Review dari heliyon

I. **MANUSCRIPT TITLE:** The Demographic Change and Economic Features: The Nexus with Internet Use.
II. **MANUSCRIPT NUMBER:** HELIYON-D-21-11053

General Comment	(1) I WASN'T PART OF THE ORIGINAL REVIEWER OF THIS MANUSCRIPT (2) MOST OF THE COMMENTS BY THE ORIGINAL REVIEWERS (ESPECIALLY REVIEWER II) WAS NOT EFFECTED BY THE AUTHOR(S)
Title	
Abstract	
1. Introduction	One of the reviewer comment is: (1) The introductory section is meant to introduce the study, the gap and set pace for the remaining sections. (2) This section has failed to link the three key variables, demographic change, economic features and internet usage. Author(s) did not introduce any gap or set pace for the remaining section, To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … " To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c. Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.
2. Literature Review	

3. Data and Method	Author did not discuss the countries of study and their regions rationale for selecting them need to be explained Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?" Author did not understand this question, therefore did not give appropriate response. The question is, Did you use the original data as it is or you transformed the data using natural log? Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature Author did not understand this question, therefore did not give appropriate response, The question is, why did you decided to use variables like; information technology, typology of pre-, early- (*EarlyDD*), late- (*LateDD*), and postdemographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.
4. Results and Discussion	
6. Conclusion and Recommendation	Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing. (i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation
References	

III. Manuscript. Number.: HELIYON-D-21-11053R1

Title: The Demographic Change and Economic Features: The Nexus with Internet Use

Journal: Heliyon

Dear Wilson,

Thank you for submitting your manuscript to Heliyon. We have completed the review of your manuscript and a summary is appended below. The reviewers recommend major revisions are required before publication can be considered.If you are able to address all reviewer comments in full, I invite you to resubmit your manuscript. We ask that you respond to each reviewer comment by either

outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism.

This should be carried out in a point-by-point fashion as illustrated here: https://www.cell.com/heliyon/guide-for-authors#Revisions.

To allow the editors and reviewers to easily assess your revised manuscript, we also ask that you upload a version of your manuscript highlighting any revisions made. You may wish to use Microsoft Word's Track Changes tool or, for LaTeX files, the latexdiff Perl script (https://ctan.org/pkg/latexdiff).To submit your revised manuscript, please log in as an author at https://www.editorialmanager.com/heliyon/, and navigate to the "Submissions Needing Revision" folder.

Your revision due date is May 24, 2022.We understand that the COVID-19 pandemic may well be causing disruption for you and your colleagues. If that is the case for you and it has an impact on your ability to make revisions to address the concerns that came up in the review process, please reach out to us. I look forward to receiving your revised manuscript.

Kind regards,

Romanus Osabohien

Associate Editor - Business & Economics

Heliyon

Editor and Reviewer comments:

Reviewer 3: Methods:

Author did not discuss the countries of study and their regions

rationale for selecting them need to be explained

Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?"

Author did not understand this question, therefore did not give appropriate response.

The question is, Did you use the original data as it is or you transformed the data using natural log?

Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature

Author did not understand this question, therefore did not give appropriate response,

The question is, why did you decided to use variables like; information technology, typology of pre-, early- (EarlyDD), late- (LateDD), and postdemographic dividend (PostDD) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.

Results:

Interpretation:

Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing.

(i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation

Other comments:

One of the reviewer comment is:

(1) The introductory section is meant to introduce the

study, the gap and set pace for the remaining sections.

(2) This section has failed to link the three key variables,

demographic change, economic features and internet

usage.

Author(s) did not introduce any gap or set pace for the remaining section,

To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … "

To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c.

Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.

Reviewer 4: Methods: The conceptualization and operationalization of this study are problematic. This study has shown a low degree of novelty. No clear problem statement nor research gap is highlighted. No details of data collection.

Results: Therefore, I am not convinced by the findings.

Interpretation: The interpretation of the findings is rather weak and not rigorous.

Other comments: Need to highlight the theoretical and practical of this study

Reviewer 5: Methods: The method used is descriptive method using documentary analysis. However, the documents analyzed did not cover countries included in the sample respondents. The analysis of findings would have been more comprehensive and exciting to readers if name of countries were included in the findings.

Results: The results of the study is comprehensive, however if there is labelling of countries included in the variables it would have more exciting.

Interpretation: The interpretation based from statistical analysis of the document is comprehensive.

Other comments: Labelling countries in the demographic typology is recommended.

Reviewer 6: Methods:

Results:

Interpretation:

Other comments:

Reviewer 8: Methods: The methods employed by the author(s) are suitable. However, there is need to first specify the implicit function of the model before the explicit function. In addition, the specified model is not correctly specified without the subscript 'it'. It looks more like a time series model.

Results: The results are adequately explained. Although there is a need for theoretical framework to link all parts of the study.

Interpretation: The explanation still lacks theoretical basis.

Other comments: The issues raised by the author(s) are important and adequately addressed, but poor grammatical expressions alter the correct discussion of findings in the study. I hereby suggest a thorough editing by an expert in English language writing to edit the manuscript before publication.

Reviewer 9: Methods:

The process of subject selection was clear.

The variables were defined and measured appropriately.

The study methods were valid and reliable.

There is enough detail to replicate the study.

Results:

The text in the results added to the data.

A statistically significant result was clear.

A practically meaningful result was clear.

Interpretation:

was clear

Other comments:

Reviewer 10: Methods: clear enough; it needs more appropriate reasoning in choosing GMM estimator

Results: clear enough

Interpretation: Still using the old references for justifying the findings

Other comments:

*****

Data in Brief (optional):

We invite you to convert your supplementary data (or a part of it) into an additional journal publication in Data in Brief, a multi-disciplinary open access journal. Data in Brief articles are a fantastic way to

describe supplementary data and associated metadata, or full raw datasets deposited in an external repository, which are otherwise unnoticed. A Data in Brief article (which will be reviewed, formatted, indexed, and given a DOI) will make your data easier to find, reproduce, and cite.

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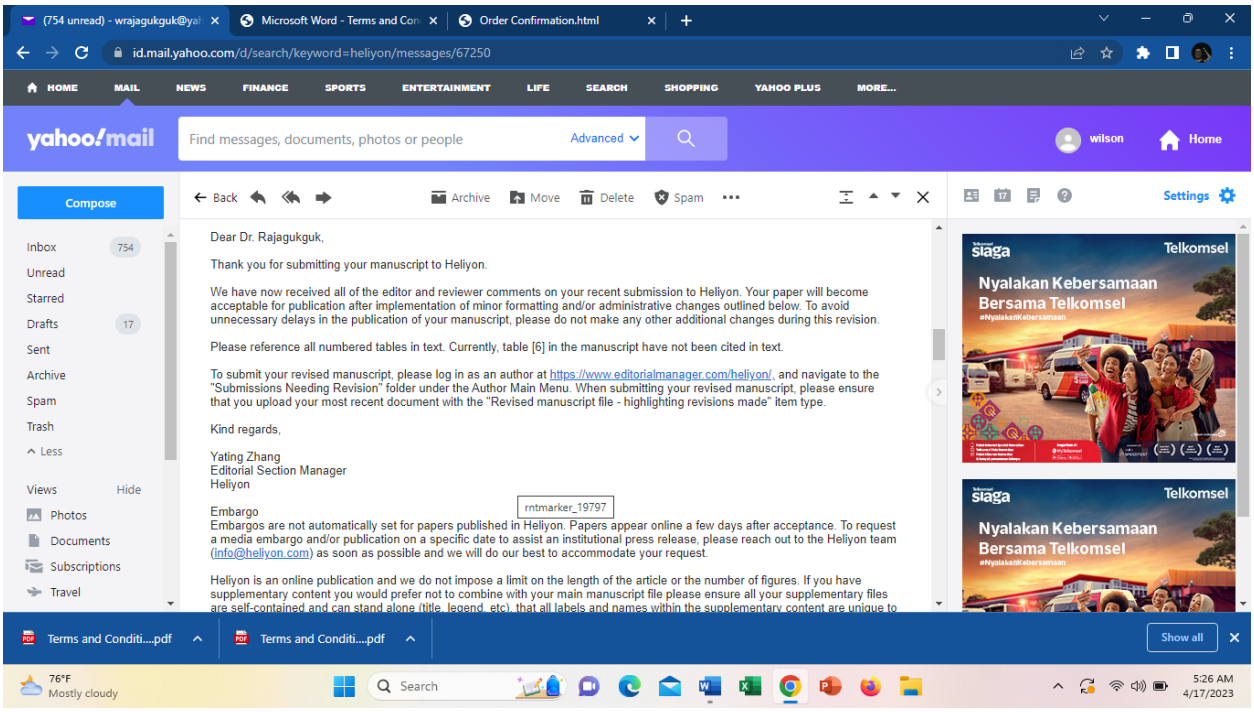
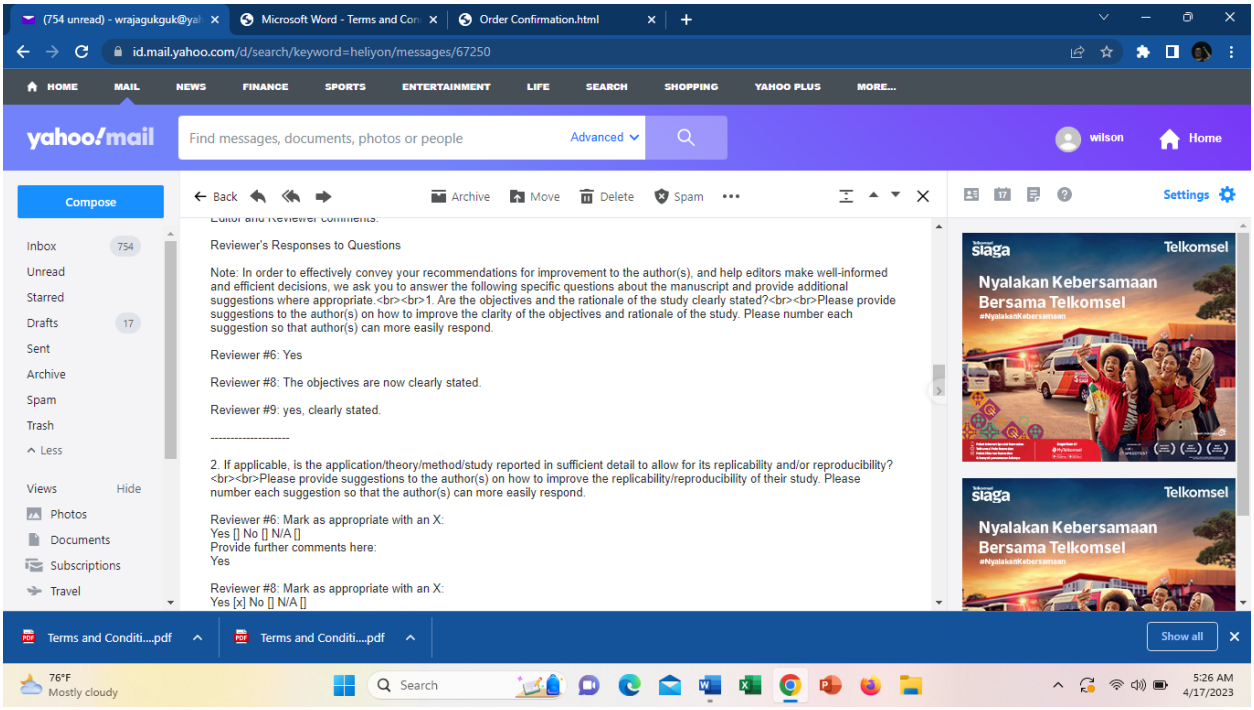
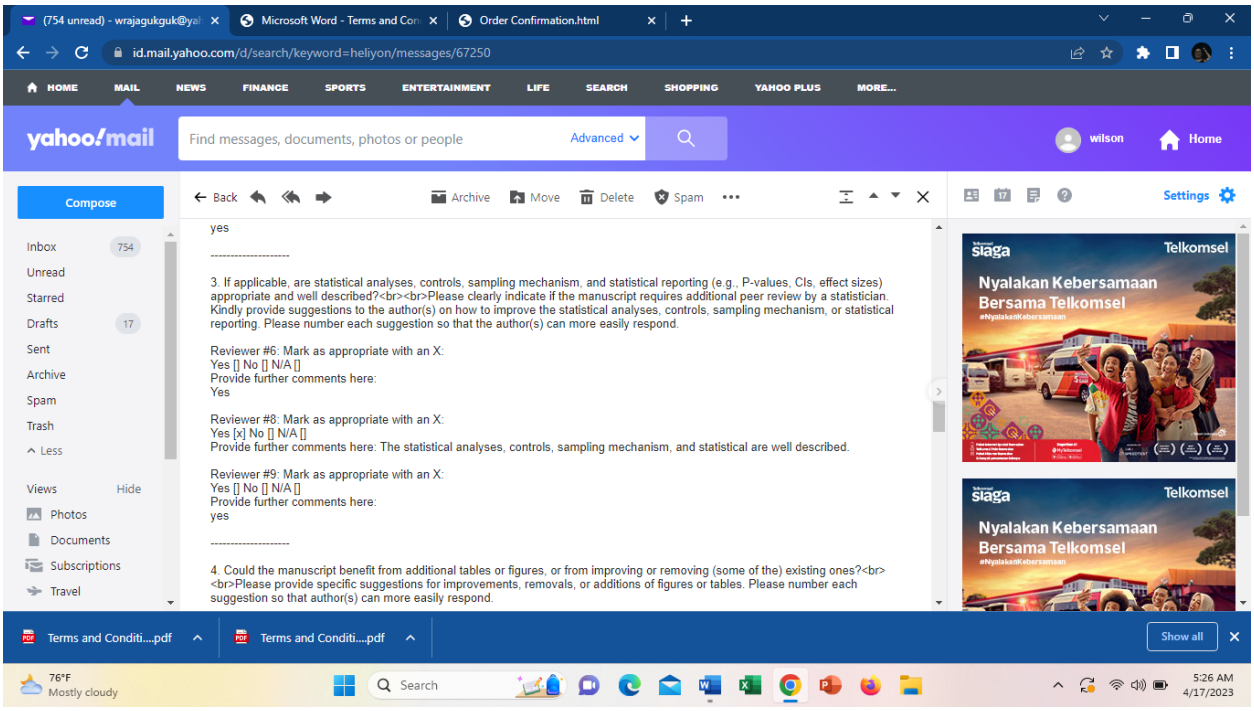
IV. Decision



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3. If applicable, are statistical analyses, controls, sampling mechanism, and statistical reporting (e.g., P-values, CIs, effect sizes) appropriate and well described?

Please clearly indicate if the manuscript requires additional peer review by a statistician. Kindly provide suggestions to the author(s) on how to improve the statistical analyses, controls, sampling mechanism, or statistical reporting. Please number each suggestion so that the author(s) can more easily respond.
Reviewer #6: Mark as appropriate with an X:
Yes [] No [] N/A []
Provide further comments here:
Yes
Reviewer #8: Mark as appropriate with an X:
Yes [x] No [] N/A []
Provide further comments here: The statistical analyses, controls, sampling mechanism, and statistical are well described.
Reviewer #9: Mark as appropriate with an X:
Yes [] No [] N/A []
Provide further comments here:
yes
---
4. Could the manuscript benefit from additional tables or figures, or from improving or removing (some of the) existing ones?

Please provide specific suggestions for improvements, removals, or additions of figures or tables. Please number each suggestion so that author(s) can more easily respond.
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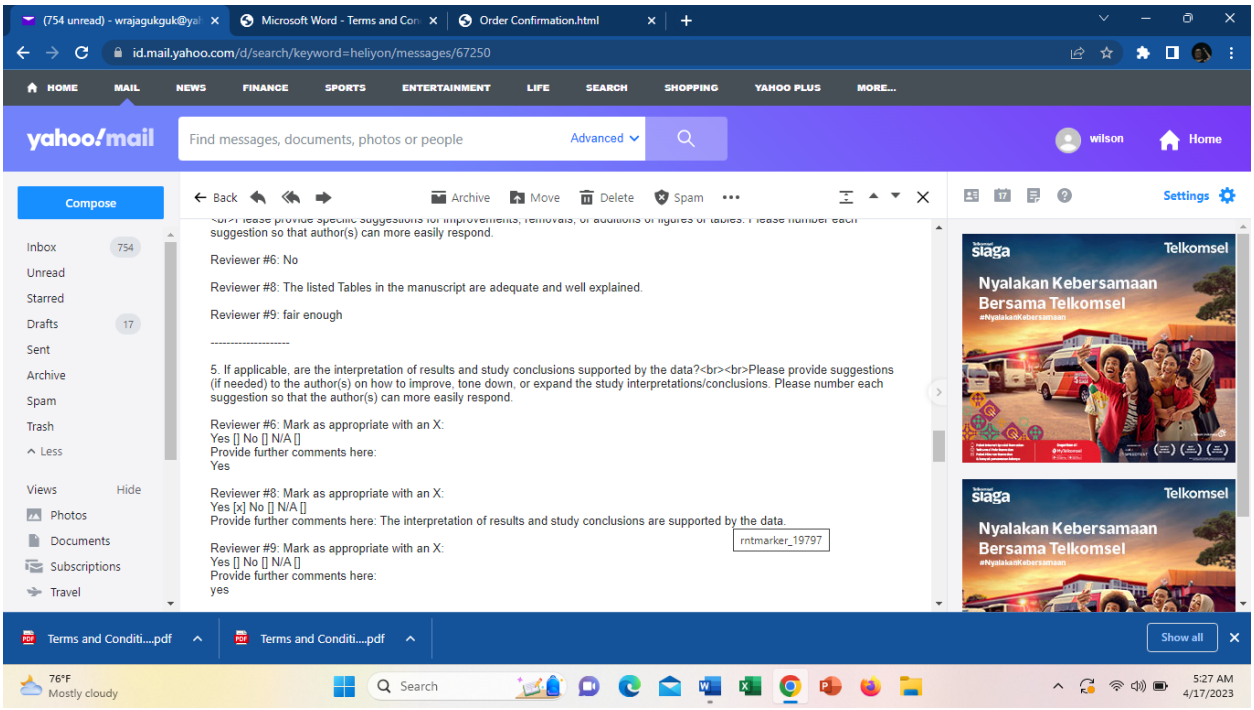
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suggestion so that author(s) can more easily respond.
Reviewer #6: No
Reviewer #8: The listed Tables in the manuscript are adequate and well explained.
Reviewer #9: fair enough
---
5. If applicable, are the interpretation of results and study conclusions supported by the data?

Please provide suggestions (if needed) to the author(s) on how to improve, tone down, or expand the study interpretations/conclusions. Please number each suggestion so that the author(s) can more easily respond.
Reviewer #6: Mark as appropriate with an X:
Yes [] No [] N/A []
Provide further comments here:
Yes
Reviewer #8: Mark as appropriate with an X:
Yes [x] No [] N/A []
Provide further comments here: The interpretation of results and study conclusions are supported by the data.
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Reviewer #9: Mark as appropriate with an X:
Yes [] No [] N/A []
Provide further comments here:
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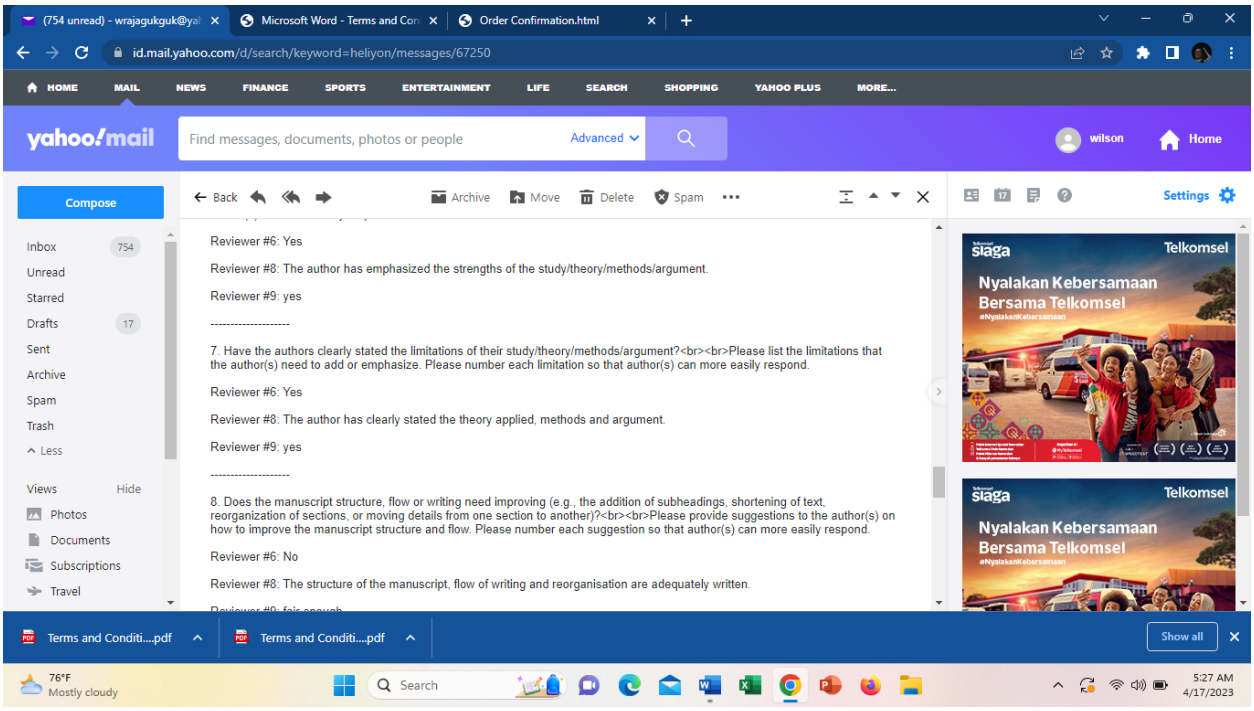
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Reviewer #6: Yes
Reviewer #8: The author has emphasized the strengths of the study/theory/methods/argument.
Reviewer #9: yes
---
7. Have the authors clearly stated the limitations of their study/theory/methods/argument?

Please list the limitations that the author(s) need to add or emphasize. Please number each limitation so that author(s) can more easily respond.
Reviewer #6: Yes
Reviewer #8: The author has clearly stated the theory applied, methods and argument.
Reviewer #9: yes
---
8. Does the manuscript structure, flow or writing need improving (e.g., the addition of subheadings, shortening of text, reorganization of sections, or moving details from one section to another)?

