47-70.
- Zhang, W.B., 1993, "Woman's Labor Participation and Economic Growth - Creativity, Knowledge Utilization and Family Preference", *Economics Letters*, 42, 105-10.
- Zhang, W.B., 2005, *Economic Growth Theory*, Hampshire: Ashgate.
- Zhang, W.B., 2014, "Global Economic Growth and Environmental Change", *SPOUDAI Journal of Economics and Business*, 64, 3-29.
- Zhang, W.B., 2016, "Gold Value with Tradable and Non-tradable Goods in a Multi-Country Growth Model with Free Trade", *Economic Review - Journal of Economics and Business*, 14, 35-52.
- Zhang, W.B., 2020, *The General Economic Theory: An Integrative Approach*, Switzerland: Springer International Publishing.

THE GLOBAL FINANCIAL CRISIS (GFC) AND REMITTANCES RECEIVED IN AFRICA: ANY LESSONS FOR COVID-19?

EMEKA OKORO AKPA^a
SEGUN SUBAIR AWODE^b
ANDY TITUS OKWU^c
ISIAQ OLASUNKANMI OSENI^a

^aOlabisi Onabanjo University, Nigeria

^bNigerian Institute of Social and Economic Research (NISER), Nigeria

^cBabcock University, Nigeria

Abstract

We estimated the effect of the GFC on remittances into 8 SSA countries from 1999 to 2019 using the Fixed Effects (FE) model. Results showed that the GFC had a positive and significant effect on remittances. Per capita income of migrant home country exerted a negative but insignificant effect on remittances, while per capita income in remittance source country had a positive and significant effect; the effects of exchange rate and inflation on remittances were positive and negative, respectively, but insignificant. Findings showed the effect of the GFC on remittances is robust to remittance measures and large country sample size.

JEL Classification: F24, G01

Keywords: Global Financial Crisis, Remittances, COVID-19, Fixed Effects, Panel Data

Corresponding Author: **Emeka Okoro AKPA**, Student, PhD Economics, Department of Economics, Olabisi Onabanjo University, P.M.B 2002, Ago-Iwoye, Ogun State, Nigeria.

E-mail: akpaemeka@gmail.com

Segun Subair AWODE, Nigerian Institute of Social and Economic Research (NISER), Nigeria.

E-mail: awodesegun@gmail.com

Andy Titus OKWU, Department of Economics, Babcock University, Nigeria.

E-mail: okwua@babcock.edu.ng

Isiaq Olasunkanmi OSENI, Department of Economics, Olabisi Onabanjo University, Nigeria.

E-mail: osenioou@yahoo.com

1. Introduction

For Low and Middle Income (LMI) countries, remittances have come to represent their largest foreign exchange earner. It has exceeded Official Development Assistant (ODA) and inched close to Foreign Direct Investment in 2018 (World Bank, 2019). The importance of remittances to many LMI countries is seen in the proportion of their Gross Domestic Product (GDP) it accounts for. This fact is obvious in some countries in Sub-Saharan Africa (SSA). For countries such as Liberia, Comoros, The Gambia, Lesotho, Senegal and Cabo Verde, remittances represent 24.6 percent, 20.2 percent, 20.0 percent, 17.4 percent, 10.3 percent and 10.2 percent of their GDP, respectively (World Bank, 2016). The World Bank (2019) had predicted that remittances inflow to LMI countries would reach \$551 billion, \$574 billion, and \$597 billion in 2019, 2020 and 2021, respectively. However, following the pronouncement of the coronavirus (the official name of which is COVID-19) pandemic in 2020 by the World Health Organization (WHO), the World Bank revised remittance expectations to lower figures for 2020 in LMI countries, projecting that remittances to LMI countries would fall by about 20% to \$445 billion from the initially projected \$574 billion (World Bank, 2020).

As with the COVID-19 outbreak, the Global Financial Crisis (GFC) affected financial flows across the world and in LMIs; according to Milesi-Ferretti and Tille (2011), one of the effects of the GFC was its contributing to lowering international capital flows, remittances accounting for $\frac{3}{4}$ of such capital flows from the US and Western Europe into SSA (IMF, 2010). Potential reduction in its flow, following the GFC, may be resulting from the shock to the labour market the crisis caused. This effect is a result of laying off millions of workers, cuts in wages, work hours and other benefits of those who still kept their jobs (Verick, 2011). The extent to which this, actually, affected the ability of migrants in most GFC affected countries to remit to households in most-remittance-dependent countries in Africa remains to be seen. The extent to which the GFC affected remittances to LMIs and the insight that may be gleaned from this, as the world grapples with the COVID-19 pandemic, is the crux of this study. The GFC started in the financial sector in the US but spread to the real economy/estate sector. It started in the US sub-prime mortgage market, and spread to the real economy through the financial system, both in the US and throughout the world. Before the economic crisis of the COVID-19 pandemic, the GFC was said to have precipitated the worst recession in history since the Second World War (Verick, 2011).

While studies, by authors such as Nyamongo, Misati and Kipyegon (2012), Adams and Klobodu (2016), Makun (2017), Meyer and Shera (2017) Kadozi (2019), and Sobiech (2019), have all evaluated the remittances-growth nexus in Africa and other LMI and developing countries; other authors, such as Gupta, Patillo and Wagh (2009), Adams and Cueuecha (2013), Akobeng (2015), Inoue (2017), Vacaflor

(2017), and Wagle and Devkota (2018), have studied the effect of remittances on poverty. However, given the observation of Bakrania and Lucas (2009) that fragile states in SSA were more susceptible to financial shocks, given their dependency on remittances, it is worth studying the remittance effect of the GFC on SSA economies that may be rendered fragile if their receipt of remittance declines, as it represents a significant proportion of their GDP. Besides the GFC, studies have been carried out on the effects of different crises on economies in Africa. For example, the Tunisian revolution (the beginning of the Arab Spring) of the early 2000s necessitated the investigation into its impact on remittances received, undertaken by Edelbloude, Sers and Makhlouf (2017). Their study found that the Arab Spring induced more remittances into Tunisia; in Pakistan, Ghorpade (2017) found that domestic conflict decreased the likelihood of household-received remittances but increased in households with the lowest food expenditure quantile. Other studies, such as that by Shapiro and Mandelman (2016), examined the effect of fluctuations in remittances on the labour market and aggregate macroeconomy in Mexico; Opperman and Adjasi (2018) studied the effect of remittance volatility on the development of the financial sector in SSA, and Tachibana *et al* (2019) studied the effect of remittances in countering the negative effects of the 2015 earthquake in Nepal. These studies have not dealt with the effect of a financial crisis of the GFC type on remittances into Africa, and more specifically, on economies in SSA for which remittances are a significant portion of their GDP.

This study focuses on the effect a crisis of an economic/financial nature has on remittances into SSA countries for which it represents a significant portion of the GDP, and the lessons that can be drawn on the possible impact of the economic fallout of the COVID-19 pandemic on the region. More specifically, we hope to find the effect of the GFC on remittances received in sampled SSA countries. The rest of the paper is organized as follows: The next section discusses some related empirical studies. Section 3 gives theoretical considerations on determinants of remittances. In section 4 we give details of data used and methodology adopted, while in section 5 we evaluate findings from the study, including a robustness check. Finally, section 6 contains our concluding remarks and lessons from/implications of the COVID-19 pandemic, based on estimation results.

2. Empirical Literature

While empirical literature on the effect(s) of the GFC on remittances is sparse, it is even more so concerning the countries of focus in this study. While this review concentrates on the specific effect of the GFC on remittances, we also attempted to highlight the impact of other socio-political events on remittances received by recipient countries.

Gupta (2005), in a study on India, found a strong relationship between the economic conditions of remittance source countries and remittances returned. The study further showed that remittance was countercyclical in the receiving country. Using the OLS estimation technique, the study found that factors, such as political uncertainty, interest rates, exchange rate depreciation, were not important determinants of remittances into India.