Please provide suggestions to the author(s) on how to improve the manuscript structure and flow. Please number each suggestion so that author(s) can more easily respond.
Reviewer #6: No
Reviewer #8: The structure of the manuscript, flow of writing and reorganisation are adequately written.
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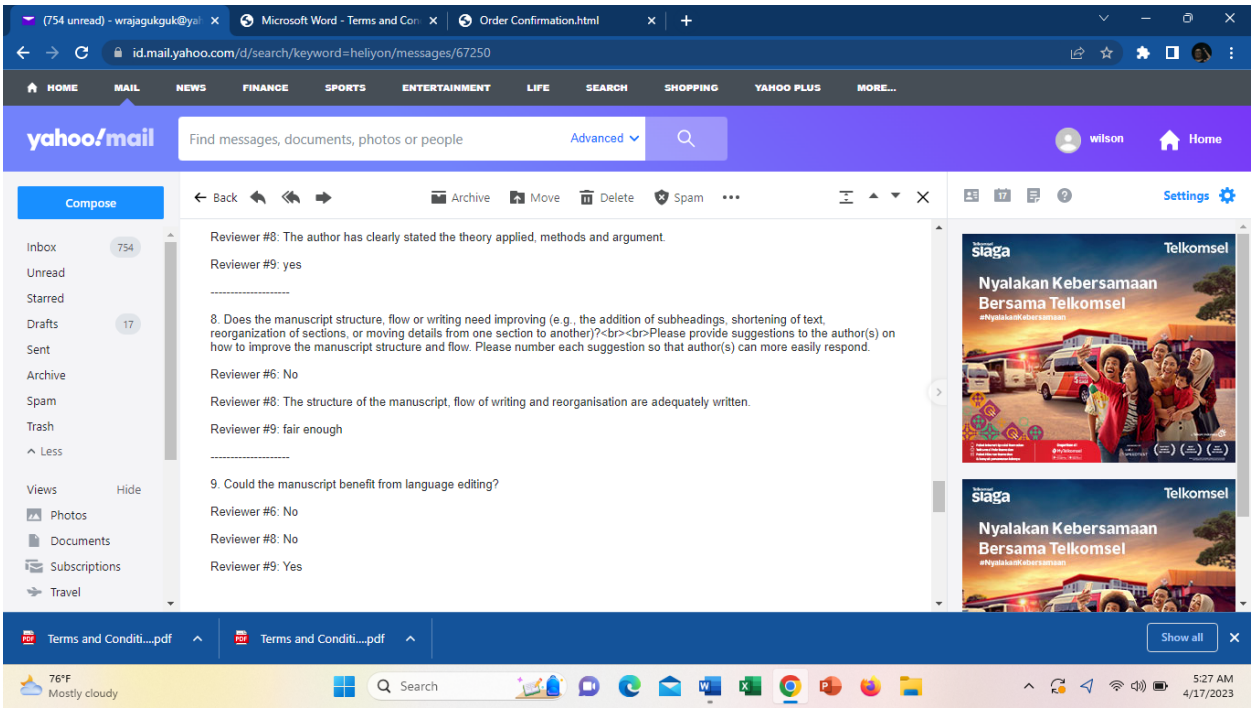
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Reviewer #9: yes
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Please provide suggestions to the author(s) on how to improve the manuscript structure and flow. Please number each suggestion so that author(s) can more easily respond.
Reviewer #6: No
Reviewer #8: The structure of the manuscript, flow of writing and reorganisation are adequately written.
Reviewer #9: fair enough
---
9. Could the manuscript benefit from language editing?
Reviewer #6: No
Reviewer #8: No
Reviewer #9: Yes
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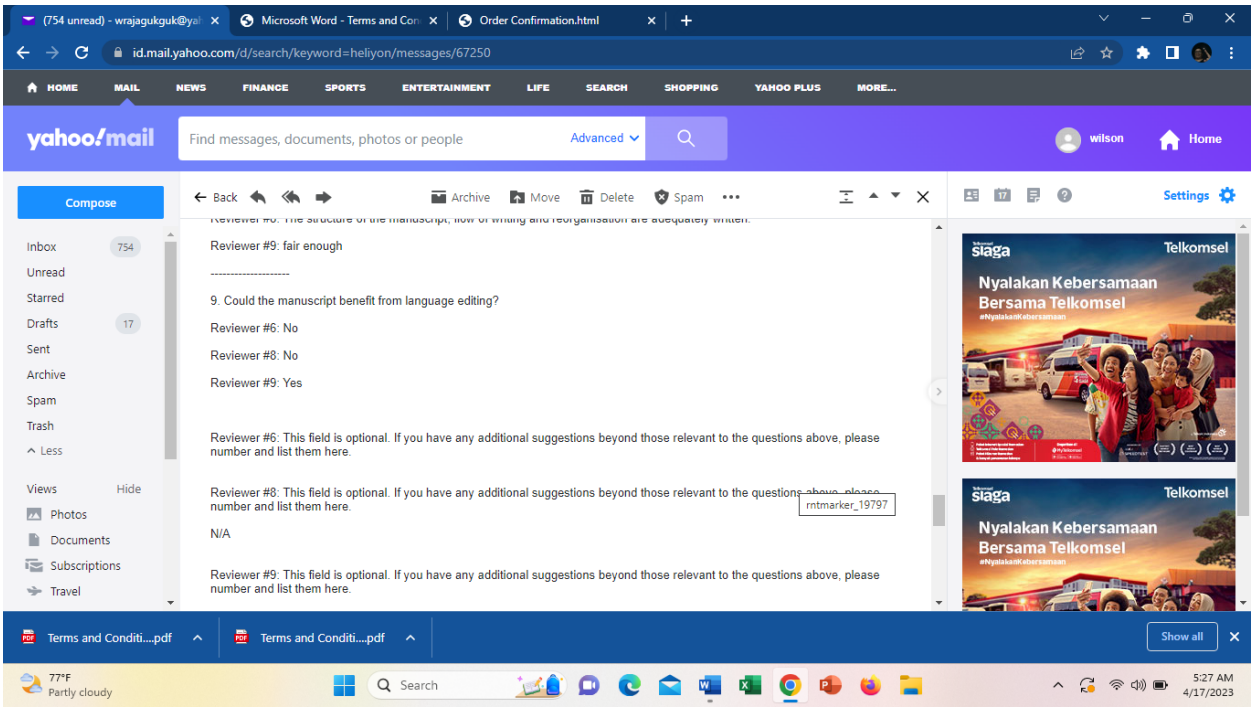

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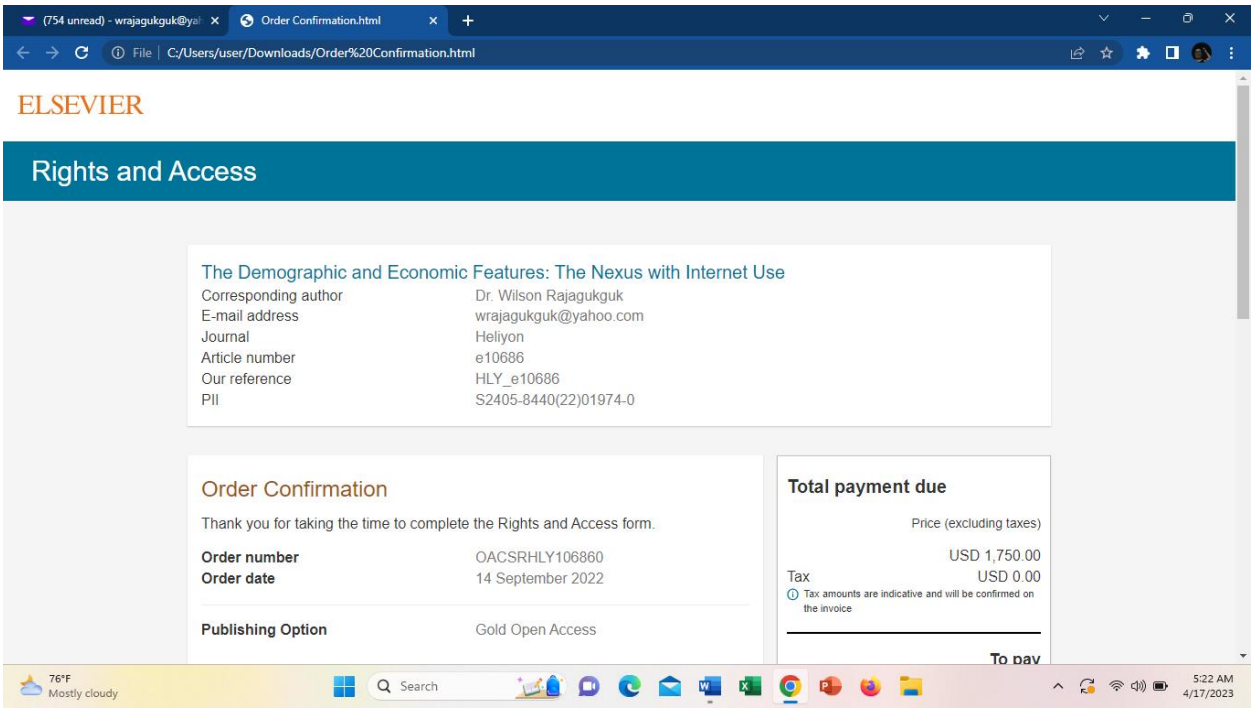

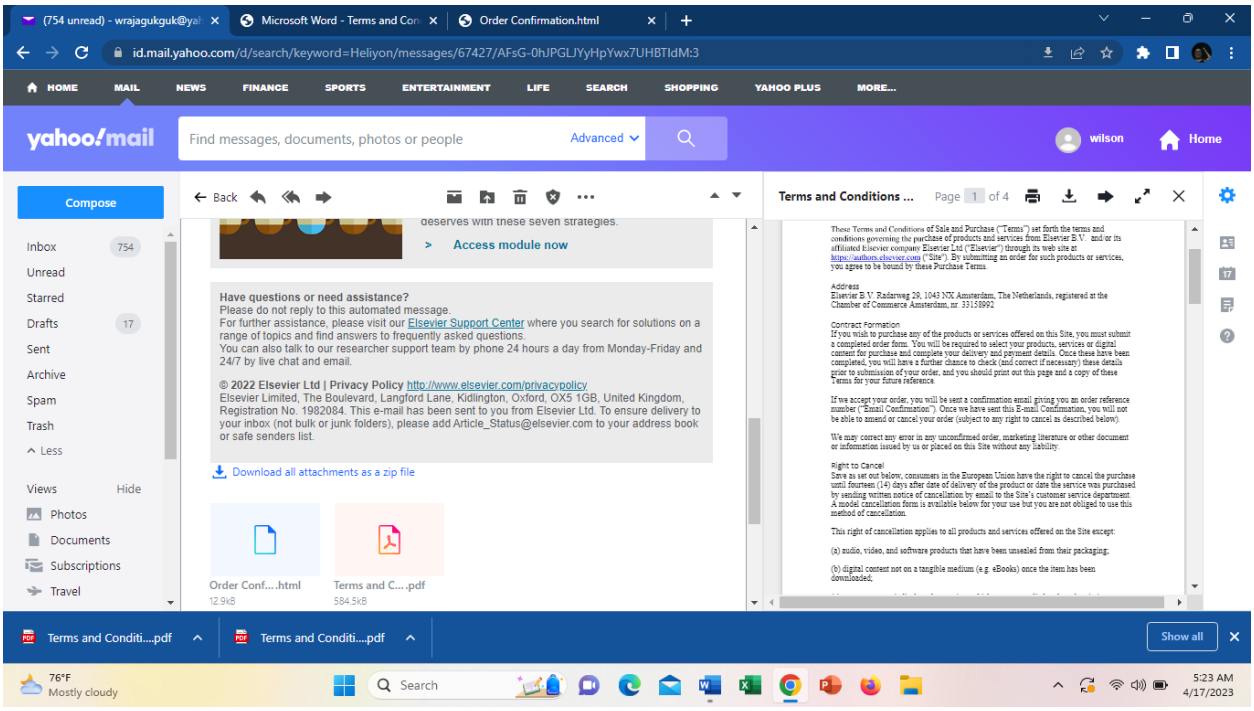
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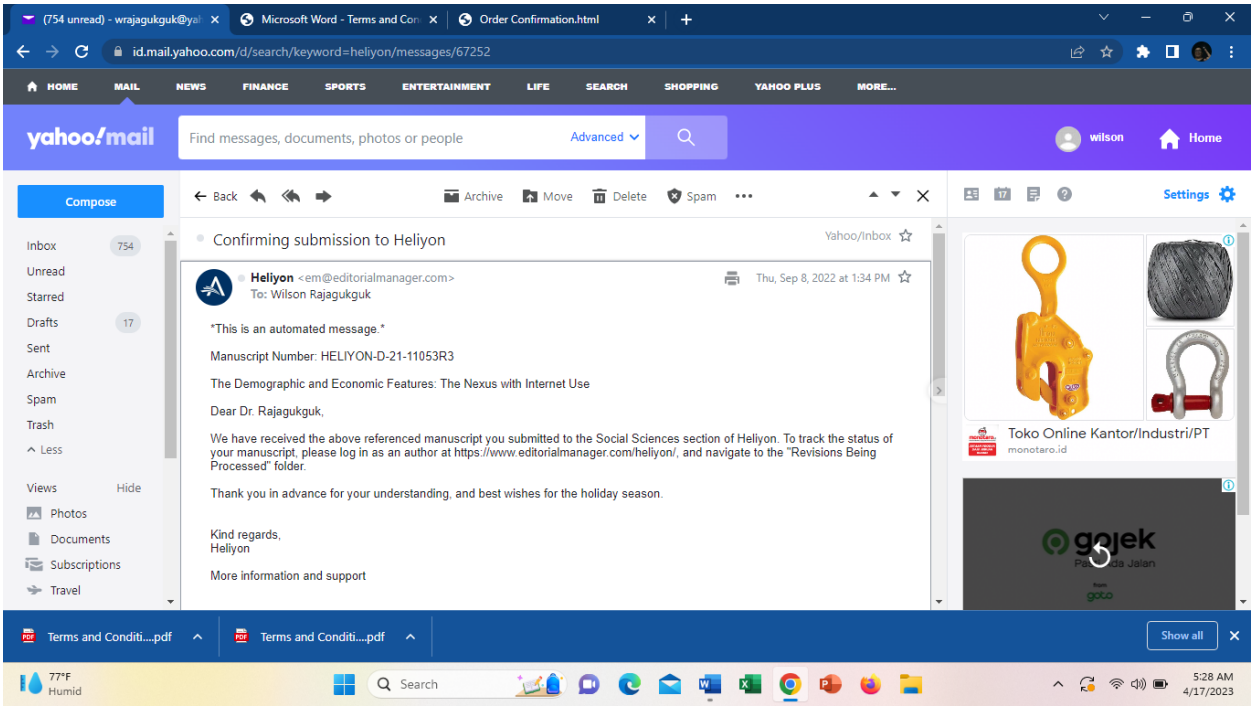
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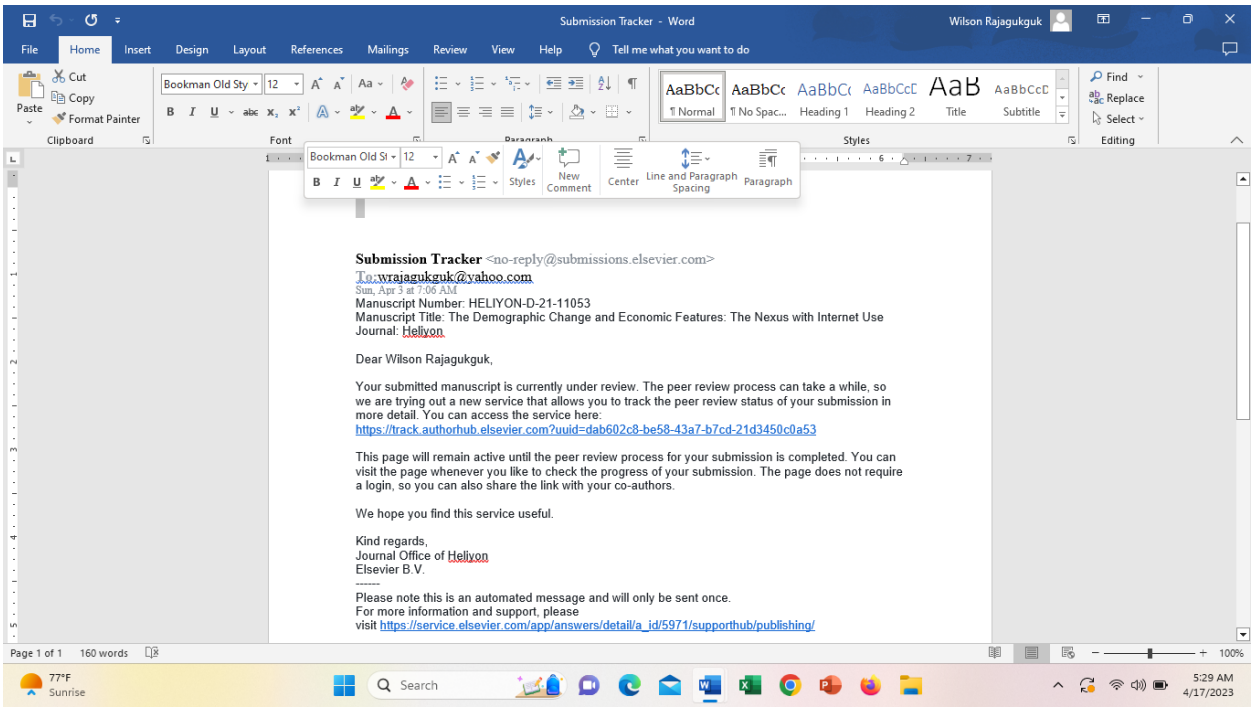
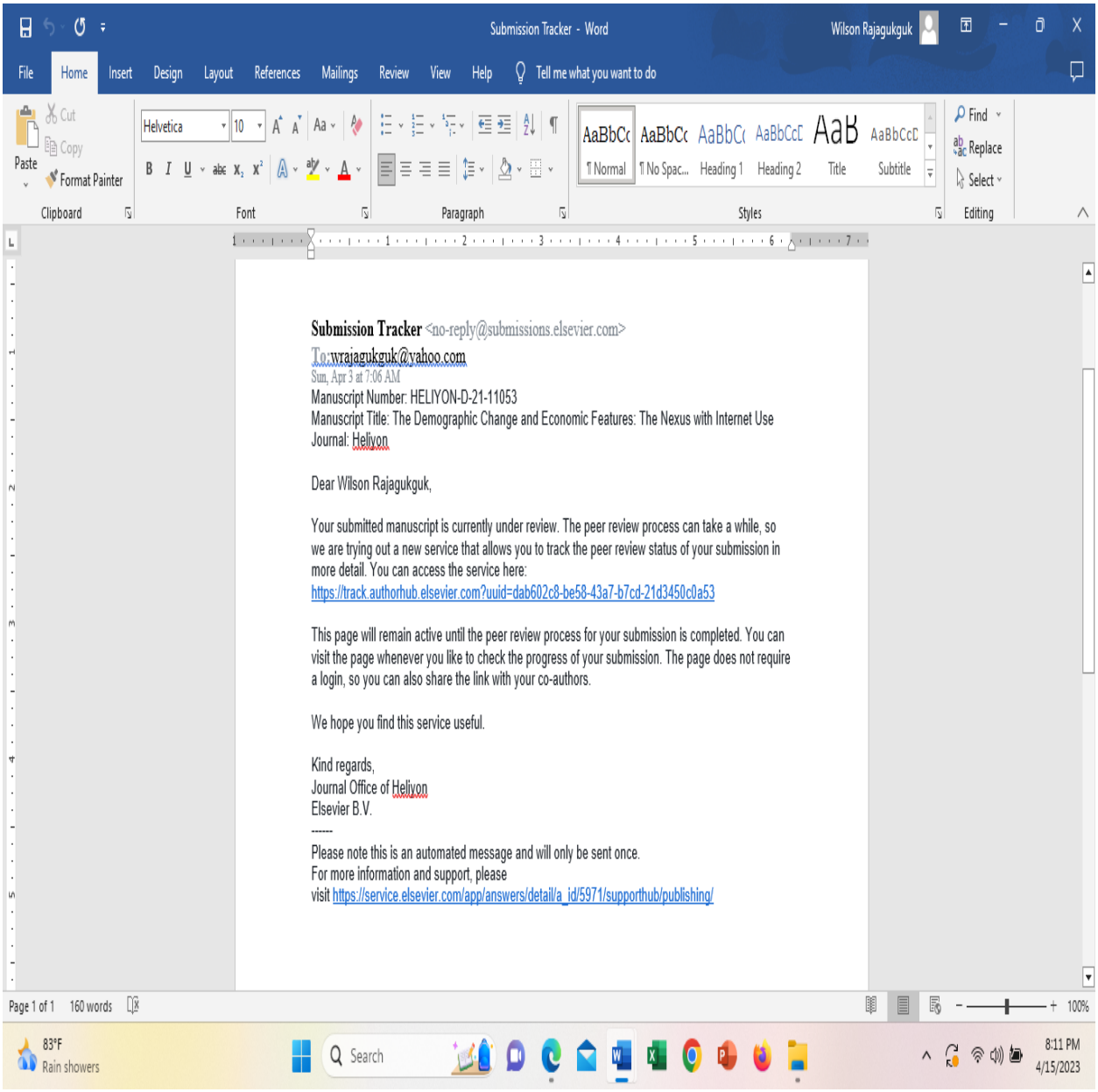


VI. Final Review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Manuscript Number: HELIYON-D-21-11053R3
Title: The Demographic and Economic Features: The Nexus with Internet Use
Journal: Heliyon
Dear Dr. Rajagukguk,
Thank you for submitting your manuscript to Heliyon.
I am pleased to inform you that your manuscript has been accepted for publication.
Your accepted manuscript will now be transferred to our production department. We will create a proof which you will be asked to check, and you will also be asked to complete a number of online forms required for publication. If we need additional information from you during the production process, we will contact you directly.
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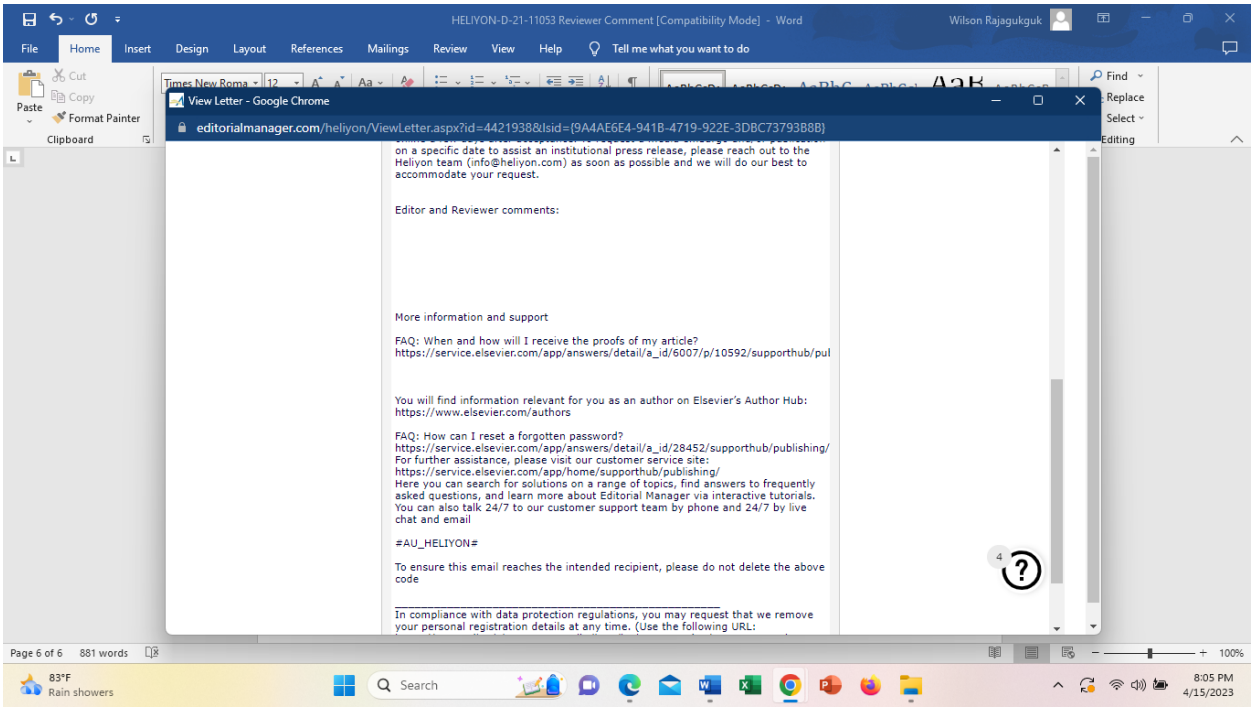
HELIYON-D-21-11053 Reviewer Comment [Compatibility Mode] - Word
Wilson Rajagukguk
View Letter - Google Chrome
editorialmanager.com/heliyon/ViewLetter.aspx?id=4421938&lsid={9A4AE6E4-941B-4719-922E-3DBC73793B8B}
on a specific date to assist an institutional press release, please reach out to the Heliyon team (info@heliyon.com) as soon as possible and we will do our best to accommodate your request.
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More information and support
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881 words
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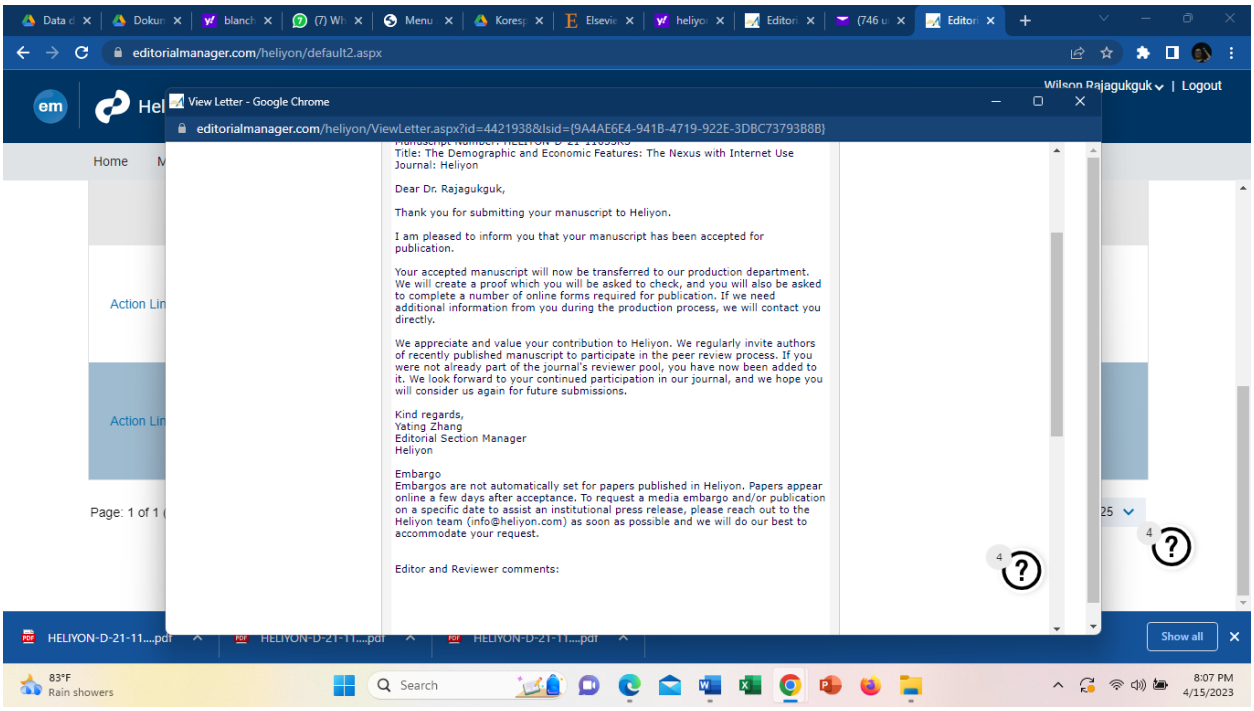
4/15/2023


editorialmanager.com/heliyon/default2.aspx
View Letter - Google Chrome
editorialmanager.com/heliyon/ViewLetter.aspx?id=4421938&lsid={9A4AE6E4-941B-4719-922E-3DBC73793B8B}
Title: The Demographic and Economic Features: The Nexus with Internet Use
Journal: Heliyon
Dear Dr. Rajagukguk,
Thank you for submitting your manuscript to Heliyon.
I am pleased to inform you that your manuscript has been accepted for publication.
Your accepted manuscript will now be transferred to our production department. We will create a proof which you will be asked to check, and you will also be asked to complete a number of online forms required for publication. If we need additional information from you during the production process, we will contact you directly.
We appreciate and value your contribution to Heliyon. We regularly invite authors of recently published manuscript to participate in the peer review process. If you were not already part of the journal's reviewer pool, you have now been added to it. We look forward to your continued participation in our journal, and we hope you will consider us again for future submissions.
Kind regards,
Yating Zhang
Editorial Section Manager
Heliyon
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Embargos are not automatically set for papers published in Heliyon. Papers appear online a few days after acceptance. To request a media embargo and/or publication on a specific date to assist an institutional press release, please reach out to the Heliyon team (info@heliyon.com) as soon as possible and we will do our best to accommodate your request.
Editor and Reviewer comments:
Wilson Rajagukguk | Logout
Home
Page: 1 of 1
Show all
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4/15/2023

Paper title: The Demographic Change and Economic Features: The Nexus with Internet Use **Aim(s):** Reviewing

DOI: HELIYON-D-21-11053R1 **Review due date:** 11 / 4 /2022

Section	Points to Ponder	Review comments and notes

Abstract, title and references	• Is the aim clear?
	• Is it clear what the study found and how they did it?
	• Is the title informative and relevant?
	• Are the references:
	  ◦ Relevant?
	  ◦ Recent?
	  ◦ Referenced correctly?
	  ◦ Are appropriate key studies included?
		The aim is clear.
		The study was founded explicitly.
		The title was informative and relevant.
		The references
		• Were relevant.
		• Recent.
		• Not referenced correctly.
		• Appropriate studies were included.

Introduction/ background	• Is it clear what is already known about this topic? • Is the research question clearly outlined? • Is the research question justified given what is already known about the topic?	This topic is known clearly in this article. The research question is clearly outlined. The research question was justified.
Methods	• Is the process of subject selection clear? • Are the variables defined and measured appropriately? • Are the study methods valid and reliable? • Is there enough detail in order to replicate the study?	The process of subject selection was clear. The variables were defined and measured appropriately. The study methods were valid and reliable. There is enough detail to replicate the study.

Results	• Is the data presented in an appropriate way?
	  ◦ Tables and figures relevant and clearly presented?
	  ◦ Appropriate units, rounding, and number of decimals?
	  ◦ Titles, columns, and rows labelled correctly and clearly?
	  ◦ Categories grouped appropriately?
	• Does the text in the results add to the data or is it repetitive?
	• Are you clear about what is a statistically significant result?
	• Are you clear about what is a practically meaningful result?
		The data was presented appropriately.
		• Tables were relevant and clearly presented.
		• Units, rounding, and number of decimals were appropriate.
		• Titles, columns, and rows were labelled correctly and clearly.
		• Categories were grouped appropriately.
		The text in the results added to the data.
		A statistically significant result was clear.
		A practically meaningful result was clear.

Discussion and Conclusions	• Are the results discussed from multiple angles and placed into context without being over interpreted? • Do the conclusions answer the aims of the study? • Are the conclusions supported by references or results? • Are the limitations of the study fatal or are they opportunities to inform future research?	The results were discussed from multiple angles and placed into context with being interpreted. The conclusions have answered the aims of the study. The conclusions were supported by results only. The limitations of the study are opportunities to inform future research.
Overall	• Was the study design appropriate to answer the aim? • What did this study add to what was already known on this topic? • What were the major flaws of this article? • Is the article consistent within itself?	The study design was appropriate to answer the aim. This study adds to what was already known more knowledge on this topic. There were minor flaws in this article in reference mistakes only. The article consistent was within itself.

Structure your comments into a full review:

Overall statement or summary of the article and its findings in your own words	Minor errors start with an uncompleted some words, punctuation, incorrect references, and some misspelled words.
Overall **strengths** of the article and what **impact** it might have in your field	The strength of the article lies in the way it works to study and cite sober sources and participating institutions.
Specific comments on **weaknesses** of the article and what could be done to improve it	Major points in the article which needs clarification, refinement, reanalysis, rewrites and/or additional information and suggestions for what could be done to improve the article. 1. Wrong words. Minor points like figures/tables not being mentioned in the text, a missing reference, typos, and other inconsistencies. 1. Wrong citation. 2. Typos.

References should be corrected.

United Nations. (2021). The Sustainable Development Goals Report 2021.

World Bank, 2021, World Developent Indicator.

Heliyon

The Demographic and Economic Features: The Nexus with Internet Use

--Manuscript Draft--

Manuscript Number:	HELIYON-D-21-11053R2
Article Type:	Original Research Article
Keywords:	Demographic dividend type; economic determinants; internet use; fixed effects
Manuscript Classifications:	140: Social Sciences
Corresponding Author:	Wilson Rajagukguk, Ph.D. Universitas Kristen Indonesia Jakarta Timur, Jakarta INDONESIA
First Author:	Wilson Rajagukguk, Ph.D.
Order of Authors:	Wilson Rajagukguk, Ph.D.
Abstract:	The goal of this study was to examine the nexus between demographic dividend type and economic features with internet use. The data source was from the World Development Indicator of the World Bank. The unit analysis was country. The panel data analysis method were used for the examination, employing fixed effects regression models using country income level, country regional group, and year as identifiers. The random effects regression model, pooled least square model, and static generalized method of moments were utilized for robustness checks. The dependent variable was the percentage of population using the internet. The independent variables consisted of demographic and economic variables. The demographic variable was the demographic dividend type, while the economic variables were access to electricity, GDP, inflation rate, and foreign direct investment. The results of fixed effects regression indicate that after controlling for the economic features, higher internet use in a country was associated with late- and post-demographic dividend type. Higher internet use was also associated with higher access to electricity, higher GDP, lower inflation rate, and higher foreign direct investment inflow. Robustness checks using random-effects and pooled least square models, using fixed-effects model by country income level, using two-stage least square, and using second stage regression by G20 and non-G20 country group division and year, similarly gave consistent results. The association of internet use with the demographic and economic features may imply that population-based and economic development program should be enhanced toward the favorable ones that increase internet usage among the population.
Opposed Reviewers:	

Manuscript. Number.: HELIYON-D-21-11053R1

Title: The Demographic Change and Economic Features: The Nexus with Internet Use

Journal: Heliyon

Dear Wilson,

Thank you for submitting your manuscript to Heliyon. We have completed the review of your manuscript and a summary is appended below. The reviewers recommend major revisions are required before publication can be considered. If you are able to address all reviewer comments in full, I invite you to resubmit your manuscript. We ask that you respond to each reviewer comment by either outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism.

This should be carried out in a point-by-point fashion as illustrated here: https://www.cell.com/heliyon/guide-for-authors#Revisions.

To allow the editors and reviewers to easily assess your revised manuscript, we also ask that you upload a version of your manuscript highlighting any revisions made. You may wish to use Microsoft Word's Track Changes tool or, for LaTeX files, the latexdiff Perl script (https://ctan.org/pkg/latexdiff).To submit your revised manuscript, please log in as an author at https://www.editorialmanager.com/heliyon/, and navigate to the "Submissions Needing Revision" folder.

Your revision due date is May 24, 2022.We understand that the COVID-19 pandemic may well be causing disruption for you and your colleagues. If that is the case for you and it has an impact on your

ability to make revisions to address the concerns that came up in the review process, please reach out to us. I look forward to receiving your revised manuscript.

Kind regards,

Romanus Osabohien

Associate Editor - Business & Economics

Heliyon

Editor and Reviewer comments:

Reviewer 3: Methods:
Author did not discuss the countries of study and their regions rationale for selecting them need to be explained.

Author: Thank you very much for the comments. A table of list of countries of the study has been added in Appendix Table A. The discussion about the countries also has been added in line 329–334.

Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?"
Author did not understand this question, therefore did not give appropriate response.
The question is, Did you use the original data as it is or you transformed the data using natural log?

Author: Thank you very much for the comments. The Author used the original data for all variables, except for GDP where natural log was used as explained in the models in line 282–283 and 297–303.

Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature.

Author: Thank you very much for the comments.

As stated in Section 1 (Introduction) that there was a significant inequality in access to the internet across countries in the world.

The Author was interested to study the factors of this inequality in the internet use with a hope that it will contribute to the understanding of the determinants of internet use as well as to improve access to the internet use as a part of sustainable development goals (SDGs).

Author did not understand this question, therefore did not give appropriate response,
The question is, why did you decided to use variables like; information technology, typology of pre-, early- (EarlyDD), late- (LateDD), and postdemographic dividend (PostDD) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.

Author: Thank you very much for the comments.

The Author chose the demographic and economic features as the independent variables. Demographic dividend type was selected as demographic feature, while access to electricity, GDP, inflation, and FDI as economic features. The types of demographic dividend were based

on Ahmed et al. (2016) in line 89–103 and the availability of the data from the World Bank.

Study on the role of demographic change on development, including access to information and communication technology was limited. Therefore, the Author chose this variable as the independent variable. The selection of electricity, GDP, inflation, and FDI as economic features was based on the literature review and availability of data.

Results:

Interpretation:
Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing.
(i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation

Author: Thank you very much for the comments. The Conclusion has been revised as in line 506–533.

Other comments:
One of the reviewer comment is:

(1) The introductory section is meant to introduce the study, the gap and set pace for the remaining sections.

Author: Thank you very much for the comments. The gap and pace for remaining sections have been added, respectively in line 115–118 and 127–129.

(2) This section has failed to link the three key variables, demographic change, economic features and internet usage.

Author: Thank you very much for the comments. This study focused on (1) the association between demographic change and internet and (2) the association between economic features and internet. The links of these variables have been added in line 79 – 87.

Author(s) did not introduce any gap or set pace for the remaining section,
To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … "

To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c.

Author: Thank you very much for the suggestions. The gap and pace for remaining sections have been added, respectively, in line 115–118 and 127–129.

Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.

Author: Thank you very much for the suggestions. The gap has been added in line 127–129.

Reviewer 4: Methods: The conceptualization and operationalization of this study are problematic. This study has shown a low degree of novelty. No clear problem statement nor research gap is highlighted. No details of data collection.

Author: Thank you very much for the suggestions. The gap has been added in line 115–118.

Results: Therefore, I am not convinced by the findings.

Author: Thank you very much for the suggestions. The findings have been improved by conducting robustness checks in line 426–503.

Interpretation: The interpretation of the findings is rather weak and not rigorous.

Author: Thank you very much for the suggestions. The interpretation of findings has been improved in line 375–492.

Other comments: Need to highlight the theoretical and practical of this study.

Author: Thank you very much for the suggestions. The theoretical and practical of this study have been added in line 121 –125.

Reviewer 5: Methods: The method used is descriptive method using documentary analysis. However, the documents analyzed did not cover countries included in the sample respondents. The analysis of findings would have been more comprehensive and exciting to readers if name of countries were included in the findings.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Results: The results of the study is comprehensive, however if there is labelling of countries included in the variables it would have more exciting.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Interpretation: The interpretation based from statistical analysis of the document is comprehensive.

Author: Thank you very much for the comments.

Other comments: Labelling countries in the demographic typology is recommended.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Reviewer 6: Methods:

Results:

Interpretation:

Other comments:

Reviewer 8: Methods: The methods employed by the author(s) are suitable. However, there is need to first specify the implicit function of

the model before the explicit function. In addition, the specified model is not correctly specified without the subscript 'it'. It looks more like a time series model.

Author: Thank you very much for the comments. The models have been revised in line 282–283 and 297–303.

Results: The results are adequately explained. Although there is a need for theoretical framework to link all parts of the study.

Author: Thank you very much for the comments. Theoretical framework to link all parts of the study have been added in, for example, line 372–373.

Interpretation: The explanation still lacks theoretical basis.

Author: Thank you very much for the comments. Theoretical basis has been added in, line 79–87.

Other comments: The issues raised by the author(s) are important and adequately addressed, but poor grammatical expressions alter the correct discussion of findings in the study. I hereby suggest a thorough editing by an expert in English language writing to edit the manuscript before publication.

Reviewer 9: Methods:
The process of subject selection was clear.
The variables were defined and measured appropriately.
The study methods were valid and reliable.
There is enough detail to replicate the study.

Author: Thank you very much for the comments.

Results:
The text in the results added to the data.
A statistically significant result was clear.
A practically meaningful result was clear.

Interpretation:
was clear

Author: Thank you very much for the comments.

Other comments:

Reviewer 10: Methods: clear enough; it needs more appropriate reasoning in choosing GMM estimator.

Author: Thank you very much for the comments. Reasoning in choosing GMM estimator has been addressed in line 285–290.

Results: clear enough

Author: Thank you very much for the comments.

Interpretation: Still using the old references for justifying the findings.

Author: Thank you very much for the comments. Recent references for justifying the findings have been added in line 79–87.

Other comments:

*****

Data in Brief (optional):
We invite you to convert your supplementary data (or a part of it) into an additional journal publication in Data in Brief, a multi-disciplinary open access journal. Data in Brief articles are a fantastic way to describe supplementary data and associated metadata, or full raw datasets deposited in an external repository, which are otherwise unnoticed. A Data in Brief article (which will be reviewed, formatted, indexed, and given a DOI) will make your data easier to find, reproduce, and cite.

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I

MANUSCRIPT TITLE: The Demographic Change and Economic Features: The Nexus with Internet Use

MANUSCRIPT NUMBER: HELIYON-D-21-11053

General Comment	(1) I WASN'T PART OF THE ORIGINAL REVIEWER OF THIS MANUSCRIPT (2) MOST OF THE COMMENTS BY THE ORIGINAL REVIEWERS (ESPECIALLY REVIEWER II) WAS NOT EFFECTED BY THE AUTHOR(S)	Author	Note Line
Title			
Abstract			
1. Introduction	One of the reviewer comment is: (1) The introductory section is meant to introduce the study, the gap and set pace for the remaining sections. (2) This section has failed to link the three key variables, demographic change, economic features and internet usage. Author(s) did not introduce any gap or set pace for the remaining section, To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … "	Thank you for the comments. Research gap has been added.	105–108

	To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c. Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.	The statement has been added. Research gap has been added.	113–115 105–108
2. Literature Review			
3. Data and Method	Author did not discuss the countries of study and their regions rationale for selecting them need to be explained: Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?" Author did not understand this question, therefore did not give appropriate response. The question is, Did you use the original data as it is or you transformed the data using natural log? Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature.	Thank you for the comments. The list of countries in the study by demographic dividend type has been added in Appendix Table 1. The author used original series. The justification of the variables used was provided in Section 2 (Literature Review)	

	Author did not understand this question, therefore did not give appropriate response, The question is, why did you decided to use variables like; information technology, typology of pre-, early- (*EarlyDD*), late- (*LateDD*), and postdemographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.	As stated in Section 1 (Introduction) that there was a significant inequality in access to the internet across countries in the world. The Author was interested to study the factors of this inequality in the internet use with a hope that it will contribute to the understanding of the determinants of internet use as well as to improve access to the internet use as a part of sustainable development goals (SDGs). The Author chose the demographic and economic features as the independent variables. Demographic dividend type was selected as demographic feature, while access to electricity, GDP, inflation, and FDI as economic features. The types of demographic dividend were based on Ahmed et al. (2016) in line 82–96 and the availability of the data from the World Bank. Study on the role of demographic change on development, including access to	

		information and communication technology was limited. Therefore, the Author chose this variable as the independent variable. The selection of electricity, GDP, inflation, and FDI as economic features was based on the literature review and availability of data.	
4. Results and Discussion			
6. Conclusion and Recommendation	Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing. (i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation	Thank you for the suggestions. Conclusion has been revised.	487–514
References			

Rating of the manuscript: Use (1 = Excellent) (2 = Very Good) (3 = Average) (4 = Fair) (5 = poor)

Originality	4
Contribution To The Field	4
Technical Quality	5
Clarity of Presentation	4
Depth Of Research	4

Recommendation: Please, mark with an X

Accept As It Is	

Minor Corrections	
Moderate Revision	
Major Revision	**X**
Reject (Give Reasons)	

Paper title: The Demographic Change and Economic Features: The Nexus with Internet Use **Aim(s):** Reviewing
DOI: HELIYON-D-21-11053R1 **Review due date:** 11 / 4 /2022

Section	Points to Ponder	Review comments and notes

Abstract, title and references	• Is the aim clear?
	• Is it clear what the study found and how they did it?
	• Is the title informative and relevant?
	• Are the references:
	  ◦ Relevant?
	  ◦ Recent?
	  ◦ Referenced correctly?
	  ◦ Are appropriate key studies included?
		The aim is clear.
		The study was founded explicitly.
		The title was informative and relevant. The references
		• Were relevant.
		• Recent.
		• Not referenced correctly
		Author: Thank you very much for the comment. The references have been corrected.
		• Appropriate studies were included.

Introduction/ background	• Is it clear what is already known about this topic? • Is the research question clearly outlined? • Is the research question justified given what is already known about the topic?	This topic is known clearly in this article. The research question is clearly outlined. The research question was justified.
Methods	• Is the process of subject selection clear? • Are the variables defined and measured appropriately? • Are the study methods valid and reliable? • Is there enough detail in order to replicate the study?	The process of subject selection was clear. The variables were defined and measured appropriately. The study methods were valid and reliable. There is enough detail to replicate the study.

Results	• Is the data presented in an appropriate way?
	  ◦ Tables and figures relevant and clearly presented?
	  ◦ Appropriate units, rounding, and number of decimals?
	  ◦ Titles, columns, and rows labelled correctly and clearly?
	  ◦ Categories grouped appropriately?
	• Does the text in the results add to the data or is it repetitive?
	• Are you clear about what is a statistically significant result?
	• Are you clear about what is a practically meaningful result?
		The data was presented appropriately.
		• Tables were relevant and clearly presented.
		• Units, rounding, and number of decimals were appropriate.
		• Titles, columns, and rows were labelled correctly and clearly.
		• Categories were grouped appropriately. The text in the results added to the data.
		A statistically significant result was clear.
		A practically meaningful result was clear.

Discussion and Conclusions	• Are the results discussed from multiple angles and placed into context without being over interpreted? • Do the conclusions answer the aims of the study? • Are the conclusions supported by references or results? • Are the limitations of the study fatal or are they opportunities to inform future research?	The results were discussed from multiple angles and placed into context with being interpreted. The conclusions have answered the aims of the study. The conclusions were supported by results only. The limitations of the study are opportunities to inform future research. Author: Thank you very much for the comments. The limitations

		of the study have been addressed in line 534–539.
Overall	• Was the study design appropriate to answer the aim? • What did this study add to what was already known on this topic? • What were the major flaws of this article? • Is the article consistent within itself?	The study design was appropriate to answer the aim. This study adds to what was already known more knowledge on this topic. There were minor flaws in this article in reference mistakes only. The article consistent was within itself.

Structure your comments into a full review:

Overall statement or summary of the article and its findings in your own words	Minor errors start with an uncompleted some words, punctuation, incorrect references, and some misspelled words. Author: Thank you very much for the comments. Minor errors have been corrected.
Overall **strengths** of the article and what **impact** it might have in your field	The strength of the article lies in the way it works to study and cite sober sources and participating institutions.
Specific comments on **weaknesses** of the article and what could be done to improve it	Major points in the article which needs clarification, refinement, reanalysis, rewrites and/or additional information and suggestions for what could be done to improve the article. 1. Wrong words. Author: Thank you very much for the comments. Wrong words have been corrected. Minor points like figures/tables not being mentioned in the text, a missing reference, typos, and other inconsistencies. 1. Wrong citation. 2. Typos. Author: Thank you very much for the comments. Wrong citation and typos have been corrected.

References should be corrected.

United Nations. (2021). The Sustainable Development Goals Report 2021.

World Bank, 2021, World Development Indicator.

Author: Thank you very much for the comments. References have been corrected.

The Demographic ~~Change~~ and Economic Features: The Nexus with Internet Use

Wilson Rajagukguk

Faculty of Economic and Business, Universitas Kristen Indonesia

Email: wrajagukguk@yahoo.com

Abstract

The goal of this study was to examine the nexus between demographic ~~change~~ dividend type and economic features with internet use. The data source was from the World Development Indicator of the World Bank. The unit analysis was country. The ~~P~~panel data analysis method~~s~~ were used for the examination, employing fixed effects regression models using country income level, country regional group, and year as identifiers~~, random effects regression, and pooled least square models~~. ~~The unit analysis was country.~~ The random effects regression model, pooled least square model, and static generalized method of moments ~~and two stage least square~~ were utilized ~~as~~ for ~~the~~ robustness checks. The dependent variable was the percentage of population using the internet. The independent variables consisted of demographic and economic variables. The demographic variable was the demographic dividend typ~~ology~~e, while the economic variables were access to electricity, GDP, inflation rate, and foreign direct investment. The results of fixed effects regression indicate that ~~using country income level, country regional group, and year as identifiers and~~ after controlling for the economic features, higher internet use in a country was associated with late- and post-demographic dividend ~~typology~~type. Higher internet use was also associated with higher access to electricity, higher GDP, lower inflation rate, and higher foreign direct investment inflow. ~~The r~~Robustness checks using random-effects and pooled least square models, using fixed-effects model by country income level, using two-stage least square, and using second stage regression by G20 and non-G20 country group division and year, similarly gave consistent results. The association of internet use with the demographic and economic features may imply that population-based and economic development program should be enhanced toward the favorable ones that increase internet usage among the population.

Key words: Demographic dividend typ~~ology~~e, economic determinants, internet use, fixed effects.

1. Introduction

The world is marked by a considerable inequality in human development achievement. The United Nations Development Programme (UNDP) reported that in 2019 the human development index (HDI) varied greatly from a lowest of 0.394 in Niger to a highest of 0.957 in Norway (UNDP, 2020). This disparity could be attributed to the inequity in access to digital technology, including broadband internet.

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Widespread access to broadband internet is a key driver of human development. Improving access to the internet is also identified as an instrument to achieve the Sustainable Development Goals (SDGs) in goal 4 (Quality education), goal 9 (Industry, innovation, and infrastructure), and goal 17 (Partnership for the Goals). Internet allows people to be connected, work, shop, and study especially during the COVID-19 pandemic lockdowns (United Nations, 2021).

Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.

The World Bank (2022) estimated that increasing internet penetration from 35% to 75% of the population in all developing countries could increase about US$2 trillion to their joined gross domestic product and generate more than 140 million works around the world. However, there wasere a great inequality in the internet access across the world.

The World Bank (2021) reported that in 2019, among 174 countries in the world where the data was available, this access varied greatly across countries, lowest in Burundi (5.2%) and almost universal in Bahrain (99.7%).

Information and communication technology (ICT), in particular internet, is a most developed business and business product in this century. The study of ICT encounters economists and demographers with two sides, as consumers and producers. ~~As it can be seen from Figure 1,~~ tThere was a rapid increase of internet consumers in the world. The percentage of internet users in the world from 1990–2018 increased from 0% in 1990 to 51% in 2018 only in 28 years. The time trends of the percentage of internet users was not the linear one, but the power one. Therefore, the internet business is a promising one.

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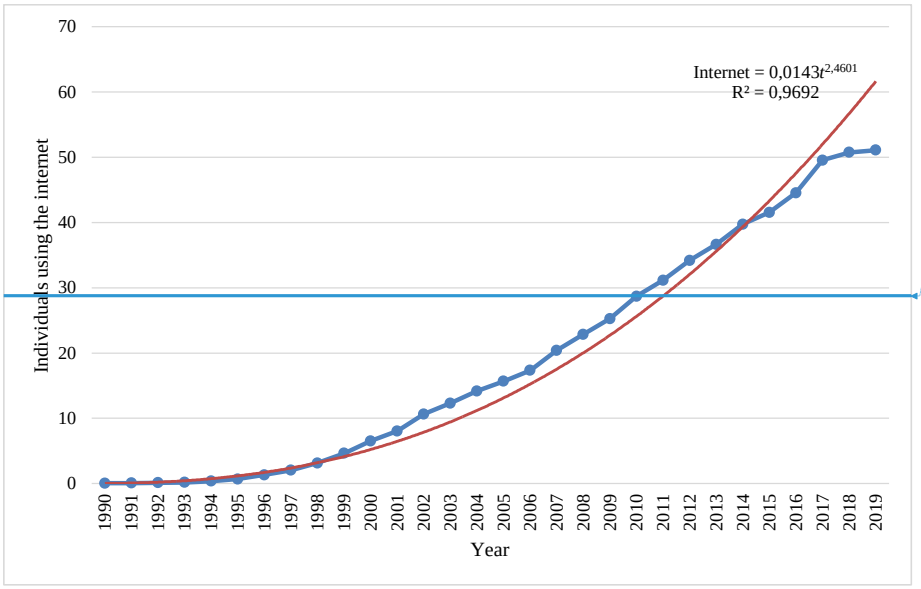

~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 1~~

~~Individuals Using the Internet (% of population): World 1990-2018~~

On the other hand, decline in fertility and mortality level and change in migration patterns have caused countries to experience demographic change that has been related to demographic dividend. ~~.~~Demographic dividend is economic growth as the results of changes in age structure in a country due to the decline in family size and longer life that cause increase in the percentage of productive age population aged 15–64 years old. As a result, lower investment is needed for young population aged 0–14 years old. At the same time, productive age population increases that open the window of opportunity to accelerate economic growth and family welfare. At micro level, this demographic transition can result in family living standard improvement and higher income. At macro level, demographic transition can affect economic development in a country.