Schiopu and Siegfried (2006) presented a comparison of the altruistic and investment motives of migrants' remitting funds. The paper examined the bilateral flows of remittances from 21 Western European countries to 7 European Union neighbours using panel data. The study found that the altruism motive for sending remittances (in which case remittances increased, the poorer the receiving country, relative to the sending country) was more significant than the investment motive.

Ruiz and Vargas-Silva (2009) evaluated the effects of the GFC on migrant remittances into Latin America between 2007 and 2008 using the Spearman and Standard Correlation Coefficients. Findings from the study showed that the GFC had a negative relationship with inward migrant remittances.

Jha, Sugiyarto and Vargas-Silva (2009) evaluated the effect of remittances into Asia in the face of the GFC. Their findings revealed that, while the crisis had caused immediate negative effect on inward remittances, the effect did not run into the long run.

Mohapatra and Ratha (2009) noted that remittances into developing countries dropped from US\$336 billion in 2008 to US\$316 billion in 2009. This decline was more acute in countries where migrants' destination was not diversified.

The study by Barajas *et al* (2010) estimated the effect of the global financial crisis on the economy of Africa through its effect on remittances. A panel of 44 countries was selected to estimate a reduced form equation with remittance as an exogenous variable, after estimating a remittance determination equation. Findings from the study showed that home countries from which migrants move more to Europe suffered more from the global financial crisis than home countries whose migrants move to other African countries.

Selim (2010) studied the effect of the GFC on migration and remittances in Bangladesh from a survey of 217 households with at least one member of their family living or working abroad in August 2007 and September 2008. The global financial crisis had a negative effect on inward migrant remittances, to the extent that there was a 6.4% fall in remittances received by households in Bangladesh.

Acosta, Baez, Beazley, Murrugarra (2012) estimated that, in El Salvador, remittances fell by 8.5% from \$3.5 billion in 2009, following the GFC. The study reported that this was the first decline in remittances in 20 years. They found a strong correlation between remittances into El Salvador and the US GDP, and between employment in the US and remittances in El Salvador. Furthermore, the study also reported that inward remittances suffered a negative effect following the 2007-2008 international food and commodities crisis, by accentuating poverty and wiping out the gains from previous effects of remittances.

Rajan and Narayana (2012), in a study on the effect of the global financial crisis (GFC) on migration and remittances from GCC to South Asian countries, estimated that remittances flow from the GCC into South Asia following the global financial crisis remained stagnant or had a mild increase. This may have resulted from the fall in the value of the currencies of South Asian countries, as the US dollar appreciated following the crisis. The study surveyed 50 returning migrants from GCC to four South Asian countries.

Naudé and Bezuidenhout (2012) studied the effect of the GFC on remittance flows in 23 SSA countries from 1980 to 2007, using the GMM estimation technique. Findings from the study showed that remittances were not significantly affected by the global financial crisis, despite the negative effect.

Diaz and Soydemir (2013) examined the effect on Mexican migrant remittances of the 2007-to-2009 housing market crisis in the US. The study spanned the period January 1995 to June 2008. Adopting a vector autoregressive (VAR) estimation technique, the study found that the rise in foreclosures in the US housing market had a significantly negative effect on remittances sent by Mexican migrants.

Naudé and Bezuidenhout (2014) investigated the impact on migrant remittances in 23 SSA countries, from 1980 to 2007, of natural and man-made disasters, and financial crises like the GFC of 2008/2009. Using the GMM estimation technique, the study found that remittances were negatively, but not significantly related to financial crises, especially of the GFC type. This negative relationship is hinged on the underdeveloped financial system in remittance receiving countries.

Bonjuka, Xhema, Dervishi and Limani (2017) studied the relationship between unemployment in Germany, Italy and Switzerland and remittances into Kosovo. While there was a negative relationship between unemployment in Germany and Italy and inward remittances into Kosovo, rising unemployment rates in Switzerland did not affect remittances into Kosovo between 2008 and 2010.

In a country like Mexico where lots of remittance are received from the United States, Sidaoui, Ramos-Francia and Cuadra (n.d.) noted that the global financial crisis and the resultant negative effect it had on labour market in the US, resulted in declining remittances received by Mexico.

A recent study by Olayungbo and Quadri (2019), using the pooled mean group estimation (PMG) technique, found that remittances and financial development had a positive effect on economic growth in the short and long-run in a panel of 20 SSA countries. This study, and that of Barajas *et al.* (2010), have used remittances to target economic growth, whereas this study targets remittances with determinants such as exchange rate and per capita income, besides the global financial crisis.

The World Bank (2020) estimated that remittance flows into Low-and Middle-Income (LMIC), as a result of the COVID-19 pandemic, would fall by about 20% in 2020, after it had exceeded the inflow of foreign direct investment

(FDI) in 2019. Two factors were recognized as potentially going to bring this about, namely, decline in domestic economic conditions of remittance source countries, such as Russia, which has seen economic fortunes decline with falling oil prices, and depreciation of currencies of remittance source countries against the US dollar. For SSA, the study predicted a 23.1% decline in remittance inflow following loss of jobs in construction, hospitality, and services (where majority of SSA migrants work), as a result of the economic impact of the crisis. This study is valid for migrants who choose Russia as their destination. Migrants in the countries sampled for this study mostly migrate to Europe, hence, the experiences of migrants in Russia and Europe may not be the same.

In the study by Bisong *et al* (2020) which are an integral part of development finance, proved relatively resilient during the 2008 financial crisis and the 2014 Ebola epidemic. However, they are currently under threat by the COVID-19 pandemic. Lockdown measures implemented in host countries have caused many migrants to lose their jobs, consequently reducing remittance flows to developing countries. In 2020, the World Bank estimates a historical decline in global remittances of US\$110 billion, with sub-Saharan Africa (SSA, it has been projected that the decline in remittances, as a result of the effect of the COVID-19 pandemic in some selected African countries like Nigeria, Kenya and Ghana, may have a negative effect on welfare. While these countries may be large numbers of recipients of remittances, they may withstand a shortfall in such inflow being bigger economies than some of the other countries selected for this study, such as Liberia, The Gambia and Lesotho.

Scanning through literature, we find that most studies on the effect of financial crises - like the GFC - on Africa lumped up countries into developing, SSA or single countries. To the best of our knowledge, no study exists that focuses on the effects of the GFC on remittances in countries for which remittance is most significant in terms of GDP percentage. The present study is unique in that it isolates those countries in Africa for which inward remittances are a substantial part of their economic output and tries to learn what insight the GFC could give to the potential impact of the COVID-19 pandemic on such economies. The studies by Naudé and Bezuidenhout (2012, 2014) may have attempted to estimate the impact of financial crises on remittances into SSA, but these studies did not recognize the heterogeneity in GDP significance of remittances to the various countries selected. Furthermore, we hope to compare the outcome of our study to the findings by Naudé and Bezuidenhout (2012, 2014) after extending the timeframe beyond the 2007, when they stopped, and focusing, more specifically, on the global financial crisis effect on remittances into most-remittance-dependent economies in SSA, against the effect on remittances received after natural disasters, financial crises and other conflicts, as presented in Naudé and Bezuidenhout (2012, 2014).

3. Theoretical Considerations

Theoretically, Arun and Ulku (2011) categorized the determinants of remittances into three groups, depending on their motives, namely: altruism, self-interest and satisfying requirements on inter-temporal contractual agreements.

3.1 Altruism

The altruistic determinant of remittances was advanced by Johnson and Whitelaw (1974), whose study considered the reasons for remitting by urban dwelling Kenyans to rural areas. Altruistic remittance was possible because the urban dwellers considered rural areas as an extension of their lives – that is where their wives and children live. Therefore, migrants have a permanent tie to the remittance receiving country or region. Altruistic determinants of remittance include income. Johnson and Whitelaw (1974) posited that there was a negative relationship between income and amount remitted. In his study, Fonchamnyo (2012) posited that remittances to countries in SSA was positively and significantly related to altruism (income differential between host and receiving countries); negatively related to home country per capita income and positively and significantly related to a developed financial sector.

However, Poirine (1997) argued that the implicit loan theory applied more to real life events – supplementing the consumption of rural families, while altruistic reasons for remittances worked well when remittances are invested in capital projects. The study argued that altruism, as a reason for remitting, occurs better when migration is internal within a poor country because the return to emigration remittance is less than the return to internal immigration remittance.

3.2 The Self-interest theory

The self-interest theory of remittances posits that migrants remit when they do not find investment opportunities in their host country or are unwilling to invest. Thus, “an obvious place to invest, at least part of his assets, is in the home country by buying property, land, financial assets, and so on. These assets may earn a higher rate of return than assets in the host country although their risk profile can also be greater. In turn, the family can administer, during the emigration period, those assets for the migrant, thus acting as a trusted agent.” (Addison, 2004, pp. 7).

3.3 Inter-temporal Contractual Agreement

This theory of remittances states that households in origin countries send one or more family member abroad so that they may be able to hedge against adverse economic situations. However, under this arrangement, migrants are able to remit to the country of origin if the macroeconomic volatilities of the host country are not correlated with those of the home country, in which case the migrant will remit to allow smooth consumption and investment for the household in the home country (Rehm, 2012).

Other theories of remittances include the motive to bequest, where remittances occur when the migrant remits to increase the family wealth, making the family increase their capacity to inherit wealth. Finally, the target earning theory posits that migrants move to a new country for a limited number of years, within which they earn income that is channelled to specific objectives, such as buying consumer durables, building houses or starting a business (Rehm, 2012).

4. Data and Methodology

This study will be framed around the inter-temporal contractual agreement theory of Lucas and Stark (1985), in which remittances are placed within the context of adverse economic conditions, despite uncorrelated macroeconomic volatility of home and host countries. It is to hedge against these adverse economic conditions that family members pool resources to send one of them abroad. The GFC falls within such adverse economic conditions that may potentially affect the ability of migrants to remit. According to Cali and Dell'Erba (2009), it is important to account for the role of the GFC as a determinant of remittances in the selected countries because of the possible effect of a crisis to the wage-earning potential of migrants and their ability to keep their jobs. It is equally important to capture the effect of the GFC, as it mirrors (albeit not completely) the economic fallout of the current COVID-19 pandemic. While the economic consequences of the GFC were more severe in developed economies, those of the COVID-19 pandemic were global and their effects potentially more severe than those of the GFC due to a simultaneous negative impact on consumers' demand and producers' supply. It is important to note that this study is not attempting to equate the economic effect of COVID-19 to that of the GFC; however, both events have affected the ability of people to keep their jobs and earn income, thus potentially affecting the ability of migrant workers to send remittances.

4.1 Characteristics of data

For the study, secondary data on remittances, per capita income of migrant home country, exchange rate, inflation and per capita income of remittance source countries were drawn from the World Development Indicator (WDI), while the global financial crisis was proxied with a dummy variable – 0 before the GFC (1999 to 2008) and 1 thereafter (from 2009 to 2019); this is similar to the approach by Girgin *et al.* (2017). The data scope was from 1999 to 2019. This corresponds to a period when remittances to SSA grew very rapidly, and for which data can be found for all countries sampled. Data was originally sought for the 10 largest remittance-to-GDP countries in SSA, according to the World Bank (2016). These countries are also described by Massa and te Velde (2008) as highly-remittance-dependent. They are Liberia (24.6 percent), Comoros (20.2 percent), The Gambia (20.0 percent), Leso-

tho (17.4 percent), Senegal (10.3 percent), Cabo Verde (10.2 percent), Togo (8.8 percent), São Tomé and Príncipe (8.0 percent), Mali (7.4 percent), Guinea-Bissau (6.2 percent). Two outliers (Mali and Senegal), however, were dropped (see section 4.3 for a discussion on this).

The panel data for this study is unbalanced. Data on remittances at level and its share of GDP was not available for Liberia from 1999 to 2003, Comoros and for The Gambia from 1999 to 2002. Data on remittance share of GDP for Sao Tome and Principe was not available for 1999 and 2000. There were missing data points in per capita income, exchange rate and inflation for several countries and several years. Only data on per capita income of remittance source countries is balanced. Table 1 summarizes the characteristics of the variables adopted for this study.

Table 1. Characteristics of data

Variable	Definition	Measurement	Source	Mean	S.D
Remittances (REM)	“Personal transfers and compensation of employees. Personal transfers include all current transfers in cash or in kind between resident and non-resident individuals, independent of the source of income of the sender. Compensation of employees refers to the income of border, seasonal, and other short-term workers who are employed in an economy where they are not residents and of residents employed by non-resident entities.” WDI (2019)	At level (for main analysis) in line with Naudé and Bezuidenhout (2012) and Remittances-to-GDP ratio (for robustness) in line with Fonchamnyo, (2012)	WDI (2019)	2.13e+08	2.13e+08
Global financial crisis (GFC)	The global financial crisis occurred in 2008/2009.	Dummy binary variable that takes on 0 for periods before the GFC (1999 to 2008) and 1 thereafter (2009 to 2019)	Authors	.5714286	.4978439
Per capita income	Per capita income is the gross domestic product (GDP) per person in the remittance	Constant 2010 US Dollars	WDI (2020)	950.1743	318.5861

(PCI)	receiving country				
Exchange rate (EXR)	The annual average (of monthly averages) of local currency to the US dollar	Rate	WDI (2020)	255.6776	245.4619
Inflation (INF)	Persistent rise in general prices of goods and services.	Annual percentage change in consumer Price Index (CPI)	WDI (2020)	96.54315	29.07488
Per capita income of remittance source country (PCIX)	Per capita income is the gross domestic product (GDP) per person in the remittance source country	Constant 2010 US Dollars	WDI (2020)	16716.97	17321.42

Source: Compiled by Authors 2020

4.2 Econometric Methodology

Panel data analysis will be used in this study. Time series observations will be sourced across the 8 cross-sections.

The model to be estimated is given as:

$$\ln REM_{it} = \beta_0 + \alpha_0 GFC_{it} + \alpha_1 \ln PCI_{it} + \alpha_2 \ln EXR_{it} + \alpha_3 \ln INF_{it} + \alpha_4 \ln PCIX_{it} + \varepsilon_{it} \quad (1)$$

Where $\ln REM_{it}$ is the dependent variable, while, GFC_{it} , $\ln PCI_{it}$, $\ln EXR_{it}$, $\ln INF_{it}$ and $\ln PCIX_{it}$ are independent/exogenous variables. The main independent variable, GFC , is expected to negatively or positively influence remittances received. Its influence will be negative if adverse economic conditions in migrant host countries is positively related to those of the migrant home countries, as espoused in the inter-temporal contractual agreement theory reviewed in section 3.3. Its effects are expected to be positive if migrants who have strong ties to their home countries still choose to remit to their families despite positively correlated home and host country harsh economic conditions. Besides, they rely on the social safety net of the host country to smoothen out their consumption. Control variables – PCI , EXR , INF and $PCIX$ were selected based on studies such as those by Olubiyi and Kehinde (2015), Aydas, Metin-Ozcan and Neyapti (2005) and Fonchamnyo (2012). According to Fonchamnyo (2012), the relationship between the per capita income (PCI) of remittance recipient countries and remittances received is expected to be negative; by implication,

the wealthier an economy becomes, the lesser it attracts remittances. According to Olubiyi and Kehinde (2015), a depreciation in domestic exchange rate (EXR) (domestic currency vis-à-vis the US dollar) leads to a fall in remittances received. Yet, a depreciating domestic exchange rate may signal adverse domestic economic conditions, which may raise remittance inflows. Following Aydas, Metin-Ozcan and Neyapti (2005), rising inflation (INF) is evidence of unsound economic policy in the home country, which significantly and negatively affects remittance inflows. In addition, the effect of inflation on remittances could be negative if the motive for remitting is investment but positive if the motive is to meet family needs. Apart from GFC, control variables – exchange rate and inflation, especially – reflect the instability of the home economy about which the inter-temporal contractual agreement theory predicts that it is related to remittances received. PCIX is a variable that represents the per capita income of remittance source countries. The inclusion of the variable PCIX in equation (1) is in accordance with Barajas *et al* (2010) and Schiopu and Siegfried (2006), who identified it as a key determinant of inward remittances. According to these studies, the higher the income of remittance source countries, the higher the remittance received from those countries. In this study, remittance source countries are identified as the top migrant destination countries for migrants from SSA. Table (2) presents the countries selected for the study (including those chosen for robustness checks) and their top migrant destinations.