It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including economic and information and communication technology development. Demographic change of fertility and mortality decline could help create a period

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of sustainable economic growth as happened in some East Asian economies (e.g. Bloom et al., 2020; Amornkitvikai, Y. et al., 2022, Hosan et al., 2022, Liu and McKibbin, 2022). The mechanism of growth that is the policy area is through public health, family planning, economic policy that promote labor market flexibility, trade openness, and saving. The government of countries has window of opportunity to capitalize productive age population to reap the demographic dividend of economic growth and family welfare acceleration. This economic growth then enables countries to enlarge their heavily internet-based economies and consequently rises internet usage (Pradhan et al., 2017; Anuj, et al. 2018; Amaluddin 2020).

~~Bonus demografi adalah pertumbuhan ekonomi yang merupakan hasil dari perbuahan struktur umur sebuah negara, perubahan dari sebuah keluarga yang besar berumur pendek menjadi keluarga kecil dan berumur berumur lebih panjang.~~

~~Karena perubahan dalam distwribusi umur, diperlukan investasi yang lebih sedikit untuk membangun penduduk kelompok usia mudda dan kemudian sumberdaya yang lebih besar digunakan untuk pembangunan (economic gift). Berbarengan dengan hal tersebut, Angkatan kerja bertumbuh lebih cepat (more rapidly) dibandingkan dengan penduduk yang tergantung padanya menciptakan sebuah jendela kesempatan percepatan pertumbuhan ekonomi dan kesejahteaan keluarga. Dalam skala mikro, transisi ini dapat berbuahkan dalam perbaikan standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.~~

Ahmed et al. (2016) grouped countries into four demographic dividend ~~typology~~ type based on the demographic change and economic development achievement. The demographic dividend typology is classified as the pre-, early-, late-, and post-demographic dividend. Countries with a fertility level above four children per woman, increasing percentage of working age population (15–64 years), and low income level are categorized as the pre-demographic dividend countries. Meanwhile, countries with a fertility level between 2.1 and four children per woman, increasing percentage of working age population, and low-middle and middle-high income level are categorized as the early-demographic dividend countries. Further, countries with a fertility level below 2.1 children per woman, increasing percentage of working age population, and high income level are also categorized as the early-demographic

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dividend countries. Furthermore, countries with a fertility level between 2.1 children and four per woman, declining percentage of working age population, and low, low-middle, and middle-high income level are categorized as the late-demographic dividend countries. Lastly, countries with a fertility level below 2.1 children per woman, decreasing percentage of working age population, and high income level are categorized as the post-demographic dividend countries.

~~It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including information and communication technology development. As it can be seen from Figure 2, t~~There wa~~i~~s a significant difference in the percentage of internet users and its trends across the demographic dividend typologies. The percentage of internet users was consistently highest in the post-demographic dividend countries, followed by in the late- and early-demographic dividend countries, and lowest in the pre-demographic dividend countries. ~~It also can be seen that during 1990–2018 t~~The percentage of internet users during 1990–2018 increased more rapidly in more developed countries, the post-demographic dividend typology countries.

The determinants of internet use have been proposed (e.g. Scheerder et al. 2017). These include demographic and socioeconomic factors. The association between demographic and economic features and information and communication technology has also been studied (e.g. Bianchini et al. 2021; Yesuf, -2021; Singh et al. 2020; Baumann et al. 2017). However, a summary of the reviewed literature revealed that no study on demographic dividend type and internet use had been carried out. In order to address the gap indicated above, in general this study sought to

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standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.

Espinoza Bianchini, G., Navia, P., & Ulriksen Lira, C. (2021) melakukan studi tentang dampak umur, identifikasi ideological pada pemakaian jaringan sosial on line untuk mendapatkan informasi politik. Indikator sosio demographic dan indentifikasi ideologikal, akses serta pemakaiaan jaringan sosial ditemukan mempengaruhi keterlibatan demokratik. Di negara-negara di mana digital divide (akses ke internet) dan digital inequality (penggunaan internet) terjadi berdampingan (Coexist), dampak indikator sosio-demografis lebih kuat, karena mereka yang memiliki lebih sedikit alat dan sumber daya mepunyai lebih sedikit akses dan lebih sedikit menggunakan jejaring sosial. untuk keterlibatan demokratis.

Yesuf, K. A. (2021) melakukan studi untuk menginvestigasi determinan sosiodemographic internet dan dampaknya pada perilaku keluarga berencana diantara laki-laki muda (young male) di Ethiopia menggunakan data dari Ethiopia health and demographic survey 2016. Besarnya penggunaan internet di Ethiopia (magnitude of internet use) sebesar 14% berasosiasi dengan dengan pemakaian internet adalah umur 20-24 tahun, tingkat Pendidikan yang tinggi, hidup pada region kota administrative, menggunakan mobile phone, responden yang dapat membaca seluruh kalimat, dan responden yang mempunyai computer dirumah. Responden dengan pekerjaan di sector pertanian dan pekerja manual kurang cenderung menggunakan internet.

Singh, S., Sahni, M. M., & Kovid, R. K. (2020). Melakukan studi bahwa kegunaan yang dirasakan (Perceived usefulness) dan Pengaruh social (social influence) merupakan determinan

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kunci niat perilaku menggunakan layanan Fintech. Selanjutnya ditemukan bahwa digital behavior serta karakteristik demografi (umur dan gender) memperkuat hubungan tersebut

Filippova, I., & Turutina, E. (2015) menggunakan sampel yang merupakan representasi seluruh penduduk Rusia melakukan studi mengukur secara empiris penggunakan internet dalam proses Pendidikan di Rusia. Perbedaan umur dan gender, finansial status, dan tingkat Pendidikan merupakan determinan penggunakan internet untuk tujuan pendidikan.

Online health information seeking behavior (OHISB) is currently a widespread and common behavior that has been described as an important prerequisite of empowerment and health literacy. Baumann, E., Czerwinski, F., & Reifegerste, D. (2017). Ditemukan bahwa factor demografi seperti status sosio ekonomi, umur, gender merupakan determinan penting untuk OHISB. Wang, J., Xiu, C., & Shahzad, F. (2019) selain faktor kunci untuk OHISB seperti self-efficacy, Internet experience, and perceived ease of use, membagi determinan OHISB ke dalam empat kategori yakni demographic characteristic factors, cognitive factors, internal factors, and external factors.

Sharma, S. K., Govindaluri, S. M., & al Balushi, S. M. (2015) melakukan riset mengekplorasi determinan utama dari pemakai internet banking. Menggunakan Two staged regression ditemukan bawah service qualitu, trust, perceived usefulness, perceive ease of use, attitude and demographic variabels merupakan dterminan internet banking users.

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Pertumbuhan ekonomi dipengaruhi secara signifikan oleh digitalisaai dan transisi demographi (Zaman, K. A. U. and T. Sarker., 2021). Menggunakan Bangladesh sebagai sebuah case study, Zaman dn Sarker mengadopsi model three-stage least square menganalisis bagaimana digitalisasi, dan transisi demographi mempercepat pertumbuhan ekonomi di Bangladesh.

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Setiap kenaikan 1% jumlah pengguna internat, GDP akan meningkat sebesar 0,11%, ceteris paribus. Sementara itu setiap penurunan 10- basis poin dalam dependency ratio akan meningkatkan GDP sebesr 1.2%. Faktor kunci untuk digitalisasi adalah labor participation rate, produktivitas pekerja, dan mobil pentration. Urbanisasi secara bolak-balik mempengaruhi peningkatan pemakai internet. Skor Human Development Index (HDI) dan angka urbanisasi secara negative signifikan berpengaruh pada angka ketergantungan, sementara itu partisipasi perempuan dalam Angkatan kerja mempunyai pengaruh positif.

Zaman, K. A. U. and T. Sarker. 2021. Demographic Dividend, Digital Innovation, and Economic Growth: Bangladesh Experience. ADBI Working Paper 1237. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/demographicdividend-digital-innovation-economic-growth-bangladesh

Bonus demografi memainkan peran penting sehubungan dengan hampir 850 Juta pelanggan langganan seluler (4 kali penetrasi Internet yang mencapai sekitar 205 Juta) di India (Burragoni, V.,2017). Pasca liberasisasi ekonomi India, pengembangan system perbankan mengalami pertumbuhan yang sama dengan penduduk. Seriring dengan pertumbuhan penduduk, permintaan dan tantangan juga meningkat dalam perkembangan system perbankan dan pembayaran. Untuk mengangani permsalahan ini pemrintah India mendisain sangat banyak strategi untuk meningkatkan ekonomi massa di India. Pemerintah India memulai program inklusi keiangan untuk mendapatkan pertumbuhan yang berkesinambungan melalui isu sosial seperti pengentasan kemiskinan (removing poverty), pendidikan untuk semua, dan well balance society melalui sitem keuangan dapat diperkuat. Seknario ini berbuah banyak (fruitful) karena India mempunyai advantage of demographic advantage, technological advandement, dan financial literacy, penignkatan penetration of Internet technology, dan juga pentration of mobil technology melalui smartphone. Demographic dividden memainkan sebuah peranan krusial. Hal ini mendorong perkembangan dan sebuah kompetisis yang lebih ketat dalam system pembayaran diluar insitusi.

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Myovella, G., Karacuka, M., & Haucap, J. (2021) melakukan studi tentang determinants of digitalization and digital divide in Sub-Saharan African economies. Hasil temuannya adalah bahwa GDP per capita, gross capital formation, political stability, regulatory efficacy and electricity infrastructure secara langsung mempengaruhi digital divide. Juga ditemukan bahwa GDP per capita, population growth, government consumption, trade openness, and electricity infrastructure secara tidak langsung mempengaruhi digital divide melalui efek spillover (spillover effects)

Pertanian merupakan sebuah sector kunci dalam mendorong pertumbuhan eknomi dan pengentasan kemiskiman di Vietnam (Giang, M. H., Xuan, T. D., Trung, B. H., & Que, M. T. ,2019). Produktivitas diukur sebagai Total Factor Productivity. Determinan dari TFT di Vietnam termasuk size and age, share of state and foreign ownership, export, accessibility to Internet and bank loan of firms.

Teknologi internet telah menjadi perangkat teknologikal esensial untuk individu, organisasi, dan pendorong pertumbuhan serta kemakmuran negara (Isaac, O., Abdullah, Z., Ramayah, T., & Mutahar, A. M.,2018). Negara seperti Yaman dimana terdapat pemakaian internet yang sangat rendah kita lihat mempunyai kemajuan ekonomi, sosial dan kultural yang rendah.

Pertertumbuhan ekonomi melalui internet kepada keluarga

Inovasi dan kewirausahaan merupakan factor pendorong penting untuk pertumbuhan ekonomi, dan internet memainkan sebuah peranakan oenting dalam aktivitas kewirausahaan. Menngunakan dataset dari China Family Panel Studies (CFPS) dataset in 2014 and 2016, Tan, Y., & Li, X. (2022) melakukan studi dan menemukan bahwa internet mempunyai pengaruh signifikan dan positif pad kewirausahaan di China. Juga ditemukan bahwa intenet mendorong (promote) kewirausahaan dan menolong pengusaha memperoleh pendanaan informal.

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~~Slazus, B. J., & Bick, G. (2022). Factors that Influence FinTech Adoption in South Africa: A Study of Consumer Behaviour towards Branchless Mobile Banking. *Athens Journal of Business & Economics*, *8*(1). https://doi.org/10.30958/ajbe.8-1-3~~

~~Pemakaian luas mobile phot dan pertumbuhan penetrasi internet telah menciptakan sebuah kesempatan unit untuk meningkatkan pelayanan keuangan. Perusaaann Financial Technology (FinTech) dan mobile banking (m-banking) membedayakan konsumen menggunakn platform digital menggunakan jasa finansial tanpa dipelukan akses fisik sebagaimana yang terjadi pada bank tradisional (Slazus, B. J., & Bick, G. ,2022). Pertumbuhan FinTech berdampak pada pertumbuhan ekonomi keluarga dan sebuah bangsa.~~

~~Teknologi ingernet telah memecahkan batas-batas ruang geographical tradisional, mempersingkat jarak tempuh antar wilayah, memaksimisasi integrasi berbagai sumberdaya. Dalam era teknologo digital, perkembangan jaringan internet yang cepat, dapat menghemat pemakaian dan konsumsi energi (Ren, S., Hao, Y., Xu, L., Wu, H., & Ba, N. ,2021).terjadi hbubungan negatif antara pengebangan internet dengan struktur konsumsi energi melalui pertumbuhan ekonomi, investasi R&D, human capital, financial development dan struktur industrial di China.~~

~~Wu, S., Wang, P., & Sun, B. (2022) menggunakan city-level data from China for the period 2003–15 menemukan bahwa internet mempengartuhi disparitas ekonomi antar kota di Chian melalui dampak heterogeneous pada pertumbuhan ekonomi. Internet memperlebar disparitas ekonomi antar kota dengan angka penetrasi internet yang rendah dan kota dengan angka penetrasi internet yang tinggid.~~

investigate the relationship between demographic and economic features and internet use. Specifically, the objectives of this study were to examine the differentials in internet use by demographic and economic features and to analyze the effects of demographic and economic features on internet use. It is hoped that the findings of this study will contribute to the

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understanding of the association between demographic change and economic features and internet usage. In addition, it is hoped that the recommendation from this study will support the government of countries in order to improve internet usage in their countries in order to accelerate their development.

This paper consists of five sections. In Section 2 the related literature was reviewed. Data and methods used in this study were discussed in Section 3. The results of analyses were presented in Section 4. Conclusion of the study was given in Section 5.

2. Literature Review

Bianchini et al. (2021) studied the impacts of age and ideological identification on the use online social network to obtain political information. They found that socio-demographic factors had strong impacts on internet use. Meanwhile, a study in Ethiopia by Yesuf (2021) found higher internet use among those who were aged 20–24 years, had higher education, lived in urban areas, had a mobile phone, literate, had a personal computer, and worked in formal sectors. Further, a study by Singh et al. (2020) found that perceived usefulness and social influence were the key determinants of the use of Fintech services. They also found that age and gender also influenced this behaviour.

The importance of demographic and socioeconomic factors on internet use for health purposes were also found. Studies by Baumann et al. (2017) ~~and Wang et al. (2019)~~ found age, gender, and socioeconomic factors were important determinants of online health information-seeking behaviour.

Studies also found the significance of demographic and socioeconomic determinants in internet use for financial purposes. A study in Russia by Filippova and Turutina (2015) found that age, gender, financial status, and education level were the determinants of internet use for education

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purposes. Meanwhile, Sharma et al. (2015) found the importance of demographic variables in internet use for banking purposes.

A study by Burragoni (2017) found that demographic dividend played an important role in 850 million cellular subscriptions in India. In the post-economic liberalization, banking system development grew together with the population. Together with economic growth, demand and challenges in banking and payment system development also grew.

Myovella et al. (2021) studied the effects of demographic and economic features on digitalization and digital divide in Sub-Saharan African economies. They found that GDP per capita, gross capital formation, trade openness, population growth, and electricity infrastructure influenced digital divide. Meanwhile, low internet use was found related to low economic, social, and cultural development. A study in Yaman by Isaac et al. (2018) found that low internet use was associated with low economic, social, and cultural development. Another study in Indonesia also found the importance of access to electricity in internet use (Amaluddin, 2020).

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~~Mungkin salah satu pertanyaan dan yang menyita banyak perhatian dalam literatur ekonomi adalah : mengapa sejumlah negara lebih kaya dibandingkan dengan negara lain" (Solow, 1956). Solow suggested bahwa perbedaan dalam angka pertumbuhan pada akumulasi kapital dapat mengakibatkan perbedaan dalam output per kapital. Selanjutnya Lucas (1988), disparitas dalam human capital merupakan central role dalam analisis pertumbuhan dan perkembangan. Selanjutnya Klenow dan Rodriguez-Clare (1997), Hall and Jones (1999), Parente dan Prescott (2000) dan kemudian Bils dan Klenow (2000) berargumen bahwa perbedaan output per pekerja tidak diakibatkan oleh perbedaan dalam human capital (atau physical capital) tetapi oleh perbedaan dalam sebuah residual yang dinamakan Total Factor Productivity (TFT)~~

~~Total factor productivity (TFP) kemudian merupakan sebuah ukuran produktivitas dihitung dengan membagi total produkis dengan rata-rata tertimbang dair input, yakni tenaga labor dan capital. Human capital diperkaya dengan internet dan internet merupakan physical capital yang sangat berkembang pada revolusi Industri 4.0.~~

Pertumbuhan internet namoaknya memainkan peran yang lebih penting dalam meningkatkan produktivitas factor hijau di Cina (Li, T., Han, D., Ding, Y., & Shi, Z.,2020). Green Total Factor Productivity merupakan pilihan yang tak terelakkan untuk secara berkesu=inambungan menignkatkan kualitas ekonomi China, dan juga promote global development. Sejumlah factor seperti Internet development, human capital, urbanization, energy efficiency, and external dependence all exert a positive influence on China's green total factor productivity

Song, Y., & Liu, H. (2020) menunjukkan bahwa internet memperbaiki TFT di sejumlah pelabuhan Sungai Yangtze. Juga ditemukan bahwa pengembangan internet pada area dengan tingkat perkembangan ekonomi yang lebih rendah memperbaiki TFT. Pengembangan internet relevan untuk pembangunan ekonomi.

Zelenyuk, V. (2014) mengembangkan sebuah kerangka kerja menguji dan mendapat signifikansi dari dampak teknologi informasi dan komunikasi pada distribusi produktivitas tenaga kerja pada negara berkembang pada tahun 1980-1995. Internet of Things (IoT) merupakan sebuah innovational complemetary pada ICT dan berimplikasi pada pertumbuhan Total Factor Productivity (Edquist, H., Goodridge, P., & Haskel, J. ,2021).

Jika internet merupakan factor pertumbuhan eknomi, maka studi ini memeplajari factor-faktor yang memperngaruhi pertumbuhan dan pemakaian internet.

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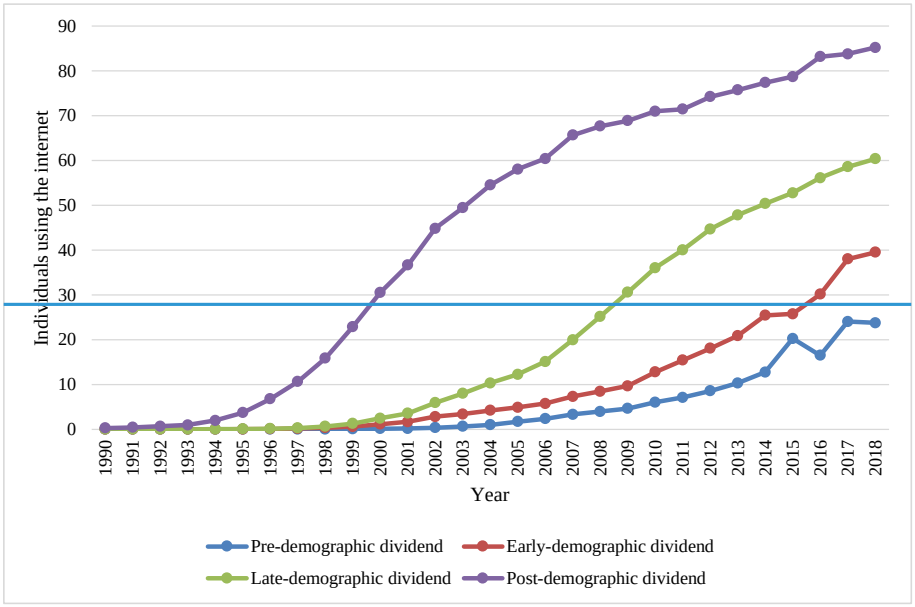

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~~Figure 2~~

~~Individuals Using the Internet (% of population) by the Demographic Dividend Typology~~

~~Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.~~

~~The use of internet and access to digital devices are continuously increasing in all parts of the world (Horn & Rennie 2018). For example, in Sarawak in Borneo island, Malaysia, a number of remote villages were lack of infrastructure, such as asphalt road and electricity network. But, a number of people had a mobile phone and internet access.~~

Salahuddin and Alam (2015) studied the association between the internet usage~~, electricity consumption,~~ and economic growth in Australia. They found ~~that~~ bidirectional causal link

between ~~higher electricity consumption was associated with higher electricity consumption~~internet usage and economic growth.

Stork et al. (2013) analyzed internet access and use trends in some African countries in 2007/2008 and 2011/2012. They found that the use of internet increased very significantly in these countries despite of some barriers, such as large-scale computers and expensive connectivity costs. In addition, mobile phone had been used as key entry point to internet use. As a result, the internet penetration increased by 11.5% in these countries from 2007/2008 to 2011/2012.

Meanwhile, Nigeria experienced economic growth as an impact of ICT business and telecommunication liberalization during the 2000s (Akinwale et al. 2018). There was a co-integration between ICT and economic growth in the long run. In the short run, only with secure internet server per 1 million and mobile cellular subscription per 100 people resulted in positive and significant impact on economic growth.

Gholizadeh et al. (2014) studied the relationship between gross domestic product (GDP) and internet use in some ASEAN countries during 1996–2011. They found that there was a positive and significant association between internet use and GDP, although there were differences between those ASEAN countries. Meanwhile, a study by Bahrini & Qaffas (2019) in the Middle East and North Africa (MENA) and Sub-saharan Africa (SSA) found that ICT, i.e. mobile phone, internet usage, and broadband adoption were the main driver of economic growth during 2007–2016.

Internet fosters economic growth (Jiménez et al. 2014). An increase of 10% in internet connectivity was found to boost up GDP growth by 1.38% in the world. In OECD countries, high internet access generated GDP by 2%.

Meanwhile, Salahuddin et al. (2016) studied the effects of internet and real GDP on social capital creation measured by trust in Australia during 1985–2013. They found that internet increased social capital in the short run, but reduced social capital in the long run. In addition, there was a short and long run positive relationship between internet and GDP per capita.

Not only in developing countries that internet affects economic growth. Amiri & Reif (2013) in their study in Nordic region found that in countries with highest internet penetration there was an association between highest internet penetration and highest GDP per capita in the world.

Internet penetration is determined by a number of factors. Feng (2015) studied the factors influencing internet penetration in China. It was found that internet penetration was mainly affected by internet access cost, internet content, and GDP per capita.

Meanwhile, a study by Lera-Löpez et al. (2011) found that socioeconomic, demographic, and regional factors influenced internet use. The use of internet was primarily associated with education, age, occupation, employment in service sector, nationality, living in urban areas, and regional GDP per capita. They also found that internet use was positively related with broadband connection and education, while internet skill was influenced by gender and population size.

The relationship between inflation and internet use has also been studied. Yi & Choi (2005) found that internet improved productivity and reduced inflation. An increase of 1% in the ratio of the internet users to total population reduced inflation from 0.04264% point to 0.13193% point. Subsequently, inflation has a positive effect on internet demand.

The new economic theory proposed that humankind is entering an era with high output growth, low unemployment, and low inflation (Meijers, 2006). It is described that inflation suppresses internet growth and on the other side, internet will increase inflation in the long run. Sharma et al. (2014) studied the relationship between inflation and internet use through online shopping in India. They found that inflation had an indirect effect on internet growth.

Choi (2003) investigated the effects of internet on the volume of inward foreign direct investment (FDI). Internet was assumed to boost up higher FDI through productivity improvement. Using 53 FDI recipient country data and FDI gravity equation it was found that when the number of hosts and internet users in a country increased by 10%, FDI inflow increased by more than 2%.

The international community supports developing countries by building up digital infrastructure and regulation in order to be able to participate in international trade, in particular through larger diversification series in export. The study by Gnangnon (2020) using panel data from 131 countries during 1995–2014 found that greater internet access was positively associated with export diversification in particular both in less developed and developed countries. Internet access creates innovation level of a country, merchandise export including its concentration export products, and the size of inflow FDI. The results of this study emphasized the need of digital infrastructure development and regulation that facilitate access to the internet.

Pradhan et al. (2017) also studied the association between FDI, economic growth, and use of communication technology in 21 Asian countries during 1965–2012. Communication technology included fixed telephone, mobile phone, and internet use and service including fixed broadband. The results of the study show that there was a positive association between FDI, economic growth, and communication technology. Using the Granger causality analysis, these three variables were positively related.

A study on the association between FDI and internet use in 10 ASEAN countries had been carried out (Ramdan et al. 2020). It was found that higher internet use was associated with higher FDI. A 1% increase in FDI was associated with a 0.0681 increase in internet use.

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Based on the above literature review, ~~this study aims to investigate the association between demographic and economic factors with internet use in the world. I~~it is hypothesized that higher internet use is associated with higher demographic dividend typ~~ology~~e, higher access to electricity, higher GDP, lower inflation, and higher FDI.

~~2.~~3. Data and Methods

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This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The countries and study period were selected based on the availability of data on variables used in the study. In addition, the selected countries were classified by demographic dividend type by the World Bank (Appendix Table A).

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The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the type of demographic dividend (TDD) which was a categorical variable (=0 if pre, =1 if early, =2 if late, and =3 if post). Therefore, there were three (3) dummy variables for TDD, that is *EarlyDD* (=1 if early, =0 otherwise), *LateDD* (=1 if late, =0 otherwise), and *PostDD* (=1 if post, =0 otherwise), and pre-demographic dividend was the reference category. Meanwhile, the economic variables included access to electricity (% of population, *Electric*), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

This study employed panel data analyses. The econometric model used was a fixed effects regression model using income level group, regional group, and year as identifiers. This model was also carried out based on G20 country group and income level group. The proposed model in this study was as follows.

$$Internet_{it} = \beta_0 + \beta_{11} EarlyDD_{it} + \beta_{12} LateDD_{it} + \beta_{13} PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

This fixed effects regression model still had endogeneity problem and measurement errors in the variables used. The demographic dividend type can influence internet use and on the other hand internet use can affect the demographic dividend type. In addition, the demographic dividend type is endogenous, that is a variable that is influenced by other variables. Therefore, other approaches were employed as robustness checks using the static generalized method of moment (GMM). This GMM is a simultaneous model between an endogenous variable and instrument or exogenous variables in the first stage regression and an endogenous model between the dependent variable and independent variables in the second stage regression. The instrument variables used consisted of crude death rate (deaths per 1,000 people, CDR), population density (population per km^2, Density), and crude birth rate (births per 1,000 people, CBR).