According to Thorpe (2010), estimating equation (1) by using the pooled OLS is appropriate when there is insignificant country (cross-section) or time effects, thus rendering the slope and intercept constant. Given that there are likely to be considerable country and/or time effects in the model, not accounting for them may render the pooled OLS estimator inconsistent as the error will be correlated with the observation. To fix this problem of heterogeneity, either fixed effects (FE) or random effects (RE) is employed.

To understand the assumptions about the residual term made by the FE and RE estimators, we have to re-write equation (1) by decomposing ε_{it} into $v_i + u_{it}$ so that we have

$$\ln REM_{it} = \beta_0 + \alpha_0 GFC_{it} + \alpha_1 \ln PCI_{it} + \alpha_2 \ln EXR_{it} + \alpha_3 INF_{it} + \alpha_3 \ln PCIX_{it} + v_i + u_{it} \quad (2)$$

In equation (2), v_i represents the country fixed effects and u_{it} a random term. In a random effects model, v_i is not fixed for each cross-section, and it is not the same across time: it is a random variable. According to Allen and Giovannetti (2010), the RE model is more efficient than FE, but less consistent than FE. Yet, to settle on the choice between RE and FE, we will have to carry out the Hausman test. The hypothesis that is tested in the Hausman test is:

H_0 : Random effects estimator is correct

H_1 : Fixed effects estimator is correct

Table 2. Top Migrant destinations of selected countries (first 8 for main analysis and last 12 added for robustness)

S/N	Country	Top migrant destination country
1	Liberia	Guinea
2	Comoros	France
3	The Gambia	Spain
4	Lesotho	South Africa
5	Cabo Verde	Portugal
6	Togo	Ghana
7	São Tomé and Príncipe	Portugal
8	Guinea-Bissau	Portugal
9	Senegal	France
10	Mali	Cote d'Ivoire
11	Ghana	Nigeria
12	Nigeria	United States
13	Congo, Democratic Republic	The Republic of Congo
14	Uganda	Rwanda
15	Madagascar	France
16	Burkina Faso	Cote d'Ivoire
17	Kenya	United Kingdom
18	Malawi	Zimbabwe
19	Eswatini	South Africa
20	Rwanda	Congo, Democratic Republic

Source: Compiled by authors from World Bank (2016)

Note: The top migrant destination for Uganda is South Sudan. However, due to data paucity for South Sudan, it was dropped from the analysis for the next country - Rwanda.

4.3 Stylized facts

Fig. 1 Personal Remittances Received (REM) in \$'000

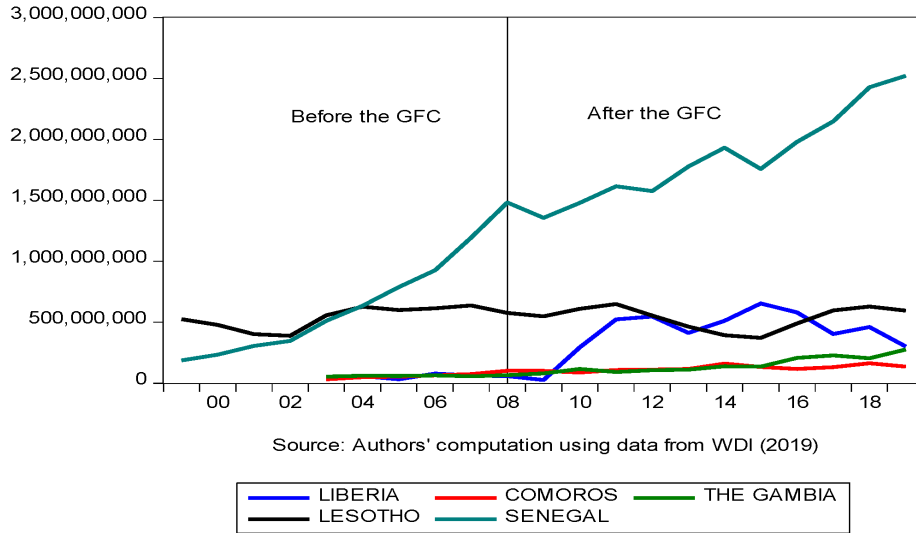


Fig. 2 Personal Remittances Received (REM) in \$'000

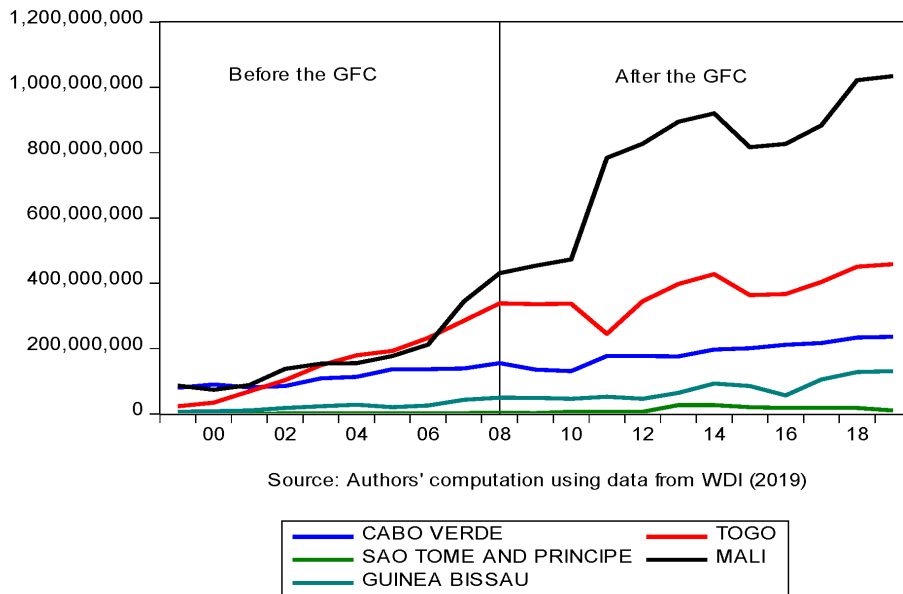


Fig.1 and 2 show the trend in remittances for the 10 (initially selected) countries for the period under review. Apart from Cabo Verde and Lesotho, the other countries sampled witnessed an upward trend in personal remittances received before the Global Financial Crisis (GFC) (1999 to 2008). For Cabo Verde and Lesotho, there was an initial rise, followed by a flattening out period.

Surprisingly, it will be noticed that Senegal's personal remittances fell in 2008, but picked up again in 2009, and remained upwardly trending throughout the period under review. The same can be said of Mali, Cabo Verde, Togo (after plateauing between 2008 and 2010 and significantly declining in 2011) and Sao Tome and Principe. After an initial fall in 2009, Liberia's personal remittances received recovered quite significantly, but suffered from episodes of declines and upswings.

Generally, the trend analysis does not indicate that the economic shock due to the GFC had a significant negative effect on the flow of personal remittances into the mostly-remittance-dependent African countries. In fact, to further drive the point home, the lowest personal remittance received of all the countries sampled, within the period under review, was recorded for Sao Tome and Principe in 2000 and not around the GFC period.

The trend analysis seems to support a positive relationship between the GFC and remittances. It remains to be seen if this relationship holds after removing the outliers - Senegal and Mali - in an econometric estimation, and how significant the relationship is.

5. Empirical results

5.1 Correlation matrix of dependent and independent variables

Table 3 presents the pattern of relationships between the independent variables in the model. Following Dormann *et al.* (2012), who placed $|r|$ at ≤ 0.7 , or collinearity becomes a problem among independent variables, we find that the independent variables do not suffer from the problem of multicollinearity.

Table 3. Correlation matrix

	GFC	lnPCI	lnEXR	INF	lnPCIX
GFC	1				
lnPCI	0.184	1			
lnEXR	0.067	-0.460	1		
INF	-0.111	-0.164	-0.123	1	
lnPCIX	0.022	0.433	-0.128	-0.053	1

Source: Authors' computation 2020

5.2 Findings

Table 4 presents the estimated effects of the global financial crisis on inward remittances to SSA, using the fixed effects estimation procedure. We made the choice for the fixed effects model based on the result of the Hausman test between this and the random effects model. In the table, we also present the result for the ordinary least squares (OLS) and random effects (RE) techniques, which are not of interest to us.

Based on visual inspection of the trend analysis, Mali and Senegal were dropped from the estimation since their remittances received within the period under review showed more significant growth trends than the rest of SSA countries. Thus, we ended up estimating the fixed effects model with 8 of the 10 countries selected.

Fixed effects (FE) results show that the global financial crisis exerted positive and significant effect on remittances received. This result is in consonance with the trend analysis carried out in section 4.3. The estimated result is in opposition to that of Naudé and Bezuidenhout (2012) who found a negative and significant effect (in a dynamic model) of global financial crisis on remittances received in 23 Sub-Saharan African countries. Their findings may have been a result of pooling countries to which remittances may be large, like Nigeria, but insignificant as a share of national output, as compared to others. Furthermore, in our study which sampled 8 selected SSA countries, only 3 had African countries as top migrant destinations, namely through the Liberia to Guinea, Lesotho to South Africa and Togo to Ghana migration corridors; migrants from the other 5 countries preferred European countries as a top destination, which necessitated the measure used in this study for income in remittance source country to be per capita values from those countries, unlike the study by Naudé and Bezuidenhout (2012), which considered the average SSA per capita as a proxy for host country economic strength. Given that the migration pattern of most of the countries selected is to advanced economies of Europe, where social safety nets in the face of adverse economic conditions are available, migrants could still remit to their home countries despite those economic conditions, contrary to the conclusion by Barajas *et al.* (2010). Our results are also different from those of Naudé and Bezuidenhout concerning the number of years employed in the analysis. The empirical findings of our study are close to those of Rajan and Narayana (2012). Although more focused on the effect of the GFC on migrants from South Asia, and remittances into South Asia from the Gulf Cooperation Council (GCC) countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, Rajan and Narayana (2012) agreed that the effect of GFC on remittances was low and easily recovered. While the findings of Rajan and Narayana (2012) were an assessment (and not an econometric analysis) of labour into and migrants' remittances from the GCC, it found that the crisis did not adversely affect labour migration to the GCC and remittances from there. While this phenomenon has been attributed to the

resilience of the economies in the GCC, especially as the price of oil recovered very quickly following the crisis, the resilience of remittances in the face of an economic crisis induced by the COVID-19 pandemic may be a combination of the resilience of the sectors into which migrants are employed and the social safety nets that may serve as a cushion to loss of income due to lockdown measures taken to contain the spread of the virus.

On the control variables, the FE model shows, as expected, that the coefficient of per capita income in the migrant home country exerts a negative effect on remittances received, which means that the higher the per capita income in the remittance recipient country, the lower the remittances received. This result agrees with that of Fonchamnyo (2012), whose static analysis found that the remittance-home per capita income relationship was negative, thus supporting the altruistic motive for remitting by migrants and implying that improving economic conditions in the home country leads to fewer remittances received, while falling income at home raises remittances received.

Exchange rate is shown to have a positive but not significant effect on remittances received, because as nominal currency adjusts and causes devaluation/depreciation, inward remittances will increase. Falling domestic exchange rate will induce more remittances as migrants will want to take advantage of the larger domestic currency amount to be exchanged for a dollar. Besides, a weaker domestic currency vis-à-vis the dollar is a signal of adverse domestic economic conditions at home, which migrants will respond to by sending more money home. This finding is unlike that by Olubiyi and Kehinde (2015), who found that depreciating home currency led to reductions in remittances.

The coefficient of inflation is seen as exerting a negative and statistically not significant effect on remittances. By implication, rising domestic prices lead to a fall in inward personal remittances. Inflation in the home country may lead migrants to send lower remittances home for consumption, but investment, which will ultimately result in better economic outcome for the households, as lower inflation increases remittance inflows. This finding agrees with that by Aydas, Metin-Ozcan and Neyapti (2005), whose single country analysis for Turkey found a similar result. Results indicate that the coefficient of per capita income for the remittance source country is positively and significantly related to remittance inflows. This result meets our expectation of remittances rising, the richer the source country is. When compared to the findings of Schiopu and Siegfried (2006), our results are shown to be robust to the time-period and remittance receiving regions considered.

Table 4. Estimation result on the effect of the global financial crisis on remittances

Dependent Variable: Remittances	OLS	FE	RE
Global financial crisis	0.722*** (0.228)	0.721*** (0.160)	0.870*** (0.142)
Per capita income	0.756*** (0.236)	-0.126 (1.220)	0.516 (0.443)
Exchange rate	-0.118 (0.087)	0.488 (0.689)	0.165 (0.166)
Inflation	-0.087*** (0.021)	-0.014 (0.014)	-0.006 (0.013)
Per capita income in remittance source country	-0.661*** (0.094)	2.389** (0.801)	-0.342 (0.227)
Constant	19.776*** (1.650)	-5.243 (13.777)	16.709*** (3.020)
Number of countries	8	8	8
Observations	130	130	130
F-statistics	17.01***	14.64***	70.82***
R-square	0.383	0.440	0.376
Hausman Test (Chi ²)		15.43***	

Source: Authors' computation 2020

Note: Values in parenthesis are standard errors which are heteroscedasticity consistent. All variables (except Global Financial Crisis and Inflation) are in logarithmic form; ***p<0.01, **p<0.05, *p<0.1.

5.3 Robustness Check

Table 5. Robustness test on the effect of the global financial crisis on remittances

Dependent Variable: Remittances as a percentage of GDP	OLS	FE	RE		OLS	FE	RE
Global financial crisis	-2.046 (1.569)	3.743** (1.213)	2.056* (1.179)		0.535 (0.776)	1.621** (0.617)	1.234** (0.525)
Per capita income	1.970 (1.630)	-28.825 (16.551)	-16.579*** (3.911)		-1.063 (0.772)	-8.717 (6.867)	- 4.146*** (1.534)
Exchange rate	-3.917*** (0.600)	2.918 (4.145)	-1.388 (1.547)		-1.413*** (0.238)	1.853* (1.087)	0.308 (0.480)
Inflation	-0.465*** (0.148)	0.042 (0.109)	0.023 (0.102)		-0.307*** (0.062)	0.003 (0.032)	-0.007 (0.040)
Per capita income in remittance source country	-2.422*** (0.646)	-2.466 (11.439)	1.519 (2.250)		0.457* (0.249)	2.334 (1.795)	1.305 (0.881)
Constant	40.909*** (11.371)	217.608 (199.055)	115.527*** (28.038)		18.269*** (5.623)	35.222 (36.273)	20.882 (10.315)
Number of countries	8	8	8		20	20	20
Observations	130	130	130		365	365	365
F-statistics	11.88***	2.91*	20.51***		10.92***	3.03**	10.21*
R-square	0.297	0.280	0.238		0.120	0.071	0.055
Hausman Test (Chi ²)		35.38***				17.45***	

Source: Authors' computation 2020

Note: Values in parenthesis are standard errors which are heteroscedasticity consistent. All variables (except Global Financial Crisis and Inflation) are in logarithmic form; ***p<0.01, **p<0.05, *p<0.1.