The first stage regression model was as follows.

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$$TDD_{it} = \alpha_0 + \alpha_{11}CDR_{it} + \alpha_{12}Density_{it} + \alpha_{13}CBR_{it} + \alpha_2 Electric_{it} + \alpha_3 \ln(GDP)_{it} + \alpha_4 Inflation_{it} + \alpha_5 FDI_{it} + \varepsilon$$

The second stage regression model was as follows.

$$Internet_{it} = \beta_0 + \beta_{11}EarlyDD_{it} + \beta_{12}LateDD_{it} + \beta_{13}PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

The endogenity problem can result in biased and inconsistent estimates when there is lag in dependent variable. This problem can be solved by employing the dynamic panel GMM model. Arellano and Bond (1991) proposed the GMM approach. There are two reasons of applying GMM approach. First, GMM is a common estimator that gives a framework for comparison and evaluation. Second, GMM gives simple alternative to other estimators in particular maximum likelihood.

However, GMM estimators also have some limitations. First, GMM estimator is asymptotically efficient if the sample size is large, but inefficient if the sample size is finite. Second, the estimator sometimes needs a number of programming implementation so that it needs software that can support GMM approach application.

There are three estimation methods that are commonly used in GMM framework, that is first-differences GMM (FD-GMM) or Arellano-Bond GMM (AB-GMM), system GMM (SYS-GMM), and "difference" and "system" GMM dynamic panel estimator. This study employed "difference" and "system" GMM dynamic panel estimator to analyze the estimators. This model was selected because the demographic dividend type was time invariant and the model can solve this problem.

~~This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the typology of demographic dividend that consisted of pre-, early- (*EarlyDD*), late- (*LateDD*), and post-demographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. Meanwhile, the economic variables included access to electricity (% of population,~~

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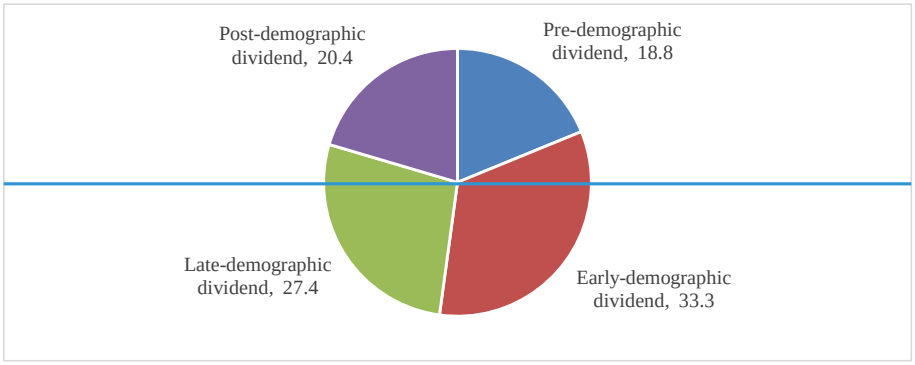
Electric), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

Data in this study were analyzed using univariate, bivariate, and multivariate analyses. For the univariate analysis, the percentage distribution of countries by the demographic dividend typology and the summary statistics (the number of observations, the mean, standard deviation, minimum, and maximum) of the continuous variables in the model were given. For the bivariate analysis, the average percentage of individuals using the internet by the demographic dividend typology and simple regression analyses between the internet use and economic variables were performed. For the multivariate analysis, a multiple regression with random effects was carried out to investigate the demographic and economic determinants of internet use in countries in the world during 2001–2017. The model was as follows.

$$Internet = \beta_0 + \beta_{11}EarlyDD + \beta_{12}LateDD + \beta_{13}PostDD + \beta_2 Electric + \beta_3 \ln(GDP) + \beta_4 Inflation + \beta_5 FDI + \varepsilon$$

3.4. Results

The results of univariate analysis are presented in Figure 3 and Table 1. It can be seen from Figure 3 that the majority of countries in the world were in early demographic dividend typology (33.3%), followed by in late demographic dividend typology (27.4%), in post-demographic dividend typology (20.4%), and in pre-demographic dividend typology (18.8%). Meanwhile, it can be seen from Table 1, the percentage of individuals using the internet ranged from none in Timor-Leste in 2001 to almost universal of 98.3% in Iceland in 2017 and the percentage of population with access to electricity varied from a low of 0.53% in Liberia in 2001 to universal, 100%, in Iceland in 2017. Further, the GDP constant ranged between US$143.2 thousand in Kiribati in 2001 and US$17.4 trillion in the United States in 2017, the annual inflation (consumer prices) varied from a low of -18.1% in Bhutan in 2004 to a high of 359.9% in the Democratic Republic of Congo in 2001, and the current net inflows foreign direct investment differed from -58.2% in Luxembourg in 2007 to 56.5% in Malta in 2007.



Source: World Bank (2021) (Author's compilation).

Figure 3

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

Table 1

Summary Statistics of Variables in the Model: Number of Observation, Mean, Standard Deviation, Minimum, and Maximum

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Individuals using the Internet (% of population)	3,162	30.5	28.3	0.0	98.3
Access to electricity (% of population)	3,162	78.3	30.6	0.53	100.00
GDP (constant 2010 US$)	3,162	347.0 billion	1,334.6 billion	143.2 thousand	17.4 trillion
Inflation, consumer prices (annual %)	3,162	6.0	11.3	-18.1	359.9
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	18.0	-58.2	56.5

Source: World Bank (2021) (Author's compilation).

The results of bivariate analysis are displayed in Figure 4 – Figure 8. These are the average percentage of individuals using the internet by the demographic dividend typology (Figure 4) and the scatter diagrams, simple regression equations and lines, and coefficient determinations between each independent variable in the model and the dependent variable (Figure 5–8). It can be seen from Figure 4 that the average percentage of individuals using the internet was

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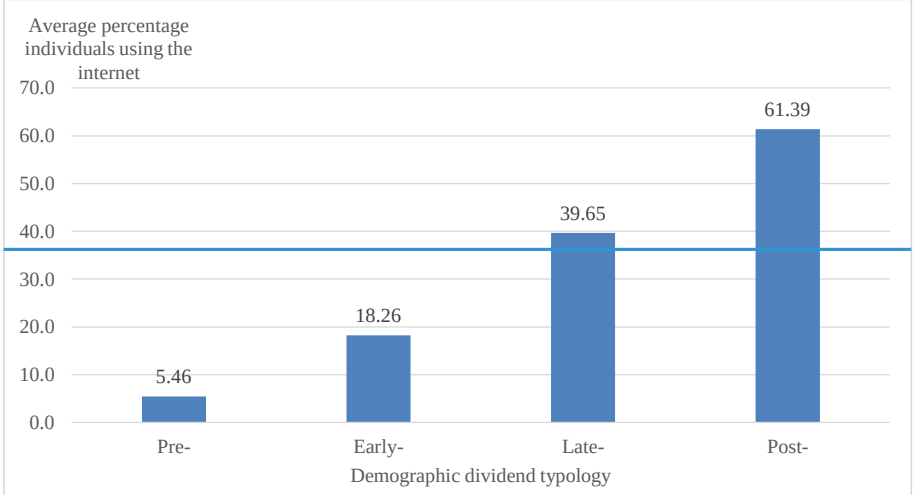
lowest in pre-demographic dividend typology countries (5.5%) and highest in post-demographic dividend typology countries (61.5%).

Figure 5 shows that there was a positive relationship between access to electricity and internet use. An increase of one percent in population with electricity was related with an increase of about 0.56% in the individuals using the internet. The coefficient of determination was 0.366 indicating that 37% of the variation in the individuals using the internet can be explained by the variation in the access to electricity.

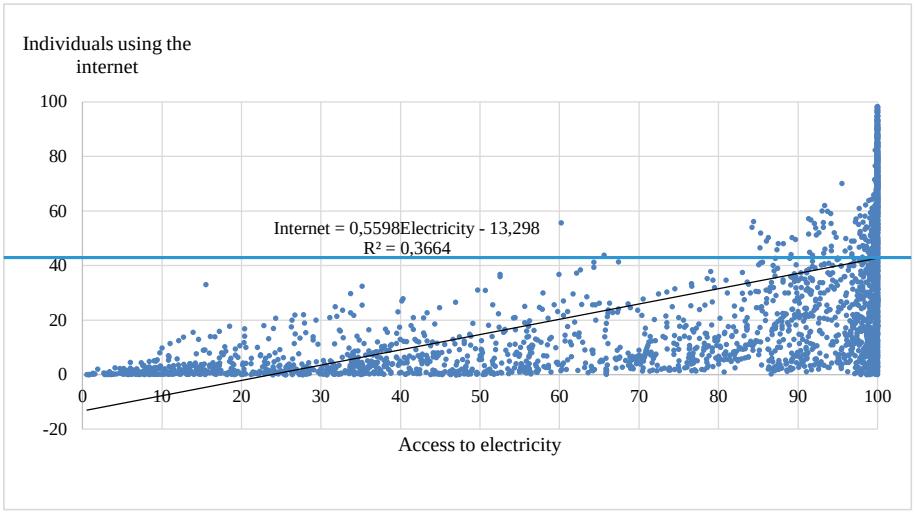
Figure 6 shows that there was a positive relationship between ln(GDP) and internet use. An increase of one percent in economic growth (GDP constant 2010) was correlated with an increase of about 0.35% in the individuals using the internet. The coefficient of determination was 0.0008 suggesting that ln(GDP) can explain the variation in the individuals using the internet by 0.08%.



Source: World Bank (2021) (Author's compilation).

Figure 4

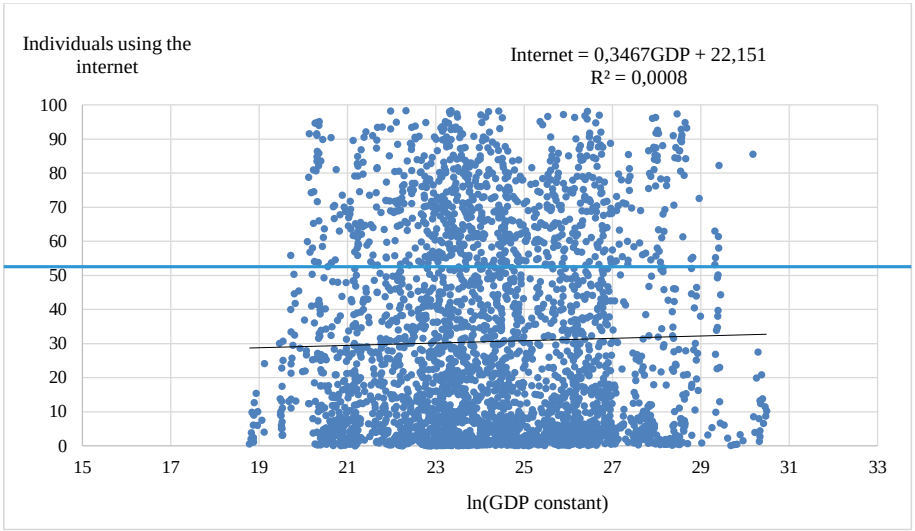
The Average Percentage of Individuals using the internet (% of population) by the Demographic Dividend Typology: World 2001–2017



Source: World Bank (2021) (Author's compilation).

Figure 5

Access to electricity (% of population) and Individuals using the internet (% of population): World 2001–2017

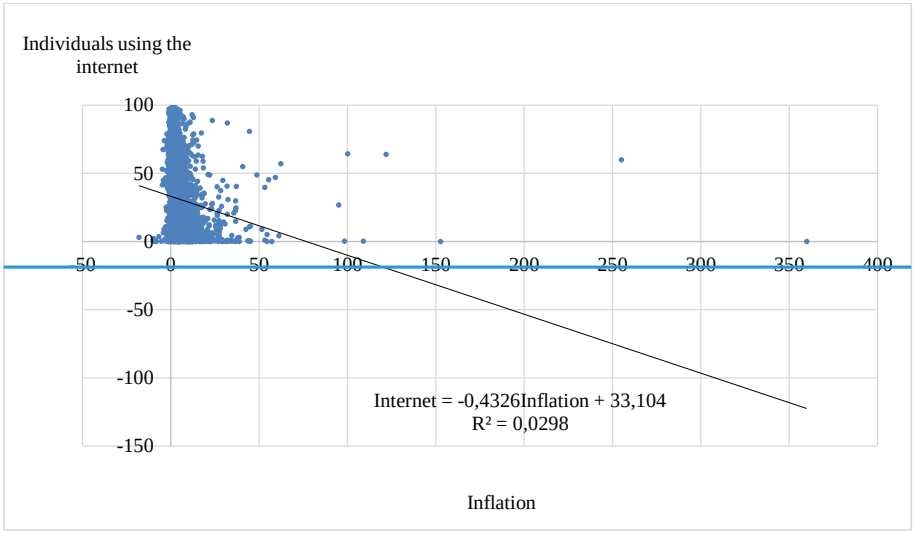


Source: World Bank (2021) (Author's compilation).

Figure 6

ln(GDP constant) and Individuals using the internet (% of population): World 2001–2017

Figure 7 indicates that there was a negative relationship between inflation and internet use. An increase of one percent in inflation was related with a decline of about 0.43% in the individuals using the internet. The coefficient of determination was 0.029 indicating that 2.9% of the variation in the individuals using the internet can be explained by the variation in inflation.

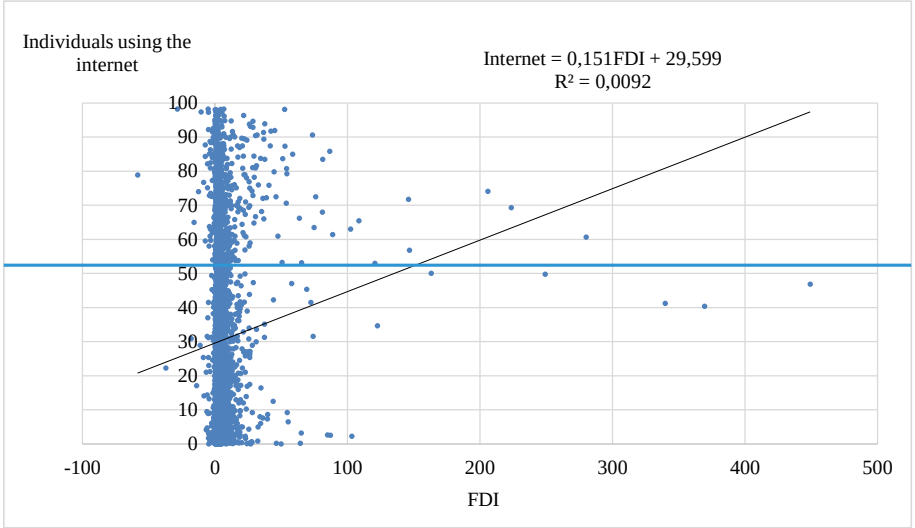


Source: World Bank (2021) (Author's compilation).

Figure 7

Inflation (% annual) and Individuals using the internet (% of population): World 2001–2017

Figure 8 shows that there was a positive relationship between FDI and internet use. An increase of one percent in FDI was correlated with an increase of about 0.009 in the individuals using the internet. The coefficient of determination was 0.009 suggesting that the variation in FDI can explain the variation in the individuals using the internet by 0.9%.

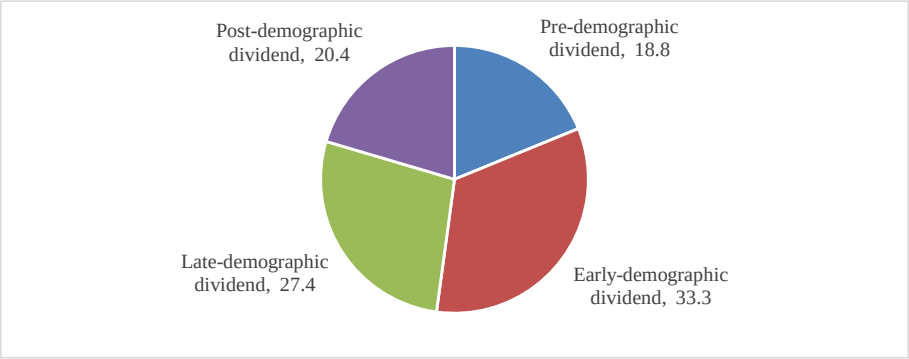


~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 8~~

~~Foreign direct investment (net inflows, % of GDP) and Individuals using the internet (% of population): World 2001–2017~~

It can be seen from Figure 1 the majority of countries in the world were in early-demographic dividend type (33.3%), followed by in late-demographic dividend type (27.4%), in post-demographic dividend type (20.4%), and in pre-demographic dividend type (18.8%). The majority of countries in early-demographic dividend type were African countries, such as Angola, Benin, Chad, Eritrea, Kenya, Niger, Sudan, Togo, Uganda, and Zambia (Appendix Table A). Meanwhile, most developed countries were in post-demographic dividend countries, such as Australia, Belgium, Canada, Denmark, Germany, Japan, Norway, Singapore, United Kingdom, and United States.



Source: World Bank (2021) (Author's compilation).

Figure 1

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

The number of observation and mean of variables used in the study both for full observations and by demographic dividend type was presented in Table 1. It can be seen that there was a significant variation in internet use across countries in the world and across demographic dividend types. The mean of individuals using the internet was 30.5% for full observations, lowest in pre-demographic dividend countries (only 5.5%), 18.3% in early-demographic dividend countries, 39.7% in late-demographic dividend countries, and highest in post-demographic dividend countries (61.4%). Other variables also show disparities in demographic and economic features across countries and demographic dividend types that reflects better development achievement in more developed countries.

Table 1. Number of observations (*n*) and mean of variables in the study for full observation and by demographic dividend type.

	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
Variable	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Individuals using the internet (% of population)	3,162	30.5	595	5.5	1,054	18.3	867	39.7	646	61.4
Access to electricity (% of population)	3,162	78.3	595	31.4	1,054	75.7	867	97.5	646	99.9
GDP (constant 2010 US$)	3,162	3.47E+11	595	2.76E+10	1,054	1.34E+11	867	2.52E+11	646	1.12E+12
Inflation, consumer prices (annual %)	3,162	6.0	595	8.3	1,054	7.10	867	5.0	646	3.2
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	595	4.7	1,054	3.36	867	8.3	646	9.3
Death rate, crude (per 1,000 people)	3,162	8.3	595	10.9	1,054	7.00	867	7.4	646	9.1
Population density (people per sq. km of land area)	3,162	312.5	595	73.3	1,054	162.05	867	140.2	646	1,009.8

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Variable	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
	n	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Birth rate, crude (per 1,000 people)	3,162	22.4	595	39.7	1,054	25.50	867	15.3	646	10.7

Source: World Bank (2021) (Author's compilation).

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The results of diagnostic tests show that the residual approached normal distribution but statistically not normal (Jarque-Bera normality test was 52.24 and χ^2 = 4.5E-12). But, this assumption only applies for certain models. This assumption is not used if random effects regression, GMM, instrumental variables, and two-stage least squares (2SLS) are used.

The results of multicollinearity test show that there was no variance inflation factor (VIF) that was greater than 10. The mean of VIF was 2.650. In addition, there was no pairwise correlations that was greater than 0.5. It means there was no multicollinearity indication in the model.

There was heteroscedasticity in the model. χ^2 = 1,726.32 and Prob > χ^2 = 0.000. This problem was solved by using STATA application by making the model that improved standard errors (robust standard errors).

The results of Chow test show that fixed effects model was better than pooled least squares model (F(3, 3151) = 181.13, Prob > F = 0.000). In addition, the results of Hausman test show that fixed effects model was better than random effects model (χ^2 = 817.94 and Prob > χ^2 = 0.000). Further, the results of Breusch and Pagan Lagrangian multiplier test show that random effects model was better than pooled least squares model.

The results of fixed effect regression using income level group, regional group, and year as identifiers show that in general demographic dividend had significant positive association with internet use (Table 2). After controlling for the economic features, the percentage of individuals using the internet was, respectively 6.5%–21% higher and 15%–39% higher in late-demographic dividend and post-demographic dividend countries than in pre-demographic dividend countries. This finding supported the results of a study by Lera-López et al. (2011) and Myovella et al. (2021) that found the role of demographic factor in increasing internet use in the world. More favorable demographic features, including being a late- and post-

demographic dividend country, had been an important factor of better development that could enhance access to information and communication technology including internet use.

Table 2 Results of Fixed Effects Regression based on Identifier.

	Identifier		
Covariates	Income level group	Regional group	Year
Early-Demographic Dividend	0.317	1.398	4.409***
	(1.221)	(1.425)	(0.921)
Late-Demographic Dividend	6.507***	14.398***	21.101***
	(1.542)	(1.749)	(1.588)
Post-Demographic Dividend	15.142***	30.349***	39.005***
	(1.721)	(1.939)	(0.691)
Access to electricity (% of population)	0.216***	0.290***	0.161***
	(0.021)	(0.022)	(0.035)
Inflation, consumer prices (annual %)	-0.115***	-0.176***	-0.070
	(0.028)	(0.030)	(0.051)
log(gdpconstant2010us)	1.650***	1.958***	1.666***
	(0.166)	(0.183)	(0.059)
Foreign direct investment, net inflows (% of GDP)	0.017	0.048**	0.052***
	(0.018)	(0.019)	(0.015)
Constant	-30.610***	-49.345***	-37.480***
	(4.017)	(4.340)	(4.490)
Observations	3,162	3,162	3,162
R-squared	0.165	0.340	0.656
Fixed effects in income level group	Yes	No	No
Fixed effects in regional group	No	Yes	No
Fixed effects in year	No	No	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: World Bank (2021) (Author's compilation).

~~Before a multiple regression was conducted, the multi-collinearity between the variables in the model were checked. It was found that there was no collinearity between variables in the model, except between the demographic dividend typology and electricity where the Spearman correlation coefficient was slightly above 0.7 (0.71). However, this did not have serious effects on the results of the regression. The results of the multiple fixed effects regression are given in Table 2. These include the regression coefficient, standard errors, and *p* value for each covariate. All covariates in the model had significant effects on internet use statistically. The coefficient of variation was 0.540 implying that 54.0% of the variation in the internet use could be explained by the model with a significance level below 0.001.~~

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~~The demographic dividend typology was positively associated with the internet use. Late- and post-demographic dividend countries had higher percentage of individuals using the internet than pre-demographic dividend countries. After controlling for the effects of economic factors, the percentage of individuals using the internet was, respectively, 13.0% and 29.7% higher in the late- and post-demographic dividend countries than in the pre-demographic dividend countries. This result supports the finding by Lera López et al. (2011) on the importance of demographic factors on internet use. Countries with more advanced demographic change, that is late- and post-demographic dividend typology had lower fertility levels and better economic development achievement so that individuals in these countries were more likely to have exposed to better development, including access internet than individuals in pre- and early-demographic dividend typology countries.~~

Access to electricity ~~was the strongest factor that affected~~ influenced internet use positively. The higher the percentage of population who had access to electricity, the higher the percentage of individuals using the internet. Other things being the same, an increase of one percent in the access to electricity was related to an increase of ~~0.27%~~ 0.161% – 0.290% in the internet use. This finding is in accordance with the finding by Myovella et al. (2021) ~~Salahuddin and Alam (2015)~~ that found the positive association between ~~internet use and~~ electricity consumption and internet use. Access to electricity can boost the electricity-based economic activity and in today's industrial internet of things era, it is a key factor of internet use since the internet cannot be used without electricity.

Economic growth ~~was~~ had ~~the second strongest factor of and had a~~ positive effect on the internet use. The higher the economic growth, the higher the percentage of internet use. Ceteris paribus, an increase of one percent in economic growth was associated with an increase of internet use by ~~4.6~~1.650% – 1.958%. This result supports the study result by Pradhan et al. (2017) and Amaluddin (2020) that found a positive relationship between economic growth and internet use. Economic growth allows a country to expand its economy that today heavily depends on the internet and hence increases internet use.

Inflation had a negative relationship with the percentage of individuals using the internet. The higher the inflation in a demographic dividend typology, the lower the percentage of individuals using the internet. After controlling for the effects of other factors, an increase of

one percent in inflation was associated with a decline of the percentage of individuals using the internet by 0.1~~8~~15% – 0.176%. This finding confirms the results of study by Yi & Choi (2005) that found a negative association between inflation and internet use. This is because ~~I~~inflation is a contributor of cost and price rise including internet cost that reduces internet use through the decline in people's purchasing power including purchasing the internet because of the price rise across the economies.

Foreign direct investment (FDI) had a positive influence on internet use. The higher the FDI, the higher the internet use. An increase of one percent in FDI was related with an increase of the percentage of individuals using the internet by 0.0485% –0.052% . This results strengthens the study finding by Gnangnon (2020) and Ramdan et al. (2020) that found a positive relationship between FDI and internet use through the capital ~~addition~~ accumulation in an economy that can increase individuals' access to the internet use.

The results of the above analyses also show that 16.5%–65.6% of variation in internet use was explained by demographic dividend type and economic features.

The above results still had heteroscedasticity and endogeneity effects problem. To obtain consistent and robust results, this study conducted robustness checks by employing other approaches and different sub-samples. The results were as follows.