We subjected the findings of this study to a robustness check by using remittances-to-GDP as a measure of remittances received for the 8 countries in the main analysis. Subsequently, we increased the number of countries selected to 20 (12 more countries were added to make the number up to 20 following Olusuyi *et al.* (2016); these countries are all in SSA) to find out if the effect of the GFC on remittances is robust to sample size and remittance measure. The 12 additional countries were selected based on the large size of their remittances-to-GDP ratios as presented in WDI (2020).

As reported in Table 5, estimating equation (1) with remittances-to-GDP as a measure of remittances with the initial sample of 8 countries produced a similar result in terms of coefficient sign and significance of the GFC dummy, to the main estimate. From the estimated model, the GFC is observed to be positively and significantly related to remittances received. Similarly, it can be observed that increasing the sample size of countries to 20 with remittances-to-GDP as a measure of remittances produced a similar outcome to that of the main analysis, in terms of coefficient sign and significance of the GFC dummy. In the estimates for the robustness test for the 8 and 20 countries, apart from the significance of the coefficient of the GFC dummy, exchange rate was the only other variable whose coefficient was reported to be statistically significant at the 10% level. Based on this sensitivity check, we can conclude that our findings are robust to remittance measures and large country sample size.

6. Concluding Remarks and Lessons for COVID-19

This study investigated the effect of the global financial crisis on remittances received in Sub-Saharan Africa, using an unbalanced panel data for 8 African countries for the period from 1999 to 2019. We employed the fixed effects model for our empirical analysis to remove the time invariant characteristics of individual countries that may bias the dependent variable. This choice was made after conducting a Hausman test between the fixed effects and random effects models. The result of the empirical analysis showed that the global financial crisis exerted a positive, and statistically significant effect on remittances. Per capita income of the migrants' home country exerted a negative but statistically insignificant effect on remittances. The effect of exchange rate on remittances was positive but not significant, inflation had a negative and insignificant effect, while the per capita income of the remittance source country was shown to be positively and significantly related to remittances received.

The study has shown that remittances flow is resilient to adverse economic conditions in both the migrant home countries and remittance source countries. The ability of the GFC to negatively affect migrants' remittances may have been diminished by the policy responses of the advanced economies of Europe, in particular, and North America, where these migrants move to, to save employment. For example, the German government, in the wake of the financial crisis, introduced the 'Kurzarbeit' to protect employment (di Mauro, 2020).

In summary, while strong home connection and policy response to the GFC in the more advanced countries may have contributed to the positive effect of the global financial crisis on remittances in the SSA countries studied, further studies may be needed to unravel if accumulated wealth and savings of migrant workers from the countries sampled played any role in their sustained remittances to families in the home countries in the face of adverse economic conditions.

The economic disruption caused by the COVID-19 pandemic may be more severe than the one caused by the GFC. This is because, besides supply disruptions, demand is also affected due to lockdown measures introduced by various governments to contain the spread of the virus. According to Lustig and Mariscal (2020, p. 186), “the efforts to contain COVID-19 have frozen many global supply channels; while the fear of contagion is causing an unprecedented retrenchment in consumer demand.” A combination of falling consumer demand and low supply will most likely lead to a fall in employment. A return to a pre-COVID-19 economic state would mean that the virus has been eliminated and the threat of lockdowns has disappeared. This hope is not misplaced because, despite the threats of new surge in cases across much of the world (especially in Europe and America), the discovery of several vaccines against the virus has rekindled hope of a return to some form of pre-COVID-19 conditions, which guarantees employment and consumption. Although the study has shown how resilient remittances can be in the face of harsh economic conditions, judging by the peculiar nature of the COVID-19 pandemic, this optimism has to be tapered as a lot depends on the public health response to the different waves of the virus and on how far-reaching the vaccines can be in migrant host countries to contain the spread of the virus. Migrants in host countries, who may have held jobs in sectors not hit by the GFC, may lose them under the COVID-19 pandemic, and in places where they do not qualify for state welfare interventions, they may rely on their savings to survive the economic effects of the pandemic. This may likely impact how much they remit.

References

- Acosta, P.A., Baez, J., Beazley, R and Murruga, E., 2012, “The Impact of the Financial Crisis on Remittance Flows: The Case of El Salvador”, *Migration and Remittances during the Global Financial Crisis and Beyond*, 183-191.
- Adams, R.H and Cuecuecha, A., 2013, “The Impact of Remittances on Investment and Poverty in Ghana”, *World Development*, 50, 24–40.
- Adams, S and Klobodu, E.K.M., 2016, “Remittances, Regime Durability and Economic Growth in Sub-Saharan Africa (SSA)”, *Economic Analysis and Policy*, DOI: <http://dx.doi.org/10.1016/j.eap.2016.01.002>
- Addison, E.K.Y., 2004, *The Impact of Macroeconomic Remittances in Ghana*, Bank of Ghana.
- Akobeng, E., 2015, “Title: Out of Inequality and Poverty: Evidence for the Effectiveness of Remittances in Sub-Saharan Africa”, *Quarterly Review of Economics and Finance*, DOI: <http://dx.doi.org/10.1016/j.qref.2015.10.008>
- Allen, F and Giovannetti, G., 2010, “The effects of the Financial Crisis on Sub-Saharan Africa”, *Review of Development Finance*, 1, 1–27.