This study presented the results of analyses employing fixed effects, random effects, and pooled least square model. The results of the three models gave consistent results that demographic dividend type had positive effects on internet use significantly. The percentage of individuals using internet was 13%–14% and around 30% higher in, respectively, late- and post-demographic dividend countries than in pre-demographic dividend countries (Table 3). In addition, higher percentage of individuals using internet was associated with higher percentage of access to electricity, economic growth, and FDI and associated with lower inflation. A one percent increase in, respectively, access to electricity, economic growth, FDI, and inflation was associated with, respectively, an increase of about 0.3%, 2%, and 0.05% individuals using internet and a decline of 0.2% individuals using internet.

Table 3. Comparison between the results of fixed effects, random effects, and pooled least square model.

Covariate	(1) Fixed Effects	(2) Random Effects	(3) Pooled Least Square
Early-Demographic Dividend	1.398	-0.917	-0.917
	(1.425)	(1.288)	(0.734)
Late-Demographic Dividend	14.398***	12.957***	12.957***
	(1.749)	(1.614)	(1.344)
Post-Demographic Dividend	30.349***	29.737***	29.737***
	(1.939)	(1.708)	(1.513)
Access to electricity (% of population)	0.290***	0.273***	0.273***
	(0.022)	(0.020)	(0.015)
Inflation, consumer prices (annual %)	-0.176***	-0.178***	-0.178**
	(0.030)	(0.030)	(0.079)
Log(gdpconstant2010us)	1.958***	2.010***	2.010***
	(0.183)	(0.179)	(0.181)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.051***	0.051**
	(0.019)	(0.019)	(0.025)
Constant	-49.345***	-47.954***	-47.954***
	(4.340)	(4.061)	(4.027)
Observations	3,162	3,162	3,162
R-squared	0.340		0.549
Number of id_regional	Yes	No	No

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 4, the results of analyses of fixed effects regressions for full observation and by income group were presented. It can be seen that the results were consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the effect of demographic dividend was largest in upper middle income countries and insignificant in high income countries.

Table 4. Results of Fix Effects Regression for full observation and by income level.

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	1.398		-0.429	3.168**	11.689***
	(1.425)		(0.986)	(1.351)	(3.587)
Late-Demographic Dividend	14.398***	-0.635		6.025***	20.667***
	(1.749)	(3.713)		(1.942)	(3.846)

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	(1)	(2)	(3)	(4)	(5)
Covariate	Full Observation	High Income	Low Income	Lower Middle Income	Upper Middle Income
Post-Demographic Dividend	30.349***	4.907		4.133	15.432***
	(1.939)	(3.909)		(3.655)	(4.449)
Access to electricity (% of population)	0.290***	1.950***	0.201***	0.322***	0.717***
	(0.022)	(0.487)	(0.019)	(0.024)	(0.089)
Inflation, consumer prices (annual %)	-0.176***	-0.746***	-0.004	-0.086*	-0.093*
	(0.030)	(0.180)	(0.014)	(0.046)	(0.049)
lgdpconstant2010us	1.958***	1.524***	1.687***	0.438*	0.763**
	(0.183)	(0.423)	(0.252)	(0.245)	(0.323)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.018	0.027	0.014	-0.321***
	(0.019)	(0.024)	(0.027)	(0.089)	(0.119)
Constant	-49.345***	-174.760***	-38.590***	-20.003***	-70.770***
	(4.340)	(48.125)	(5.630)	(5.709)	(10.270)
Observations	3,162	1,020	442	833	867
R-squared	0.340	0.071	0.286	0.258	0.155
Number of id_regional	7	6	5	6	6

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table 5, the results of analyses of fixed effects regression for full observation and by year were presented. It can be seen that the results were also consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the percentage of individuals using internet was significantly higher in early-demographic dividend countries than in pre-demographic dividend countries in 2007–2012 and in 2013–2017 with an increasing effect.

Table 5. Results of Fixed Effects Regression for Full Observations and by Year.

	(1)	(2)	(3)	(4)
Covariate	All Observation	2001-2006	2007-2012	2013-2017
Early-Demographic Dividend	1.398	0.118	3.289*	6.819***
	(1.425)	(1.638)	(1.839)	(1.965)
Late-Demographic Dividend	14.398***	9.510***	19.678***	25.449***
	(1.749)	(2.046)	(2.267)	(2.387)
Post-Demographic Dividend	30.349***	28.334***	38.265***	37.249***
	(1.939)	(2.283)	(2.500)	(2.631)
Access to electricity (% of population)	0.290***	0.083***	0.212***	0.430***
	(0.022)	(0.025)	(0.030)	(0.035)

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Inflation, consumer prices (annual %)	-0.176***	-0.078***	-0.494***	-0.027
	(0.030)	(0.027)	(0.068)	(0.042)
lgdpconstant2010us	1.958***	1.418***	1.648***	1.782***
	(0.183)	(0.216)	(0.234)	(0.244)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.088***	0.028	0.093**
	(0.019)	(0.023)	(0.020)	(0.039)
Constant	-49.345***	-32.532***	-36.721***	-48.902***
	(4.340)	(5.022)	(5.601)	(6.037)
Observations	3,162	1,116	1,116	930
R-squared	0.340	0.407	0.502	0.535
Number of id- regional	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS model used CDR, population density, and CBR as instrumental variables. The results of diagnostic test for instrumental variable in 2SLS and GMM model show that F(1, 3154) = 69.68, which was greater than 10, and Prob > F = 0.0000, meaning that the models had strong instrumental variables. In addition, the results for first stage regression show that Sanderson-Windmeijer (SW) first-stage chi-squared and F statistic was significant, meaning that all instrument variables were relevant or valid to explain the endogeneous variable (demographic dividend type). The results of the first stage regression of 2SLS model were presented in Table 6.

Table 6. The Results of First Stage Regression of 2SLS Model.

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
Death rate, crude (per 1,000 people)	-0.0447***	-0.00571**	0.0305***
	(0.00269)	(0.00246)	(0.00187)
Population density (people per sq. km of land area)	-2.33E-05***	-4.35E-05***	5.07E-05***
	(5.24E-06)	(4.80E-06)	(3.64E-06)
Birth rate, crude (per 1,000 people)	0.0137***	-0.0152***	-0.0213***
	(0.00145)	(0.00133)	(0.00101)
Access to electricity (% of population)	0.00213***	0.00244***	-0.00227***
	(0.000547)	(0.000501)	(0.000380)
Inflation, consumer prices (annual %)	0.00278***	0.000831	-0.00246***
	(0.000687)	(0.000629)	(0.000477)
lgdpconstant2010us	-0.0215***	-0.0476***	0.0490***
	(0.00383)	(0.00351)	(0.00266)
Foreign direct investment, net inflows (% of GDP)	-0.00216***	0.000313	0.000781***
	(0.000432)	(0.000396)	(0.000300)
Constant	0.755***	1.629***	-0.586***

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
	(0.125)	(0.115)	(0.0871)
Observations	3,162	3,162	3,162

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of second stage regression for full observations and based on income group were given in Table 7. It can be seen that the 2SLS method results for full observations were also consistent with the previous results. The percentage individuals using the internet was significantly higher in early-, late-, and post-demographic dividend countries than in pre-demographic dividend countries, but with much higher percentages than in the previous models. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI. By income group, demographic dividend type had significant positive effects on internet use in low and high income countries.

Table 7. The Results of Second Stage Regression for Full Observations and based on Income Group

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	33.32***		7.684***	-4.024	266.7
	(5.728)		(1.429)	(3.523)	(495.7)
Late-Demographic Dividend	34.63***	58.57***		10.17	83.94
	(4.269)	(11.17)		(9.063)	(115.5)
Post-Demographic Dividend	60.09***	49.14***		-5.432	390.4
	(5.328)	(7.119)		(10.67)	(720.7)
Access to electricity (% of population)	0.0335	-0.772	0.0599***	0.242***	1.181
	(0.0357)	(0.715)	(0.0177)	(0.0431)	(1.712)
Inflation, consumer prices (annual %)	-0.180***	-1.225***	-0.00716	-0.107**	-0.877
	(0.0350)	(0.232)	(0.0160)	(0.0500)	(1.596)
lgdpconstant2010us	2.134***	4.411***	1.267***	0.179	5.844
	(0.332)	(0.764)	(0.291)	(0.268)	(9.764)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.0319	0.0416	-0.0174	4.808
	(0.0232)	(0.0274)	(0.0305)	(0.133)	(10.14)
Constant	-55.96***	-22.53	-27.04***	-4.932	-433.5

	(6.753)	(57.65)	(6.542)	(7.799)	(765.6)
Observations	3,162	1,020	442	833	867
R-squared	0.422	-0.064	0.193	0.259	-25.924

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2

The Coefficients, Standard Error, and *p*-value of multiple regression of the determinants of individuals using the internet: World 2001–2017

Individuals using the internet (% of population)	Coefficient (95% CI)	Standard error	*p*-value
Demographic dividend typology			
Pre-	Reference		
Early-	-0.917 (-3.442, 1.608)	1.288	0.476
Late-	12.957 (9.793, 16.121)	1.614	< 0.001
Post-	29.738 (26.389, 33.087)	1.708	< 0.001
Access to electricity (% of population)	0.273 (0.234, 0.311)	0.020	< 0.001
ln(GDP constant)	4.627 (3.819, 5.435)	0.412	< 0.001
Inflation, (annual %)	-0.178 (-0.238, -0.118)	0.030	< 0.001
Foreign direct investment, net inflows (current US$)	0.051 (0.014, 0.089)	0.019	0.008
Constant	-48.992 (-56.945, -41.039)	4.056	< 0.001

In this study, the comparison between the results of fixed-effects regression and 2SLS method based on G20 and non-G20 group was also carried out. The results were presented in Table 8. It can be seen that the results were consistent with the previous results that demographic dividend type had significant positive influence on internet use both in non-G20 and G20 countries.

Table 8. The Results of Second Stage Regression based on G20 Country Group.

	(2)	(3)	(4)	(5)
	Non-G20 countries		G20-countries	
Covariate	Fixed Effects	2SLS	Fixed Effects	2SLS
Early-Demographic Dividend	29.82***	1.945		
	(5.812)	(1.935)		
Late-Demographic Dividend	32.61***	15.23**	0.0687	0.105
	(3.882)	(4.467)	(9.069)	(2.700)
Post-Demographic Dividend	56.73***	28.52***	37.58***	31.35**
	(5.297)	(4.097)	(4.276)	(11.99)
Access to electricity (% of population)	0.0490	0.284**	0.934***	1.936*
	(0.0335)	(0.0806)	(0.164)	(0.898)
Inflation, consumer prices (annual %)	-0.163***	-0.162	-0.620***	-0.619*
	(0.0346)	(0.140)	(0.235)	(0.317)
lgdpconstant2010us	2.635***	2.367*	-0.742	0.926

Covariate	(2) Non-G20 countries Fixed Effects	(3) Non-G20 countries 2SLS	(4) G20-countries Fixed Effects	(5) G20-countries 2SLS
	(0.304)	(0.930)	(1.743)	(2.186)
Foreign direct investment, net inflows (% of GDP)	0.0752***	0.0528	-0.135	-0.334
	(0.0227)	(0.0502)	(0.681)	(0.470)
Constant	-66.32***	-58.68**	-35.65	-176.3
	(6.717)	(20.34)	(52.39)	(96.33)
Observations	2,839	2,839	323	323
R-squared	0.414	0.317	0.598	0.480
Number of id_regional		6		7

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS method by year was also done. The results were presented in Table 9. It can be seen that the results were also consistent with the previous results that demographic dividend type had significant positive influence on internet use in all years. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI in all years.

Table 9. The Results of Second Stage Regression by Year.

Covariate	(1) Full observation	(2) 2001-2006	(3) 2007-2012	(4) 2013-2017
Early-Demographic Dividend	33.32***	14.754***	31.418***	50.229***
	(5.728)	(4.870)	(7.580)	(10.606)
Late-Demographic Dividend	34.63***	19.456***	37.989***	52.855***
	(4.269)	(4.548)	(5.539)	(7.230)
Post-Demographic Dividend	60.09***	41.210***	60.701***	76.687***
	(5.328)	(4.867)	(6.973)	(10.030)
Access to electricity (% of population)	0.0335	-0.014	0.023	0.014
	(0.0357)	(0.034)	(0.048)	(0.075)
Inflation, consumer prices (annual %)	-0.180***	-0.060**	-0.623***	-0.079
	(0.0350)	(0.030)	(0.085)	(0.064)
lgdpconstant2010us	2.134***	1.750***	2.132***	1.914***
	(0.332)	(0.397)	(0.429)	(0.503)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.101***	0.062**	0.135**
	(0.0232)	(0.026)	(0.025)	(0.060)
Constant	-55.96***	-43.695***	-52.040***	-47.861***
	(6.753)	(8.003)	(8.643)	(10.402)

Observations	3,162	1,116	1,116	930
R-squared	0.422	0.548	0.613	0.518

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

~~Source: World Bank (2021) (Author's compilation). Note: CI = confidence interval.~~

~~4.~~5. Conclusions

In this study the nexus between demographic and economic features with internet use in countries during 2001–2017 was investigated. A fixed effects regression model using income level group, regional group, and year as identifiers was employed to study the association between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use. Robustness checks were also carried out using the static generalized method of moment between the type of demographic dividend and instrument variables (crude death rate, population density, and crude birth rate) in the first stage regression and between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use in the second stage regression.

The results of this study confirms the previous studies on the nexus between demographic and economic features with internet use (e.g. Filippova and Turutina (2015); Sharma et al. (2015); Baumann et al. (2017); Pradhan et al. (2017); Scheerder et al. (2017); ~~Wang et al. (2019);~~ Singh et al. (2020); Bianchini et al. (2021); Myovella et al. (2021); Yesuf (2021)). It was found that internet use was higher in countries from late- and post-demographic dividend type. Meanwhile, access to electricity, economic growth, and foreign direct investment had a positive association with internet use and inflation was negatively associated with internet use.

Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries, in particular countries in the pre- and early-demographic dividend type, should manage its demographic features to the more favorable ones, i.e. lower fertility and mortality. In addition, the window of opportunity due to the decline of fertility and mortality should be capitalized in order to reap the demographic dividend of economic growth and family welfare acceleration by improving access to quality health, education, and employment opportunity. Regarding economic features, in order to

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foster internet use, government of countries should improve access to electricity, raise economic growth, reduce inflation, and enhance foreign direct investment.

Limitations

A limitation of this study is that the demographic dividend type was a time invariant variable, while other variables were time variant. However, this limitation should not significantly affect the findings and this study still provides an essential contribution to the study of internet usage. So, it is suggested that further research on the determinants of internet usage should employ time variant demographic change variable.

~~5. The results of this study confirms the previous studies on the nexus between demographic change and economic features with internet use. Countries from post-demographic dividend typology with better access to electricity, higher economic growth, lower inflation, and higher foreign direct investment had higher internet use. Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries should manage its demographic change, increase access to electricity, improve economic growth, reduce inflation, and enhance foreign direct investment.~~

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Appendix

Table A

Countries in the Study by Demographic Dividend ~~Country~~Type

No	Pre-Demographic Dividend	Early-Demographic Dividend	Late-Demographic Dividend	Post-Demogrpaphic Dividend
1	Afghanistan	Algeria	Albania	Antigua and Barbuda
2	Angola	Argentina	Armenia	Australia
3	Benin	Bahrain	Aruba	Austria
4	Burkina Faso	Bangladesh	Azerbaijan	Barbados
5	Burundi	Belize	Bahamas, The	Belarus
6	Cameroon	Bhutan	Brazil	Belgium
7	Central African Republic	Bolivia	Brunei Darussalam	Bosnia and Herzegovina
8	Chad	Botswana	Chile	Bulgaria
9	Comoros	Cabo Verde	China	Canada
10	Congo, Dem. Rep.	Cambodia	Colombia	Croatia
11	Congo, Rep.	Djibouti	Costa Rica	Cuba
12	Cote d'Ivoire	Dominican Republic	Cyprus	Czech Republic
13	Equatorial Guinea	Ecuador	Estonia	Denmark
14	Eritrea	Egypt, Arab Rep.	Fiji	Finland
15	Gambia, The	El Salvador	Georgia	France
16	Guinea	Eswatini	Guam	Germany
17	Guinea-Bissau	Ethiopia	Guyana	Greece
18	Iraq	Gabon	Iceland	Hong Kong SAR, China
19	Kenya	Ghana	Ireland	Hungary
20	Liberia	Grenada	Jamaica	Italy
21	Madagascar	Guatemala	Kazakhstan	Japan
22	Malawi	Haiti	Kuwait	Korea, Rep.
23	Mali	Honduras	Kyrgyz Republic	Lithuania
24	Mauritania	India	Latvia	Luxembourg
25	Mozambique	Indonesia	Lebanon	Macao SAR, China
26	Niger	Iran, Islamic Rep.	Malaysia	Malta
27	Nigeria	Israel	Mauritius	Netherlands
28	Senegal	Jordan	Moldova	New Zealand
29	Sierra Leone	Kiribati	Mongolia	Norway
30	Sudan	Lao PDR	Montenegro	Portugal
31	Tanzania	Lesotho	Morocco	Singapore
32	Timor-Leste	Libya	North Macedonia	Slovenia
33	Togo	Maldives	Oman	Spain
34	Uganda	Mexico	Poland	Sweden
35	Zambia	Micronesia, Fed. Sts.	Puerto Rico	Switzerland
36		Myanmar	Qatar	Ukraine
37		Namibia	Romania	United Kingdom
38		Nepal	Russian Federation	United States
39		Nicaragua	Serbia	
40		Pakistan	Seychelles	
41		Panama	Slovak Republic	
42		Papua New Guinea	Sri Lanka	
43		Paraguay	St. Lucia	
44		Peru	St. Vincent and the Grenadines	
45		Philippines	Thailand	
46		Rwanda	Trinidad and Tobago	
47		Samoa	Tunisia	

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48		Saudi Arabia	United Arab Emirates	
49		Solomon Islands	Uruguay	
50		South Africa	Vietnam	
51		Suriname	Virgin Islands (U.S.)	
52		Syrian Arab Republic		
53		Tajikistan		
54		Tonga		
55		Turkey		
56		Turkmenistan		
57		Uzbekistan		
58		Vanuatu		
59		Venezuela, RB		
60		West Bank and Gaza		
61		Yemen, Rep.		
62		Zimbabwe		

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Heliyon

The Demographic and Economic Features: The Nexus with Internet Use

--Manuscript Draft--

Manuscript Number:	HELIYON-D-21-11053R3
Article Type:	Original Research Article
Section/Category:	Social Sciences
Keywords:	Demographic dividend type; economic determinants; internet use; fixed effects
Manuscript Classifications:	140: Social Sciences
Corresponding Author:	Wilson Rajagukguk, Ph.D. Universitas Kristen Indonesia Jakarta Timur, Jakarta INDONESIA
First Author:	Wilson Rajagukguk, Ph.D.
Order of Authors:	Wilson Rajagukguk, Ph.D.
Abstract:	The goal of this study was to examine the nexus between demographic dividend type and economic features with internet use. The data source was from the World Development Indicator of the World Bank. The unit analysis was country. The panel data analysis method were used for the examination, employing fixed effects regression models using country income level, country regional group, and year as identifiers. The random effects regression model, pooled least square model, and static generalized method of moments were utilized for robustness checks. The dependent variable was the percentage of population using the internet. The independent variables consisted of demographic and economic variables. The demographic variable was the demographic dividend type, while the economic variables were access to electricity, GDP, inflation rate, and foreign direct investment. The results of fixed effects regression indicate that after controlling for the economic features, higher internet use in a country was associated with late- and post-demographic dividend type. Higher internet use was also associated with higher access to electricity, higher GDP, lower inflation rate, and higher foreign direct investment inflow. Robustness checks using random-effects and pooled least square models, using fixed-effects model by country income level, using two-stage least square, and using second stage regression by G20 and non-G20 country group division and year, similarly gave consistent results. The association of internet use with the demographic and economic features may imply that population-based and economic development program should be enhanced toward the favorable ones that increase internet usage among the population.
Opposed Reviewers:	

Manuscript. Number.: HELIYON-D-21-11053R1

Title: The Demographic Change and Economic Features: The Nexus with Internet Use

Journal: Heliyon

Dear Wilson,

Thank you for submitting your manuscript to Heliyon. We have completed the review of your manuscript and a summary is appended below. The reviewers recommend major revisions are required before publication can be considered. If you are able to address all reviewer comments in full, I invite you to resubmit your manuscript. We ask that you respond to each reviewer comment by either outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism.

This should be carried out in a point-by-point fashion as illustrated here: https://www.cell.com/heliyon/guide-for-authors#Revisions.

To allow the editors and reviewers to easily assess your revised manuscript, we also ask that you upload a version of your manuscript highlighting any revisions made. You may wish to use Microsoft Word's Track Changes tool or, for LaTeX files, the latexdiff Perl script (https://ctan.org/pkg/latexdiff).To submit your revised manuscript, please log in as an author at https://www.editorialmanager.com/heliyon/, and navigate to the "Submissions Needing Revision" folder.

Your revision due date is May 24, 2022.We understand that the COVID-19 pandemic may well be causing disruption for you and your colleagues. If that is the case for you and it has an impact on your

ability to make revisions to address the concerns that came up in the review process, please reach out to us. I look forward to receiving your revised manuscript.

Kind regards,

Romanus Osabohien

Associate Editor - Business & Economics

Heliyon

Editor and Reviewer comments:

Reviewer 3: Methods:
Author did not discuss the countries of study and their regions rationale for selecting them need to be explained.

Author: Thank you very much for the comments. A table of list of countries of the study has been added in Appendix Table A. The discussion about the countries also has been added in line 329–334.

Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?"
Author did not understand this question, therefore did not give appropriate response.
The question is, Did you use the original data as it is or you transformed the data using natural log?

Author: Thank you very much for the comments. The Author used the original data for all variables, except for GDP where natural log was used as explained in the models in line 282–283 and 297–303.

Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature.

Author: Thank you very much for the comments.

As stated in Section 1 (Introduction) that there was a significant inequality in access to the internet across countries in the world.

The Author was interested to study the factors of this inequality in the internet use with a hope that it will contribute to the understanding of the determinants of internet use as well as to improve access to the internet use as a part of sustainable development goals (SDGs).

Author did not understand this question, therefore did not give appropriate response,
The question is, why did you decided to use variables like; information technology, typology of pre-, early- (EarlyDD), late- (LateDD), and postdemographic dividend (PostDD) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.

Author: Thank you very much for the comments.

The Author chose the demographic and economic features as the independent variables. Demographic dividend type was selected as demographic feature, while access to electricity, GDP, inflation, and FDI as economic features. The types of demographic dividend were based

on Ahmed et al. (2016) in line 89–103 and the availability of the data from the World Bank.

Study on the role of demographic change on development, including access to information and communication technology was limited. Therefore, the Author chose this variable as the independent variable. The selection of electricity, GDP, inflation, and FDI as economic features was based on the literature review and availability of data.

Results:

Interpretation:
Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing.
(i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation

Author: Thank you very much for the comments. The Conclusion has been revised as in line 506–533.

Other comments:
One of the reviewer comment is:

(1) The introductory section is meant to introduce the study, the gap and set pace for the remaining sections.

Author: Thank you very much for the comments. The gap and pace for remaining sections have been added, respectively in line 115–118 and 127–129.

(2) This section has failed to link the three key variables, demographic change, economic features and internet usage.

Author: Thank you very much for the comments. This study focused on (1) the association between demographic change and internet and (2) the association between economic features and internet. The links of these variables have been added in line 79 – 87.

Author(s) did not introduce any gap or set pace for the remaining section,
To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … "

To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c.

Author: Thank you very much for the suggestions. The gap and pace for remaining sections have been added, respectively, in line 115–118 and 127–129.

Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.

Author: Thank you very much for the suggestions. The gap has been added in line 127–129.

Reviewer 4: Methods: The conceptualization and operationalization of this study are problematic. This study has shown a low degree of novelty. No clear problem statement nor research gap is highlighted. No details of data collection.

Author: Thank you very much for the suggestions. The gap has been added in line 115–118.

Results: Therefore, I am not convinced by the findings.

Author: Thank you very much for the suggestions. The findings have been improved by conducting robustness checks in line 426–503.

Interpretation: The interpretation of the findings is rather weak and not rigorous.

Author: Thank you very much for the suggestions. The interpretation of findings has been improved in line 375–492.

Other comments: Need to highlight the theoretical and practical of this study.

Author: Thank you very much for the suggestions. The theoretical and practical of this study have been added in line 121 –125.

Reviewer 5: Methods: The method used is descriptive method using documentary analysis. However, the documents analyzed did not cover countries included in the sample respondents. The analysis of findings would have been more comprehensive and exciting to readers if name of countries were included in the findings.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Results: The results of the study is comprehensive, however if there is labelling of countries included in the variables it would have more exciting.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Interpretation: The interpretation based from statistical analysis of the document is comprehensive.

Author: Thank you very much for the comments.

Other comments: Labelling countries in the demographic typology is recommended.

Author: Thank you very much for the suggestions. The list of countries in the study has been added in Appendix Table A.

Reviewer 6: Methods:

Results:

Interpretation:

Other comments:

Reviewer 8: Methods: The methods employed by the author(s) are suitable. However, there is need to first specify the implicit function of

the model before the explicit function. In addition, the specified model is not correctly specified without the subscript 'it'. It looks more like a time series model.

Author: Thank you very much for the comments. The models have been revised in line 282–283 and 297–303.

Results: The results are adequately explained. Although there is a need for theoretical framework to link all parts of the study.

Author: Thank you very much for the comments. Theoretical framework to link all parts of the study have been added in, for example, line 372–373.

Interpretation: The explanation still lacks theoretical basis.