- Arun, T and Ulku, H., 2011, "Determinants of Remittances: The Case of the South Asian Community in Manchester", *Journal of Development Studies*, 47(6), 894-912.
- Aydas, O.T., Metin-Ozcan, K and Neyapti, B., 2005, "Determinants of Workers' Remittances", *Emerging Markets Finance and Trade*, 41(3), 53-69.
- Bakrania, S and Lucas, B., 2009, The Impact of the Financial Crisis on Conflict and State Fragility in Sub-Saharan Africa, Retrieved from <https://gsdrc.org/publications/the-impact-of-the-financial-crisis-on-conflict-and-state-fragility-in-sub-saharan-africa-2/>
- Barajas, A., Chami, R., Fullenkamp, C., and Garg, A., 2010, "The Global Financial Crisis and Workers' Remittances to Africa: What's the Damage?," In *IMF Working Papers* (WP/10/24; IMF Working Papers, Issue WP/10/24), DOI: <https://doi.org/10.5089/9781451962413.001>
- Bisong, A., Ahairwe, P. E., and Njoroge, E., 2020, "The impact of COVID-19 on remittances for development in Africa", *ECDPM Discussion Paper*, 269, 1-21, Retrieved from www.ecdpm.org/dp269
- Bonjuka, K., Xhema, J., Dervishi, T and Limani, M., 2017, "The effects of the Global Financial Crisis on Kosovo's Remittances", UBT International Conference, 247
- Cali, M and Dell'Erba, S., 2009, "The Global Financial Crisis and Remittances: What Past Evidence Suggests", ODI Working Paper, 303.
- Diaz, V and Soydemir, G., 2013, "Regional foreclosures and Mexican remittances: Evidence from the housing market crisis", *North American Journal of Economics and Finance*, 24, 74-86.
- di Mauro, B.W., 2020, Macroeconomics of the Flu, in R. Baldwin and B.W. di Mauro (eds.), *Economics in the time of COVID-19*, London: CEPR Press, 31-35
- Dormann, C.F, Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., Marquéz, J.R.C., Gruber, B., Lafourcade, B., Leitão, P.J., Münkemüller, T., McClean, C., Osborne, P.E., Reineking, B., Schröder, B., Skidmore, A.K., Zurell, D and Lautenbach, S., 2012, "Collinearity: A Review of Methods to Deal With it and a Simulation Study Evaluating their Performance", *Ecography*, 35, 001-020
- Edelbloude, J., Sers, C.F and Makhlouf, F., 2017, "Do remittances Respond to Revolutions? The Evidence from Tunisia", *Research in International Business and Finance*, 42, 94-101.
- Fonchamnyo, D.C., 2012, "The Altruistic Motive of Remittances: A Panel Data Analysis of Economies in Sub Saharan Africa", *International Journal of Economics and Finance*, 4 (10).
- Gerdes, F. (2007). Focus Migration: Senegal, Retrieved from http://focus_migration.hwwi.de/Senegal.2636.0.html?&L=1
- Ghorpade, Y., 2017, "Extending a Lifeline or Cutting Losses? The Effects of Conflict on Household Receipts of Remittances in Pakistan", *World Development*, DOI: <http://dx.doi.org/10.1016/j.worlddev.2017.05.024>
- Girgin, S. C., Nguyen, H.-O., and Karlis, T., 2017, "Revisiting the Effect of Financial Development on Economic Growth after the 2008 Global Financial Crisis", *Advances in Economics and Business*, 5(8), 456-465.
- Gupta, P., 2005, "Macroeconomic Determinants of Remittances: Evidence from India", IMF Working Paper WP/05/224
- Gupta, S., Patillo, C.A and Wagh, S., 2009, "Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa", *World Development*, 37 (1), 104-115.
- Inoue, T., 2017, "Financial Development, Remittances, and Poverty Reduction: Empirical Evidence from a Macroeconomic Viewpoint", *Journal of Economics and Business*, DOI: <https://doi.org/10.1016/j.jeconbus.2017.12.001>
- International Monetary Fund (IMF)., 2010, *Coping with the Global Financial Crisis: Challenges Facing Low-Income Countries*, Washington, D.C: IMF Multimedia Services Division.
- Jha, S., Sugiyarto, G and Vargas-Silva, C., 2009, "The Global Crisis and the Impact on Remittances to Developing Asia", ADB Economics Working Paper Series, No. 185.
- Johnson, G.E and Whitelaw, W.E., 1974, "Urban-Rural Income Transfers in Kenya: An Estimated Remittances Function", *Economic Development and Cultural Change*, 22 (3), 473-479.

- Kadozi, E. (2019). Remittance Inflows and Economic Growth in Rwanda, Retrieved from <https://doi.org/10.1016/j.resglo.2019.100005>
- Lucas, R.E.B. and Stark, O., 1985, "Motivations to Remit: Evidence from Botswana", *Journal of Political Economy*, 93, 901-18.
- Lustig, N & Mariscal, J., 2020, How COVID-19 could be like the Global Financial Crisis (or worse), in R. Baldwin and B.W di Mauro (eds.), *Mitigating the COVID Economic Crisis: Act Fast and Do Whatever it Takes*, London: CEPR Press, 185-190.
- Makun, K.K., 2017, "Imports, remittances, direct foreign investment and economic growth in Republic of the Fiji Islands: An empirical analysis using ARDL approach", *Kasetsart Journal of Social Sciences*, DOI: <http://dx.doi.org/10.1016/j.kjss.2017.07.002>
- Massa, I and te Velde, D.W., 2008, *The Global Financial Crisis: Will Successful African Countries be Affected*, Overseas Development Institute (ODI)
- Meyer, D and Shera, A., 2017, "The Impact of Remittances on Economic Growth: An Econometric Model", *Economia*, 18, 147-155.
- Milesi-Ferretti, G & Tille, C., 2011, "The Great Retrenchment: International Capital Flows During the Global Financial Crisis", *Economic Policy*, 26(66), 285-342.
- Mohapatra, S and Ratha, D., 2009, *The Impact of the Global Financial Crisis on Migration and Remittances*, Migration and Development briefs 10 through 12.
- Naudé, W and Bezuidenhout, H., 2012, Remittances to Sub-Saharan Africa in the Wake of a Financial Crisis: Source of Resilience or Vulnerability? in I. Sirkeci, J.H. Cohen, and D. Ratha. (eds.), *Migration and Remittances during the Global Financial Crisis and Beyond*, Washington, DC: The World Bank Group, 337-347.
- Naudé, W.A and Bezuidenhout, H., 2014, "Migrant Remittances Provide Resilience Against Disasters in Africa", *Atlantic Economic Journal*, DOI: 10.1007/s11293-014-9403-9
- Nyamongo, E.M., Misati, R.N and Kipyegon, L., 2012, "Remittances, Financial Development and Economic Growth in Africa", *Journal of Economics and Business*, 64, 240-260.
- Olayungbo, D. O., and Quadri, A., 2019, "Remittances, financial development and economic growth in sub-Saharan African countries: evidence from a PMG-ARDL approach", *Financial Innovation*, 5(1), DOI: <https://doi.org/10.1186/s40854-019-0122-8>
- Olubiyi, E.A and Kehinde, K.O., 2015, "Does Exchange Rate Affect Remittances in Nigeria?" *The Review of Finance and Banking*, 7 (1), 031-045.
- Olusuyi, A. E., Akinbobola, T. O., Okposin, S., and Ola-David, O., 2016, "Interactive Effects of Exchange Rate Volatility and Foreign Capital Inflows on Economic Growth in Nigeria", *Proceedings of the 23rd International Conference on African Development Issues (CU-ICADI 2016)*, 139-145.
- Opperman, P and Adjasi, C.K.D., 2018, "Remittance Volatility and Financial Sector Development in sub-Saharan African", *Journal of Policy Modeling*, DOI <https://doi.org/10.1016/j.jpplm-od.2018.11.001>
- Poirine, B., 1997, "A Theory of Remittances as an Implicit Family Loan Arrangement", *World Development*, 25(4), 583-611.
- Rajan, S.I and Narayana, D., 2012, The Financial Crisis in the Gulf and Its Impact on South Asian Migration and Remittances, in I. Sirkeci, J.H. Cohen, and D. Ratha. (eds.), *Migration and Remittances during the Global Financial Crisis and Beyond*, Washington, DC: The World Bank Group, 67-80.
- Rehm, M., 2012, "Migration and Remittances: An Agent Based Approach", Submitted to the New School for Social Research of the New School in Partial fulfilment of the Requirements for the Degree of Doctor of Philosophy.
- Ruiz, I and Vargas-Silva, C., 2009, "Another Consequence of the Economic Crisis: A Decrease in Migrants' Remittances", SHSU Economics & Intl. Business Working Paper No. 09-07.

- Schiopu, I., & Siegfried, N. (2006). "Determinants of workers' remittances: evidence from the European Neighbouring Region", ECB Working Paper No. 688.
- Selim, R., 2010, "Impact of the Global Financial Crisis on Migration and Remittances in Bangladesh: A Survey Based Analysis", *MPRA Paper No. 37946*, Retrieved from <https://mpra.ub.uni-muenchen.de/37946/>
- Shapiro, A.F and Mandelman, F.S., 2016, "Remittances, Entrepreneurship, and Employment Dynamics over the Business Cycle", *Journal of International Economics*, DOI: 10.1016/j.jinteco.2016.10.001
- Sidaoui, J., Ramos-Francia, M and Cuadra, G., n.d, "The Global Financial Crisis and Policy Response in Mexico", *BIS Papers*, 54, 279-298.
- Sobiech, I., 2019, "Remittances, Finance and Growth: Does Financial Development Foster the Impact of Remittances on Economic Growth?" *World Development*, 113, 44–59.
- Tachibana, T., Goto, R., Sakurai, T., Rayamajhi, S., Adhikari, A. and Dow, W.H., 2019, Do "Remittances Alleviate Negative Impacts of Disaster on Mental Health? A Case of the 2015 Nepal Earthquake", *Social Science & Medicine*, 238, 112460.
- Thorpe, T., 2011, "Is Foreign Aid an Antidote for Human Poverty in Sub-Saharan Africa?" Paper Presented to the Department of Economics of the University of Ottawa as a Final Requirement of the M.A Degree.
- Vacaflares, D.E., 2017, "Are Remittances Helping Lower Poverty and Inequality Levels in Latin America?" *Quarterly Review of Economics and Finance*, DOI: <https://doi.org/10.1016/j.qref.2017.09.001>
- Verick, S., 2011, The Impact of the Global Financial Crisis on Labour Markets in OECD Countries: Why Youths and other Vulnerable Groups Have been Hit Hard, in I. Islam and S. Verick, (eds.), *From the Great Recession to Labour Market Recovery*, London: Palgrave, Macmillan, 119-145, Retrieved from https://link.springer.com/chapter/10.1057/9780230295186_5
- Wagle, U.R and Devkota, S., 2018, "The Impact of Foreign Remittances on Poverty in Nepal: A Panel Study of Household Survey Data, 1996–2011", *World Development*, 110, 38–50.
- World Bank., 2016, *Migration and Remittances Factbook (3rd Edition)*, Washington, DC: International Bank for Reconstruction and Development / The World Bank
- World Bank., 2019, "Migration and Remittances: Recent Developments and Outlook", *Migration and Policy Brief*, 31
- World Bank., 2019, Oct 16, "Data release: Remittances to Low- and Middle-Income Countries on Track to Reach \$551 Billion in 2019 And \$597 Billion by 2021", *World Bank*, Retrieved from <https://blogs.worldbank.org/peoplemove/data-release-remittances-low-and-middle-income-countries-track-reach-551-billion-2019>
- World Bank., 2020, "COVID-19 Crisis Through a Migration Lens, Migration and Development Brief 32"
- World Bank., 2020, Apr 22, "World Bank Predicts Sharpest Decline of Remittances in Recent History", *World Bank* Press Release, Retrieved from <https://www.worldbank.org/en/news/press-release/2020/04/22/world-bank-predicts-sharpest-decline-of-remittances-in-recent-history>
- World Development Indicators (WDI)., 2020, "GDP Per Capita (Constant 2010 US\$)", Retrieved from <https://data.worldbank.org/indicator/NY.GDP.PCAP.KD>
- World Development Indicators (WDI)., 2019, "Personal Remittances, Received (Current US\$)", Retrieved from <https://data.worldbank.org/indicator/BX.TRE.PWKR.CD.DT>
- World Development Indicators (WDI)., 2020, "Personal Remittances, Received (% of GDP) –Sub-Saharan Africa", Retrieved from <https://data.worldbank.org/indicator/BX.TRE.PWKR.DT.GD.ZS>
- World Development Indicators (WDI)., 2020, Official exchange rate (LCU per US\$, period average), Retrieved from <https://data.worldbank.org/indicator/PA.NUS.FCRF>
- World Development Indicators (WDI)., 2020, [Inflation, Consumer Prices \(Annual %\) https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG](https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG)

guide for authors

The articles should be written as follows:

(1) Papers must be in English.

(2) Papers for publication (two copies) should be sent to:

Mrs. Melina Petromelidou

Editorial Secretary

South-Eastern Europe Journal of Economics

ASECU, University of Macedonia, 156, Egnatia Str., 546 36 Thessaloniki, Greece

The *Journal's* phone number is (+30) 2310891793, fax: (+30) 2310891748

e-mail: asecu@uom.edu.gr

Submission of a paper will be held to imply that it contains original unpublished work and is not being submitted for publication elsewhere. The Editor does not accept responsibility for damage or loss of papers submitted. Upon acceptance of an article, author(s) will be asked to transfer copyright of the article to the publisher. This transfer will ensure the widest possible dissemination of information.

(3) Papers will be considered in any form, but authors of papers accepted for publication will be expected to provide a final copy conforming to the general style of the Journal as outlined in notes 4 through 13 below.

(4) Manuscripts should be 1,5 spaced, with wide margins, and printed on one side of the paper only. All pages should be numbered in sequence. Titles and subtitles should be short. References, tables, and captions for the figures should be printed on separate pages.

(5) The first page of the manuscript should contain the following information: (i) the title; (ii) the name(s) and institutional affiliation(s) of the author(s); (iii) an abstract of not more than 100 words. A footnote on the same sheet should give the name, address, and telephone and fax numbers of the corresponding author [as well as an e-mail address].

(6) The first page of the manuscript should also contain at least one classification code according to the Classification System for Journal Articles as used by the Journal of Economic Literature; in addition, up to five key words should be supplied.

The classification system used in JEL can be found at:

http://www.aeaweb.org/journals/jel_class_system.html.

(7) Acknowledgements and information on grants received can be given in a first footnote, which should not be included in the consecutive numbering of footnotes.

(8) Footnotes should be kept to a minimum and numbered consecutively throughout the text with superscript Arabic numerals.

(9) Displayed formulae should be numbered consecutively throughout the manuscript as (1), (2), etc. against the right-hand margin of the page. In cases where the derivation of formulae has been abbreviated, it is of great help to the referees if the full derivation can be presented on a separate sheet (not to be published).

(10) References to publications should be as follows: ‘Smith (1992) reported that...’ or ‘This problem has been studied previously (e.g., Smith et al., 1969)’. The author should make sure that there is a strict one-to-one correspondence between the names and years in the text and those on the list. The list of references should appear at the end of the main text (after any appendices, but before tables and captions for figures). It should be double spaced and listed in alphabetical order by author’s name. References should appear as follows:

For monographs

Sen, A., 1970, *Collective Choice and Social Welfare*, San Francisco: Holden Day.

For contributions to collective works

Kornai, J., 1991, Stabilization and Economic Transition in Hungary: The Next Two Years, in J. de Melo and A. Sapir (eds.), *Trade Theory and Economic Reform: North, South and East*, Oxford: Basil Blackwell, 307-326.

For periodicals

Magdalinos, M., 1990, “The Classical Principles of Testing Using Instrumental Variables Estimates”, *Journal of Econometrics*, 44, 241-279.

Note that journal titles should not be abbreviated.

(11) Illustrations will be reproduced photographically from originals supplied by the author; they will not be redrawn by the publisher. Please provide all illustrations in quadruplicate (one high-contrast original and three photocopies). Care should be taken that lettering and symbols are of a comparable size. The illustrations should not be inserted in the text, and should be marked on the back with figure number, title of paper, and author’s name. All graphs and diagrams should be referred to as figures, and should be numbered consecutively in the text in Arabic numerals. Illustration for papers submitted as electronic manuscripts should be in traditional form.

(12) Tables should be numbered consecutively in the text in Arabic numerals and printed on separate sheets.

(13) Accepted papers should be submitted in electronic form in a storage media (i.e. CD, DVD, USB, etc.) with accompanying manuscript. Electronic manuscripts have the advantage that there is no need for re-setting of text, thereby avoiding the possibility of introducing errors and resulting in reliable and fast delivery of proofs. The preferred format is either .doc or .docx. Make absolutely sure that the file on the disk and the printout are identical.

(14) Page proofs will be sent to the corresponding author. Proofs should be corrected carefully; the responsibility for detecting errors lies with the author. Corrections should be restricted to instances in which the proof is at variance with the manuscript. There are neither submission fees nor page charges.