Author: Thank you very much for the comments. Theoretical basis has been added in, line 79–87.

Other comments: The issues raised by the author(s) are important and adequately addressed, but poor grammatical expressions alter the correct discussion of findings in the study. I hereby suggest a thorough editing by an expert in English language writing to edit the manuscript before publication.

Reviewer 9: Methods:
The process of subject selection was clear.
The variables were defined and measured appropriately.
The study methods were valid and reliable.
There is enough detail to replicate the study.

Author: Thank you very much for the comments.

Results:
The text in the results added to the data.
A statistically significant result was clear.
A practically meaningful result was clear.

Interpretation:
was clear

Author: Thank you very much for the comments.

Other comments:

Reviewer 10: Methods: clear enough; it needs more appropriate reasoning in choosing GMM estimator.

Author: Thank you very much for the comments. Reasoning in choosing GMM estimator has been addressed in line 285–290.

Results: clear enough

Author: Thank you very much for the comments.

Interpretation: Still using the old references for justifying the findings.

Author: Thank you very much for the comments. Recent references for justifying the findings have been added in line 79–87.

Other comments:

*****

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I

MANUSCRIPT TITLE: The Demographic Change and Economic Features: The Nexus with Internet Use

MANUSCRIPT NUMBER: HELIYON-D-21-11053

General Comment	(1) I WASN'T PART OF THE ORIGINAL REVIEWER OF THIS MANUSCRIPT (2) MOST OF THE COMMENTS BY THE ORIGINAL REVIEWERS (ESPECIALLY REVIEWER II) WAS NOT EFFECTED BY THE AUTHOR(S)	Author	Note Line
Title			
Abstract			
1. Introduction	One of the reviewer comment is: (1) The introductory section is meant to introduce the study, the gap and set pace for the remaining sections. (2) This section has failed to link the three key variables, demographic change, economic features and internet usage. Author(s) did not introduce any gap or set pace for the remaining section, To introduce gap in a research work, author(s) need to start with a sentence like this, "A summary of the reviewed literature revealed that no study on …. had been carried out using ….. in order to address the gap indicated above this study sought to determine the … "	Thank you for the comments. Research gap has been added.	105–108

	To set pace for the remaining section, author(s) should provide a statement like this, "the remainder of the paper is organized as follows. In section 2.0, Data and Method was presented, section three provided the … e.t.c. Almost all the reviewers requested for the significance or motivation of this study. This can only be stated if the gaps in existing literature can be clearly highlighted.	The statement has been added. Research gap has been added.	113–115 105–108
2. Literature Review			
3. Data and Method	Author did not discuss the countries of study and their regions rationale for selecting them need to be explained: Reviewer 1 asked, "Are you use the test on series of log return series or original series? Clarify?" Author did not understand this question, therefore did not give appropriate response. The question is, Did you use the original data as it is or you transformed the data using natural log? Reviewer 1 commented that, "The paper lacks a clear justification of the variables used in the empirical section and should include updated/recent literature.	Thank you for the comments. The list of countries in the study by demographic dividend type has been added in Appendix Table 1. The author used original series. The justification of the variables used was provided in Section 2 (Literature Review)	

	Author did not understand this question, therefore did not give appropriate response, The question is, why did you decided to use variables like; information technology, typology of pre-, early- (*EarlyDD*), late- (*LateDD*), and postdemographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. The economic variables, access to electricity, gross domestic product, inflation, consumer prices and foreign direct investment net inflows.	As stated in Section 1 (Introduction) that there was a significant inequality in access to the internet across countries in the world. The Author was interested to study the factors of this inequality in the internet use with a hope that it will contribute to the understanding of the determinants of internet use as well as to improve access to the internet use as a part of sustainable development goals (SDGs). The Author chose the demographic and economic features as the independent variables. Demographic dividend type was selected as demographic feature, while access to electricity, GDP, inflation, and FDI as economic features. The types of demographic dividend were based on Ahmed et al. (2016) in line 82–96 and the availability of the data from the World Bank. Study on the role of demographic change on development, including access to	

		information and communication technology was limited. Therefore, the Author chose this variable as the independent variable. The selection of electricity, GDP, inflation, and FDI as economic features was based on the literature review and availability of data.	
4. Results and Discussion			
6. Conclusion and Recommendation	Up till now the conclusion is not well written. Authors(s) should follow this format for conclusion writing. (i) brief background, (ii) key findings, (iii) their implications, and (iii) suggestions/recommendation	Thank you for the suggestions. Conclusion has been revised.	487–514
References			

Rating of the manuscript: Use (1 = Excellent) (2 = Very Good) (3 = Average) (4 = Fair) (5 = poor)

Originality	4
Contribution To The Field	4
Technical Quality	5
Clarity of Presentation	4
Depth Of Research	4

Recommendation: Please, mark with an X

Accept As It Is	

Minor Corrections	
Moderate Revision	
Major Revision	**X**
Reject (Give Reasons)	

Paper title: The Demographic Change and Economic Features: The Nexus with Internet Use **Aim(s):** Reviewing
DOI: HELIYON-D-21-11053R1 **Review due date:** 11 / 4 /2022

Section	Points to Ponder	Review comments and notes

Abstract, title and references	• Is the aim clear?
	• Is it clear what the study found and how they did it?
	• Is the title informative and relevant?
	• Are the references:
	  ◦ Relevant?
	  ◦ Recent?
	  ◦ Referenced correctly?
	  ◦ Are appropriate key studies included?
		The aim is clear.
		The study was founded explicitly.
		The title was informative and relevant. The references
		• Were relevant.
		• Recent.
		• Not referenced correctly
		Author: Thank you very much for the comment. The references have been corrected.
		• Appropriate studies were included.

Introduction/ background	• Is it clear what is already known about this topic? • Is the research question clearly outlined? • Is the research question justified given what is already known about the topic?	This topic is known clearly in this article. The research question is clearly outlined. The research question was justified.
Methods	• Is the process of subject selection clear? • Are the variables defined and measured appropriately? • Are the study methods valid and reliable? • Is there enough detail in order to replicate the study?	The process of subject selection was clear. The variables were defined and measured appropriately. The study methods were valid and reliable. There is enough detail to replicate the study.

Results	• Is the data presented in an appropriate way?
	  ◦ Tables and figures relevant and clearly presented?
	  ◦ Appropriate units, rounding, and number of decimals?
	  ◦ Titles, columns, and rows labelled correctly and clearly?
	  ◦ Categories grouped appropriately?
	• Does the text in the results add to the data or is it repetitive?
	• Are you clear about what is a statistically significant result?
	• Are you clear about what is a practically meaningful result?
		The data was presented appropriately.
		• Tables were relevant and clearly presented.
		• Units, rounding, and number of decimals were appropriate.
		• Titles, columns, and rows were labelled correctly and clearly.
		• Categories were grouped appropriately. The text in the results added to the data.
		A statistically significant result was clear.
		A practically meaningful result was clear.

Discussion and Conclusions	• Are the results discussed from multiple angles and placed into context without being over interpreted? • Do the conclusions answer the aims of the study? • Are the conclusions supported by references or results? • Are the limitations of the study fatal or are they opportunities to inform future research?	The results were discussed from multiple angles and placed into context with being interpreted. The conclusions have answered the aims of the study. The conclusions were supported by results only. The limitations of the study are opportunities to inform future research. Author: Thank you very much for the comments. The limitations

		of the study have been addressed in line 534–539.
Overall	• Was the study design appropriate to answer the aim? • What did this study add to what was already known on this topic? • What were the major flaws of this article? • Is the article consistent within itself?	The study design was appropriate to answer the aim. This study adds to what was already known more knowledge on this topic. There were minor flaws in this article in reference mistakes only. The article consistent was within itself.

Structure your comments into a full review:

Overall statement or summary of the article and its findings in your own words	Minor errors start with an uncompleted some words, punctuation, incorrect references, and some misspelled words. Author: Thank you very much for the comments. Minor errors have been corrected.
Overall **strengths** of the article and what **impact** it might have in your field	The strength of the article lies in the way it works to study and cite sober sources and participating institutions.
Specific comments on **weaknesses** of the article and what could be done to improve it	Major points in the article which needs clarification, refinement, reanalysis, rewrites and/or additional information and suggestions for what could be done to improve the article. 1. Wrong words. Author: Thank you very much for the comments. Wrong words have been corrected. Minor points like figures/tables not being mentioned in the text, a missing reference, typos, and other inconsistencies. 1. Wrong citation. 2. Typos. Author: Thank you very much for the comments. Wrong citation and typos have been corrected.

References should be corrected.

United Nations. (2021). The Sustainable Development Goals Report 2021.

World Bank, 2021, World Development Indicator.

Author: Thank you very much for the comments. References have been corrected.

The Demographic ~~Change~~ and Economic Features: The Nexus with Internet Use

Wilson Rajagukguk

Faculty of Economic and Business, Universitas Kristen Indonesia

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Abstract

The goal of this study was to examine the nexus between demographic ~~change~~ dividend type and economic features with internet use. The data source was from the World Development Indicator of the World Bank. The unit analysis was country. The ~~P~~panel data analysis method~~s~~ were used for the examination, employing fixed effects regression models using country income level, country regional group, and year as identifiers~~, random effects regression, and pooled least square models~~. ~~The unit analysis was country.~~ The random effects regression model, pooled least square model, and static generalized method of moments ~~and two stage least square~~ were utilized ~~as~~ for ~~the~~ robustness checks. The dependent variable was the percentage of population using the internet. The independent variables consisted of demographic and economic variables. The demographic variable was the demographic dividend typ~~ology~~e, while the economic variables were access to electricity, GDP, inflation rate, and foreign direct investment. The results of fixed effects regression indicate that ~~using country income level, country regional group, and year as identifiers and~~ after controlling for the economic features, higher internet use in a country was associated with late- and post-demographic dividend ~~typology~~type. Higher internet use was also associated with higher access to electricity, higher GDP, lower inflation rate, and higher foreign direct investment inflow. ~~The r~~Robustness checks using random-effects and pooled least square models, using fixed-effects model by country income level, using two-stage least square, and using second stage regression by G20 and non-G20 country group division and year, similarly gave consistent results. The association of internet use with the demographic and economic features may imply that population-based and economic development program should be enhanced toward the favorable ones that increase internet usage among the population.

Key words: Demographic dividend typ~~ology~~e, economic determinants, internet use, fixed effects.

1. Introduction

The world is marked by a considerable inequality in human development achievement. The United Nations Development Programme (UNDP) reported that in 2019 the human development index (HDI) varied greatly from a lowest of 0.394 in Niger to a highest of 0.957 in Norway (UNDP, 2020). This disparity could be attributed to the inequity in access to digital technology, including broadband internet.

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Widespread access to broadband internet is a key driver of human development. Improving access to the internet is also identified as an instrument to achieve the Sustainable Development Goals (SDGs) in goal 4 (Quality education), goal 9 (Industry, innovation, and infrastructure), and goal 17 (Partnership for the Goals). Internet allows people to be connected, work, shop, and study especially during the COVID-19 pandemic lockdowns (United Nations, 2021).

Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.

The World Bank (2022) estimated that increasing internet penetration from 35% to 75% of the population in all developing countries could increase about US$2 trillion to their joined gross domestic product and generate more than 140 million works around the world. However, there wasere a great inequality in the internet access across the world.

The World Bank (2021) reported that in 2019, among 174 countries in the world where the data was available, this access varied greatly across countries, lowest in Burundi (5.2%) and almost universal in Bahrain (99.7%).

Information and communication technology (ICT), in particular internet, is a most developed business and business product in this century. The study of ICT encounters economists and demographers with two sides, as consumers and producers. ~~As it can be seen from Figure 1,~~ ~~t~~There was a rapid increase of internet consumers in the world. The percentage of internet users in the world from 1990–2018 increased from 0% in 1990 to 51% in 2018 only in 28 years. The time trends of the percentage of internet users was not the linear one, but the power one. Therefore, the internet business is a promising one.

~~Improving access to the internet is also identified as an instrument to achieve the Sustainable Development Goals (SDGs) in goal 4 (Quality education), goal 9 (Industry, innovation, and infrastructure), and goal 17 (Partnership for the Goals). Internet allows people to be connected, work, shop, and study especially during the COVID-19 pandemic lockdowns (United Nations 21). However, there were a great inequality in the internet access across the world.~~

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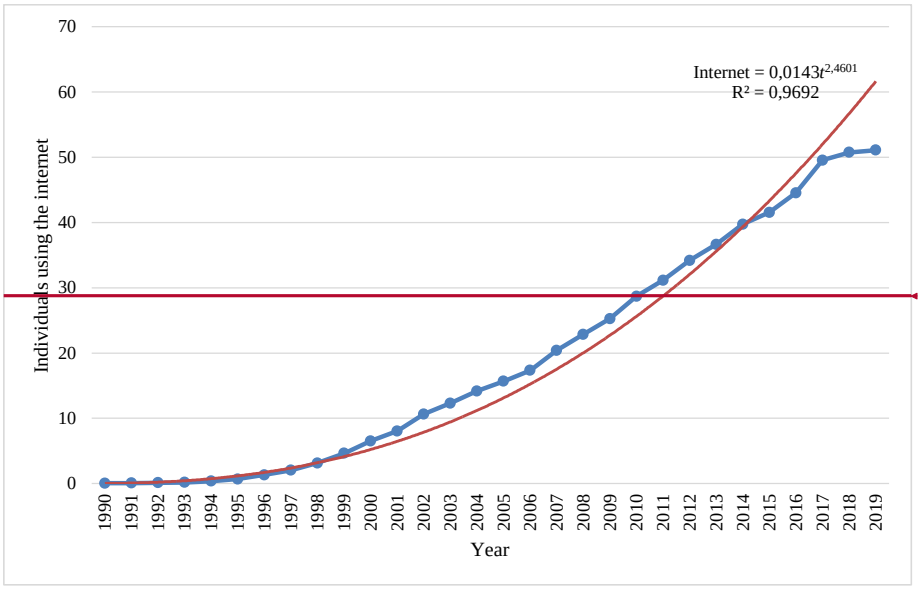

~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 1~~

~~Individuals Using the Internet (% of population): World 1990-2018~~

On the other hand, decline in fertility and mortality level and change in migration patterns have caused countries to experience demographic change that has been related to demographic dividend. ~~-~~Demographic dividend is economic growth as the results of changes in age structure in a country due to the decline in family size and longer life that cause increase in the percentage of productive age population aged 15–64 years old. As a result, lower investment is needed for young population aged 0–14 years old. At the same time, productive age population increases that open the window of opportunity to accelerate economic growth and family welfare. At micro level, this demographic transition can result in family living standard improvement and higher income. At macro level, demographic transition can affect economic development in a country.

It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including economic and information and communication technology development. Demographic change of fertility and mortality decline could help create a period

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of sustainable economic growth as happened in some East Asian economies (e.g. Bloom et al., 2020; Amornkitvikai, Y. et al., 2022, Hosan et al., 2022, Liu and McKibbin, 2022). The mechanism of growth that is the policy area is through public health, family planning, economic policy that promote labor market flexibility, trade openness, and saving. The government of countries has window of opportunity to capitalize productive age population to reap the demographic dividend of economic growth and family welfare acceleration. This economic growth then enables countries to enlarge their heavily internet-based economies and consequently rises internet usage (Pradhan et al., 2017; Anuj, et al. 2018; Amaluddin 2020).

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Bonus demografi adalah pertumbuhan ekonomi yang merupakan hasil dari perbuahan struktur umur sebuah negara, perubahan dari sebuah keluarga yang besar berumur pendek menjadi keluarga kecil dan berumur berumur lebih panjang.

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Karena perubahan dalam distwribusi umur, diperlukan investasi yang lebih sedikit untuk membangun penduduk kelompok usia mudda dan kemudian sumberdaya yang lebih besar digunakan untuk pembangunan (economic gift). Berbarengan dengan hal tersebut, Angkatan kerja bertumbuh lebih cepat (more rapidly) dibandingkan dengan penduduk yang tergantung padanya menciptakan sebuah jendela kesempatan percepatan pertumbuhan ekonomi dan kesejahteaan keluarga. Dalam skala mikro, transisi ini dapat berbuahkan dalam perbaikan standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.

Ahmed et al. (2016) grouped countries into four demographic dividend ~~typology~~ type based on the demographic change and economic development achievement. The demographic dividend typology is classified as the pre-, early-, late-, and post-demographic dividend. Countries with a fertility level above four children per woman, increasing percentage of working age population (15–64 years), and low income level are categorized as the pre-demographic dividend countries. Meanwhile, countries with a fertility level between 2.1 and four children per woman, increasing percentage of working age population, and low-middle and middle-high income level are categorized as the early-demographic dividend countries. Further, countries with a fertility level below 2.1 children per woman, increasing percentage of working age population, and high income level are also categorized as the early-demographic

dividend countries. Furthermore, countries with a fertility level between 2.1 children and four per woman, declining percentage of working age population, and low, low-middle, and middle-high income level are categorized as the late-demographic dividend countries. Lastly, countries with a fertility level below 2.1 children per woman, decreasing percentage of working age population, and high income level are categorized as the post-demographic dividend countries.

~~It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including information and communication technology development. As it can be seen from Figure 2, t~~There wa~~i~~s a significant difference in the percentage of internet users and its trends across the demographic dividend typologies. The percentage of internet users was consistently highest in the post-demographic dividend countries, followed by in the late- and early-demographic dividend countries, and lowest in the pre-demographic dividend countries. ~~It also can be seen that during 1990–2018 t~~The percentage of internet users during 1990–2018 increased more rapidly in more developed countries, the post-demographic dividend typology countries.

The determinants of internet use have been proposed (e.g. Scheerder et al. 2017). These include demographic and socioeconomic factors. The association between demographic and economic features and information and communication technology has also been studied (e.g. Bianchini et al. 2021; Yesuf, -2021; Singh et al. 2020; Baumann et al. 2017). However, a summary of the reviewed literature revealed that no study on demographic dividend type and internet use had been carried out. In order to address the gap indicated above, in general this study sought to

~~Bonus demografi adalah pertumbuhan ekonomi yang merupakan hasil dari perbuahan struktur umur sebuah negara, perubahan dari sebuah keluarga yang besar berumur pendek menjadi keluarga kecil dan berumur berumur lebih panjang.~~

~~Karena perubahan dalam distwribusi umur, diperlukan investasi yang lebih sedikit untuk membangun penduduk kelompok usia mudda dan kemudian sumberdaya yang lebih besar digunakan untuk pembangunan (economic gift). Berbarengan dengan hal tersebut, Angkatan kerja bertumbuh lebih cepat (more rapidly) dibandingkan dengan penduduk yang tergantung padanya menciptakan sebuah jendela kesempatan percepatan pertumbuhan ekonomi dan kesejahteaan keluarga. Dalam skala mikro, transisi ini dapat berbuahkan dalam perbaikan~~

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standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.

Espinoza Bianchini, G., Navia, P., & Ulriksen Lira, C. (2021) melakukan studi tentang dampak umur, identifikasi ideological pada pemakaian jaringan sosial on line untuk mendapatkan informasi politik. Indikator sosio demographic dan indentifikasi ideologikal, akses serta pemakaiaan jaringan sosial ditemukan mempengaruhi keterlibatan demokratik. Di negara-negara di mana digital divide (akses ke internet) dan digital inequality (penggunaan internet) terjadi berdampingan (Coexist), dampak indikator sosio-demografis lebih kuat, karena mereka yang memiliki lebih sedikit alat dan sumber daya mepunyai lebih sedikit akses dan lebih sedikit menggunakan jejaring sosial. untuk keterlibatan demokratis.

Yesuf, K. A. (2021) melakukan studi untuk menginvestigasi determinan sosiodemographic internet dan dampaknya pada perilaku keluarga berencana diantara laki-laki muda (young male) di Ethiopia menggunakan data dari Ethiopia health and demographic survey 2016. Besarnya penggunaan internet di Ethiopia (magnitude of internet use) sebesar 14% berasosiasi dengan dengan pemakaian internet adalah umur 20-24 tahun, tingkat Pendidikan yang tinggi, hidup pada region kota administrative, menggunakan mobile phone, responden yang dapat membaca seluruh kalimat, dan responden yang mempunyai computer dirumah. Responden dengan pekerjaan di sector pertanian dan pekerja manual kurang cenderung menggunakan internet.

Singh, S., Sahni, M. M., & Kovid, R. K. (2020). Melakukan studi bahwa kegunaan yang dirasakan (Perceived usefulness) dan Pengaruh social (social influence) merupakan determinan

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~~kunci niat perilaku menggunakan layanan Fintech. Selanjutnya ditemukan bahwa digital behavior serta karakteristik demografi (umur dan gender) memperkuat hubungan tersebut~~

~~Filippova, I., & Turutina, E. (2015) menggunakan sampel yang merupakan representasi seluruh penduduk Rusia melakukan studi mengukur secara empiris penggunakan internet dalam proses Pendidikan di Rusia. Perbedaan umur dan gender, finansial status, dan tingkat Pendidikan merupakan determinan penggunakan internet untuk tujuan pendidikan.~~

~~Online health information seeking behavior (OHISB) is currently a widespread and common behavior that has been described as an important prerequisite of empowerment and health literacy. Baumann, E., Czerwinski, F., & Reifegerste, D. (2017). Ditemukan bahwa factor demografi seperti status sosio ekonomi, umur, gender merupakan determinan penting untuk OHISB. Wang, J., Xiu, C., & Shahzad, F. (2019) selain faktor kunci untuk OHISB seperti self efficacy, Internet experience, and perceived ease of use, membagi determinan OHISB ke dalam empat kategori yakni demographic characteristic factors, cognitive factors, internal factors, and external factors.~~

~~Sharma, S. K., Govindaluri, S. M., & al Balushi, S. M. (2015) melakukan riset mengekplorasi determinan utama dari pemakai internet banking. Menggunakan Two staged regression ditemukan bawah service qualitu, trust, perceived usefulness, perceive ease of use, attitude and demographic variabels merupakan dterminan internet banking users.~~

~~-->~~

~~Pertumbuhan ekonomi dipengaruhi secara signifikan oleh digitalisaai dan transisi demographi (Zaman, K. A. U. and T. Sarker., 2021). Menggunakan Bangladesh sebagai sebuah case study, Zaman dn Sarker mengadopsi model three-stage least square menganalisis bagaimana digitalisasi, dan transisi demographi mempercepat pertumbuhan ekonomi di Bangladesh.~~

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Setiap kenaikan 1% jumlah pengguna internat, GDP akan meningkat sebesar 0,11%, ceteris paribus. Sementara itu setiap penurunan 10- basis poin dalam dependency ratio akan meningkatkan GDP sebesr 1.2%. Faktor kunci untuk digitalisasi adalah labor participation rate, produktivitas pekerja, dan mobil pentration. Urbanisasi secara bolak-balik mempengaruhi peningkatan pemakai internet. Skor Human Development Index (HDI) dan angka urbanisasi secara negative signifikan berpengaruh pada angka ketergantungan, sementara itu partisipasi perempuan dalam Angkatan kerja mempunyai pengaruh positif.

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Zaman, K. A. U. and T. Sarker. 2021. Demographic Dividend, Digital Innovation, and Economic Growth: Bangladesh Experience. ADBI Working Paper 1237. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/demographicdividend-digital-innovation-economic-growth-bangladesh

Bonus demografi memainkan peran penting sehubungan dengan hampir 850 Juta pelanggan langganan seluler (4 kali penetrasi Internet yang mencapai sekitar 205 Juta) di India (Burragoni, V.,2017). Pasca liberasisasi ekonomi India, pengembangan system perbankan mengalami pertumbuhan yang sama dengan penduduk. Seriring dengan pertumbuhan penduduk, permintaan dan tantangan juga meningkat dalam perkembangan system perbankan dan pembayaran. Untuk mengangani permsalahan ini pemrintah India mendisain sangat banyak strategi untuk meningkatkan ekonomi massa di India. Pemerintah India memulai program inklusi keiangan untuk mendapatkan pertumbuhan yang berkesinambungan melalui isu sosial seperti pengentasan kemiskinan (removing poverty), pendidikan untuk semua, dan well balance society melalui sitem keuangan dapat diperkuat. Seknario ini berbuah banyak (fruitful) karena India mempunyai advantage of demographic advantage, technological advandement, dan financial literacy, penignkatan penetration of Internet technology, dan juga pentration of mobil technology melalui smartphone. Demographic dividden memainkan sebuah peranan krusial. Hal ini mendorong perkembangan dan sebuah kompetisis yang lebih ketat dalam system pembayaran diluar insitusi.

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~~Myovella, G., Karacuka, M., & Haucap, J. (2021) melakukan studi tentang determinants of digitalization and digital divide in Sub-Saharan African economies. Hasil temuannya adalah bahwa GDP per capita, gross capital formation, political stability, regulatory efficacy and electricity infrastructure secara langsung mempengaruhi digital divide. Juga ditemukan bahwa GDP per capita, population growth, government consumption, trade openness, and electricity infrastructure secara tidak langsung mempengaruhi digital divide melalui efek spillover (spillover effects)~~

~~Pertanian merupakan sebuah sector kunci dalam mendorong pertumbuhan eknomi dan pengentasan kemiskiman di Vietnam (Giang, M. H., Xuan, T. D., Trung, B. H., & Que, M. T. ,2019). Produktivitas diukur sebagai Total Factor Productivity. Determinan dari TFT di Vietnam termasuk size and age, share of state and foreign ownership, export, accessibility to Internet and bank loan of firms.~~

~~Teknologi internet telah menjadi perangkat teknologikal esensial untuk individu, organisasi, dan pendorong pertumbuhan serta kemakmuran negara (Isaac, O., Abdullah, Z., Ramayah, T., & Mutahar, A. M.,2018). Negara seperti Yaman dimana terdapat pemakaian internet yang sangat rendah kita lihat mempunyai kemajuan ekonomi, sosial dan kultural yang rendah.~~

~~Pertertumbuhan ekonomi melalui internet kepada keluarga~~

~~Inovasi dan kewirausahaan merupakan factor pendorong penting untuk pertumbuhan ekonomi, dan internet memainkan sebuah peranakan oenting dalam aktivitas kewirausahaan. Menngunakan dataset dari China Family Panel Studies (CFPS) dataset in 2014 and 2016, Tan, Y., & Li, X. (2022) melakukan studi dan menemukan bahwa internet mempunyai pengaruh signifikan dan positif pad kewirausahaan di China. Juga ditemukan bahwa intenet mendorong (promote) kewirausahaan dan menolong pengusaha memperoleh pendanaan informal.~~

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~~Slazus, B. J., & Bick, G. (2022). Factors that Influence FinTech Adoption in South Africa: A Study of Consumer Behaviour towards Branchless Mobile Banking. *Athens Journal of Business & Economics*, *8*(1). https://doi.org/10.30958/ajbe.8-1-3~~

~~Pemakaian luas mobile phot dan pertumbuhan penetrasi internet telah menciptakan sebuah kesempatan unit untuk meningkatkan pelayanan keuangan. Perusaaann Financial Technology (FinTech) dan mobile banking (m-banking) membedayakan konsumen menggunakn platform digital menggunakan jasa finansial tanpa dipelukan akses fisik sebagaimana yang terjadi pada bank tradisional (Slazus, B. J., & Bick, G. ,2022). Pertumbuhan FinTech berdampak pada pertumbuhan ekonomi keluarga dan sebuah bangsa.~~

~~Teknologi ingernet telah memecahkan batas-batas ruang geographical tradisional, mempersingkat jarak tempuh antar wilayah, memaksimisasi integrasi berbagai sumberdaya. Dalam era teknologo digital, perkembangan jaringan internet yang cepat, dapat menghemat pemakaian dan konsumsi energi (Ren, S., Hao, Y., Xu, L., Wu, H., & Ba, N. ,2021).terjadi hbubungan negatif antara pengebangan internet dengan struktur konsumsi energi melalui pertumbuhan ekonomi, investasi R&D, human capital, financial development dan struktur industrial di China.~~

~~Wu, S., Wang, P., & Sun, B. (2022) menggunakan city-level data from China for the period 2003–15 menemukan bahwa internet mempengartuhi disparitas ekonomi antar kota di Chian melalui dampak heterogeneous pada pertumbuhan ekonomi. Internet memperlebar disparitas ekonomi antar kota dengan angka penetrasi internet yang rendah dan kota dengan angka penetrasi internet yang tinggid.~~

investigate the relationship between demographic and economic features and internet use. Specifically, the objectives of this study were to examine the differentials in internet use by demographic and economic features and to analyze the effects of demographic and economic features on internet use. It is hoped that the findings of this study will contribute to the

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understanding of the association between demographic change and economic features and internet usage. In addition, it is hoped that the recommendation from this study will support the government of countries in order to improve internet usage in their countries in order to accelerate their development.

This paper consists of five sections. In Section 2 the related literature was reviewed. Data and methods used in this study were discussed in Section 3. The results of analyses were presented in Section 4. Conclusion of the study was given in Section 5.

2. Literature Review

Bianchini et al. (2021) studied the impacts of age and ideological identification on the use online social network to obtain political information. They found that socio-demographic factors had strong impacts on internet use. Meanwhile, a study in Ethiopia by Yesuf (2021) found higher internet use among those who were aged 20–24 years, had higher education, lived in urban areas, had a mobile phone, literate, had a personal computer, and worked in formal sectors. Further, a study by Singh et al. (2020) found that perceived usefulness and social influence were the key determinants of the use of Fintech services. They also found that age and gender also influenced this behaviour.

The importance of demographic and socioeconomic factors on internet use for health purposes were also found. Studies by Baumann et al. (2017) ~~and Wang et al. (2019)~~ found age, gender, and socioeconomic factors were important determinants of online health information-seeking behaviour.

Studies also found the significance of demographic and socioeconomic determinants in internet use for financial purposes. A study in Russia by Filippova and Turutina (2015) found that age, gender, financial status, and education level were the determinants of internet use for education

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purposes. Meanwhile, Sharma et al. (2015) found the importance of demographic variables in internet use for banking purposes.

A study by Burragoni (2017) found that demographic dividend played an important role in 850 million cellular subscriptions in India. In the post-economic liberalization, banking system development grew together with the population. Together with economic growth, demand and challenges in banking and payment system development also grew.

Myovella et al. (2021) studied the effects of demographic and economic features on digitalization and digital divide in Sub-Saharan African economies. They found that GDP per capita, gross capital formation, trade openness, population growth, and electricity infrastructure influenced digital divide. Meanwhile, low internet use was found related to low economic, social, and cultural development. A study in Yaman by Isaac et al. (2018) found that low internet use was associated with low economic, social, and cultural development. Another study in Indonesia also found the importance of access to electricity in internet use (Amaluddin,-2020).

➔

~~Mungkin salah satu pertanyaan dan yang menyita banyak perhatian dalam literatur ekonomi adalah : mengapa sejumlah negara lebih kaya dibandingkan dengan negara lain" (Solow, 1956). Solow suggested bahwa perbedaan dalam angka pertumbuhan pada akumulasi kapital dapat mengakibatkan perbedaan dalam output per kapital. Selanjutnya Lucas (1988), disparitas dalam human capital merupakan central role dalam analisis pertumbuhan dan perkembangan. Selanjutnya Klenow dan Rodriguez-Clare (1997), Hall and Jones (1999), Parente dan Prescott (2000) dan kemudian Bils dan Klenow (2000) berargumen bahwa perbedaan output per pekerja tidak diakibatkan oleh perbedaan dalam human capital (atau physical capital) tetapi oleh perbedaan dalam sebuah residual yang dinamakan Total Factor Productivity (TFT)~~

~~Total factor productivity (TFP) kemudian merupakan sebuah ukuran produktivitas dihitung dengan membagi total produkis dengan rata-rata tertimbang dair input, yakni tenaga labor dan capital. Human capital diperkaya dengan internet dan internet merupakan physical capital yang sangat berkembang pada revolusi Industri 4.0.~~

Pertumbuhan internet namoaknya memainkan peran yang lebih penting dalam meningkatkan produktivitas factor hijau di Cina (Li, T., Han, D., Ding, Y., & Shi, Z.,2020). Green Total Factor Productivity merupakan pilihan yang tak terelakkan untuk secara berkesu=inambungan menignkatkan kualitas ekonomi China, dan juga promote global development. Sejumlah factor seperti Internet development, human capital, urbanization, energy efficiency, and external dependence all exert a positive influence on China's green total factor productivity

Song, Y., & Liu, H. (2020) menunjukkan bahwa internet memperbaiki TFT di sejumlah pelabuhan Sungai Yangtze. Juga ditemukan bahwa pengembangan internet pada area dengan tingkat perkembangan ekonomi yang lebih rendah memperbaiki TFT. Pengembangan internet relevan untuk pembangunan ekonomi.

Zelenyuk, V. (2014) mengembangkan sebuah kerangka kerja menguji dan mendapat signifikansi dari dampak teknologi informasi dan komunikasi pada distribusi produktivitas tenaga kerja pada negara berkembang pada tahun 1980-1995. Internet of Things (IoT) merupakan sebuah innovational complemetary pada ICT dan berimplikasi pada pertumbuhan Total Factor Productivity (Edquist, H., Goodridge, P., & Haskel, J. ,2021).

Jika internet merupakan factor pertumbuhan eknomi, maka studi ini memeplajari factor-faktor yang memperngaruhi pertumbuhan dan pemakaian internet.

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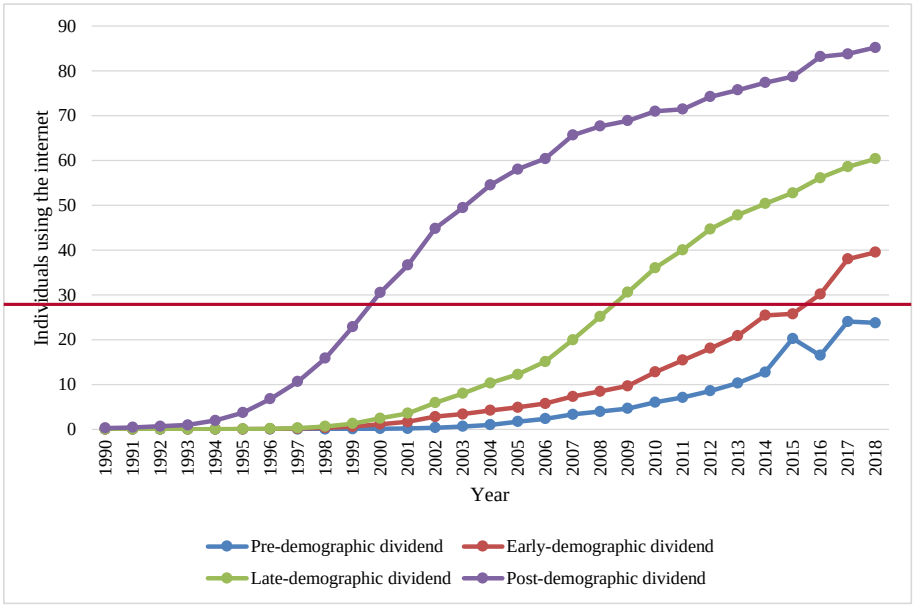

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~~Figure 2~~

~~Individuals Using the Internet (% of population) by the Demographic Dividend Typology~~

~~Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.~~

~~The use of internet and access to digital devices are continuously increasing in all parts of the world (Horn & Rennie 2018). For example, in Sarawak in Borneo island, Malaysia, a number of remote villages were lack of infrastructure, such as asphalt road and electricity network. But, a number of people had a mobile phone and internet access.~~

Salahuddin and Alam (2015) studied the association between the internet usage, ~~electricity consumption,~~ and economic growth in Australia. They found ~~that~~ bidirectional causal link

between ~~higher electricity consumption was associated with higher electricity consumption~~internet usage and economic growth.

Stork et al. (2013) analyzed internet access and use trends in some African countries in 2007/2008 and 2011/2012. They found that the use of internet increased very significantly in these countries despite of some barriers, such as large-scale computers and expensive connectivity costs. In addition, mobile phone had been used as key entry point to internet use. As a result, the internet penetration increased by 11.5% in these countries from 2007/2008 to 2011/2012.

Meanwhile, Nigeria experienced economic growth as an impact of ICT business and telecommunication liberalization during the 2000s (Akinwale et al. 2018). There was a co-integration between ICT and economic growth in the long run. In the short run, only with secure internet server per 1 million and mobile cellular subscription per 100 people resulted in positive and significant impact on economic growth.

Gholizadeh et al. (2014) studied the relationship between gross domestic product (GDP) and internet use in some ASEAN countries during 1996–2011. They found that there was a positive and significant association between internet use and GDP, although there were differences between those ASEAN countries. Meanwhile, a study by Bahrini & Qaffas (2019) in the Middle East and North Africa (MENA) and Sub-saharan Africa (SSA) found that ICT, i.e. mobile phone, internet usage, and broadband adoption were the main driver of economic growth during 2007–2016.

Internet fosters economic growth (Jiménez et al. 2014). An increase of 10% in internet connectivity was found to boost up GDP growth by 1.38% in the world. In OECD countries, high internet access generated GDP by 2%.

Meanwhile, Salahuddin et al. (2016) studied the effects of internet and real GDP on social capital creation measured by trust in Australia during 1985–2013. They found that internet increased social capital in the short run, but reduced social capital in the long run. In addition, there was a short and long run positive relationship between internet and GDP per capita.

Not only in developing countries that internet affects economic growth. Amiri & Reif (2013) in their study in Nordic region found that in countries with highest internet penetration there was an association between highest internet penetration and highest GDP per capita in the world.

Internet penetration is determined by a number of factors. Feng (2015) studied the factors influencing internet penetration in China. It was found that internet penetration was mainly affected by internet access cost, internet content, and GDP per capita.

Meanwhile, a study by Lera-Löpez et al. (2011) found that socioeconomic, demographic, and regional factors influenced internet use. The use of internet was primarily associated with education, age, occupation, employment in service sector, nationality, living in urban areas, and regional GDP per capita. They also found that internet use was positively related with broadband connection and education, while internet skill was influenced by gender and population size.

The relationship between inflation and internet use has also been studied. Yi & Choi (2005) found that internet improved productivity and reduced inflation. An increase of 1% in the ratio of the internet users to total population reduced inflation from 0.04264% point to 0.13193% point. Subsequently, inflation has a positive effect on internet demand.

The new economic theory proposed that humankind is entering an era with high output growth, low unemployment, and low inflation (Meijers, 2006). It is described that inflation suppresses internet growth and on the other side, internet will increase inflation in the long run. Sharma et al. (2014) studied the relationship between inflation and internet use through online shopping in India. They found that inflation had an indirect effect on internet growth.

Choi (2003) investigated the effects of internet on the volume of inward foreign direct investment (FDI). Internet was assumed to boost up higher FDI through productivity improvement. Using 53 FDI recipient country data and FDI gravity equation it was found that when the number of hosts and internet users in a country increased by 10%, FDI inflow increased by more than 2%.

The international community supports developing countries by building up digital infrastructure and regulation in order to be able to participate in international trade, in particular through larger diversification series in export. The study by Gnangnon (2020) using panel data from 131 countries during 1995–2014 found that greater internet access was positively associated with export diversification in particular both in less developed and developed countries. Internet access creates innovation level of a country, merchandise export including its concentration export products, and the size of inflow FDI. The results of this study emphasized the need of digital infrastructure development and regulation that facilitate access to the internet.

Pradhan et al. (2017) also studied the association between FDI, economic growth, and use of communication technology in 21 Asian countries during 1965–2012. Communication technology included fixed telephone, mobile phone, and internet use and service including fixed broadband. The results of the study show that there was a positive association between FDI, economic growth, and communication technology. Using the Granger causality analysis, these three variables were positively related.

A study on the association between FDI and internet use in 10 ASEAN countries had been carried out (Ramdan et al. 2020). It was found that higher internet use was associated with higher FDI. A 1% increase in FDI was associated with a 0.0681 increase in internet use.

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Based on the above literature review, ~~this study aims to investigate the association between demographic and economic factors with internet use in the world. I~~it is hypothesized that higher internet use is associated with higher demographic dividend typ~~ology~~e, higher access to electricity, higher GDP, lower inflation, and higher FDI.

~~2.~~3. Data and Methods

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This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The countries and study period were selected based on the availability of data on variables used in the study. In addition, the selected countries were classified by demographic dividend type by the World Bank (Appendix Table A).

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The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the type of demographic dividend (TDD) which was a categorical variable (=0 if pre, =1 if early, =2 if late, and =3 if post). Therefore, there were three (3) dummy variables for TDD, that is *EarlyDD* (=1 if early, =0 otherwise), *LateDD* (=1 if late, =0 otherwise), and *PostDD* (=1 if post, =0 otherwise), and pre-demographic dividend was the reference category. Meanwhile, the economic variables included access to electricity (% of population, *Electric*), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

This study employed panel data analyses. The econometric model used was a fixed effects regression model using income level group, regional group, and year as identifiers. This model was also carried out based on G20 country group and income level group. The proposed model in this study was as follows.

$$Internet_{it} = \beta_0 + \beta_{11} EarlyDD_{it} + \beta_{12} LateDD_{it} + \beta_{13} PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

This fixed effects regression model still had endogeneity problem and measurement errors in the variables used. The demographic dividend type can influence internet use and on the other hand internet use can affect the demographic dividend type. In addition, the demographic dividend type is endogenous, that is a variable that is influenced by other variables. Therefore, other approaches were employed as robustness checks using the static generalized method of moment (GMM). This GMM is a simultaneous model between an endogenous variable and instrument or exogenous variables in the first stage regression and an endogenous model between the dependent variable and independent variables in the second stage regression. The instrument variables used consisted of crude death rate (deaths per 1,000 people, CDR), population density (population per km^2, Density), and crude birth rate (births per 1,000 people, CBR).

The first stage regression model was as follows.

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$$TDD_{it} = \alpha_0 + \alpha_{11}CDR_{it} + \alpha_{12}Density_{it} + \alpha_{13}CBR_{it} + \alpha_2 Electric_{it} + \alpha_3 \ln(GDP)_{it} + \alpha_4 Inflation_{it} + \alpha_5 FDI_{it} + \varepsilon$$

The second stage regression model was as follows.

$$Internet_{it} = \beta_0 + \beta_{11}EarlyDD_{it} + \beta_{12}LateDD_{it} + \beta_{13}PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

The endogenity problem can result in biased and inconsistent estimates when there is lag in dependent variable. This problem can be solved by employing the dynamic panel GMM model. Arellano and Bond (1991) proposed the GMM approach. There are two reasons of applying GMM approach. First, GMM is a common estimator that gives a framework for comparison and evaluation. Second, GMM gives simple alternative to other estimators in particular maximum likelihood.

However, GMM estimators also have some limitations. First, GMM estimator is asymptotically efficient if the sample size is large, but inefficient if the sample size is finite. Second, the estimator sometimes needs a number of programming implementation so that it needs software that can support GMM approach application.

There are three estimation methods that are commonly used in GMM framework, that is first-differences GMM (FD-GMM) or Arellano-Bond GMM (AB-GMM), system GMM (SYS-GMM), and "difference" and "system" GMM dynamic panel estimator. This study employed "difference" and "system" GMM dynamic panel estimator to analyze the estimators. This model was selected because the demographic dividend type was time invariant and the model can solve this problem.

~~This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the typology of demographic dividend that consisted of pre-, early- (*EarlyDD*), late- (*LateDD*), and post-demographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. Meanwhile, the economic variables included access to electricity (% of population,~~

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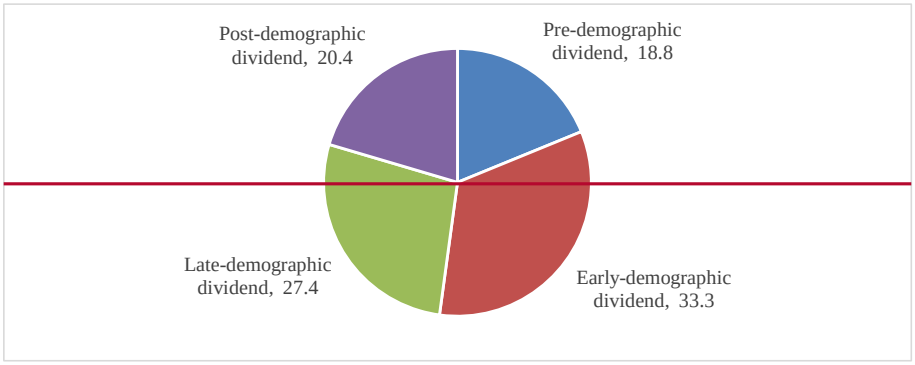
Electric), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

Data in this study were analyzed using univariate, bivariate, and multivariate analyses. For the univariate analysis, the percentage distribution of countries by the demographic dividend typology and the summary statistics (the number of observations, the mean, standard deviation, minimum, and maximum) of the continuous variables in the model were given. For the bivariate analysis, the average percentage of individuals using the internet by the demographic dividend typology and simple regression analyses between the internet use and economic variables were performed. For the multivariate analysis, a multiple regression with random effects was carried out to investigate the demographic and economic determinants of internet use in countries in the world during 2001–2017. The model was as follows.

$$Internet = \beta_0 + \beta_{11}EarlyDD + \beta_{12}LateDD + \beta_{13}PostDD + \beta_2 Electric + \beta_3 \ln(GDP) + \beta_4 Inflation + \beta_5 FDI + \varepsilon$$

3.4. Results

The results of univariate analysis are presented in Figure 3 and Table 1. It can be seen from Figure 3 that the majority of countries in the world were in early demographic dividend typology (33.3%), followed by in late demographic dividend typology (27.4%), in post-demographic dividend typology (20.4%), and in pre-demographic dividend typology (18.8%). Meanwhile, it can be seen from Table 1, the percentage of individuals using the internet ranged from none in Timor-Leste in 2001 to almost universal of 98.3% in Iceland in 2017 and the percentage of population with access to electricity varied from a low of 0.53% in Liberia in 2001 to universal, 100%, in Iceland in 2017. Further, the GDP constant ranged between US$143.2 thousand in Kiribati in 2001 and US$17.4 trillion in the United States in 2017, the annual inflation (consumer prices) varied from a low of -18.1% in Bhutan in 2004 to a high of 359.9% in the Democratic Republic of Congo in 2001, and the current net inflows foreign direct investment differed from -58.2% in Luxembourg in 2007 to 56.5% in Malta in 2007.



Source: World Bank (2021) (Author's compilation).

Figure 3

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

Table 1

Summary Statistics of Variables in the Model: Number of Observation, Mean, Standard Deviation, Minimum, and Maximum

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Individuals using the Internet (% of population)	3,162	30.5	28.3	0.0	98.3
Access to electricity (% of population)	3,162	78.3	30.6	0.53	100.00
GDP (constant 2010 US$)	3,162	347.0 billion	1,334.6 billion	143.2 thousand	17.4 trillion
Inflation, consumer prices (annual %)	3,162	6.0	11.3	-18.1	359.9
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	18.0	-58.2	56.5

Source: World Bank (2021) (Author's compilation).

The results of bivariate analysis are displayed in Figure 4 – Figure 8. These are the average percentage of individuals using the internet by the demographic dividend typology (Figure 4) and the scatter diagrams, simple regression equations and lines, and coefficient determinations between each independent variable in the model and the dependent variable (Figure 5–8). It can be seen from Figure 4 that the average percentage of individuals using the internet was

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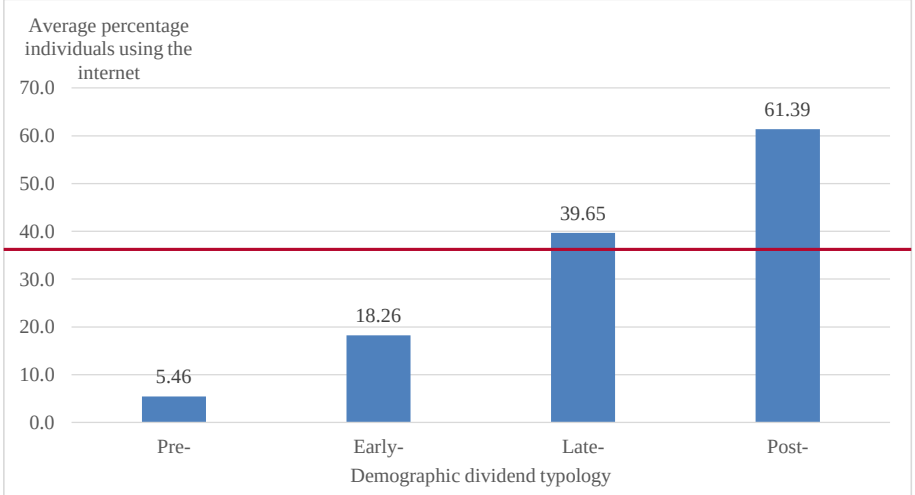
lowest in pre-demographic dividend typology countries (5.5%) and highest in post-demographic dividend typology countries (61.5%).

Figure 5 shows that there was a positive relationship between access to electricity and internet use. An increase of one percent in population with electricity was related with an increase of about 0.56% in the individuals using the internet. The coefficient of determination was 0.366 indicating that 37% of the variation in the individuals using the internet can be explained by the variation in the access to electricity.

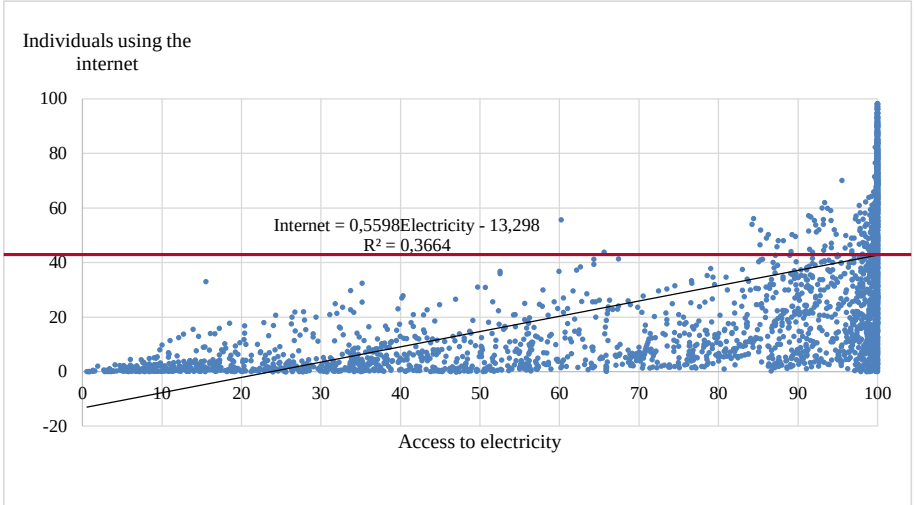
Figure 6 shows that there was a positive relationship between ln(GDP) and internet use. An increase of one percent in economic growth (GDP constant 2010) was correlated with an increase of about 0.35% in the individuals using the internet. The coefficient of determination was 0.0008 suggesting that ln(GDP) can explain the variation in the individuals using the internet by 0.08%.



Source: World Bank (2021) (Author's compilation).

Figure 4

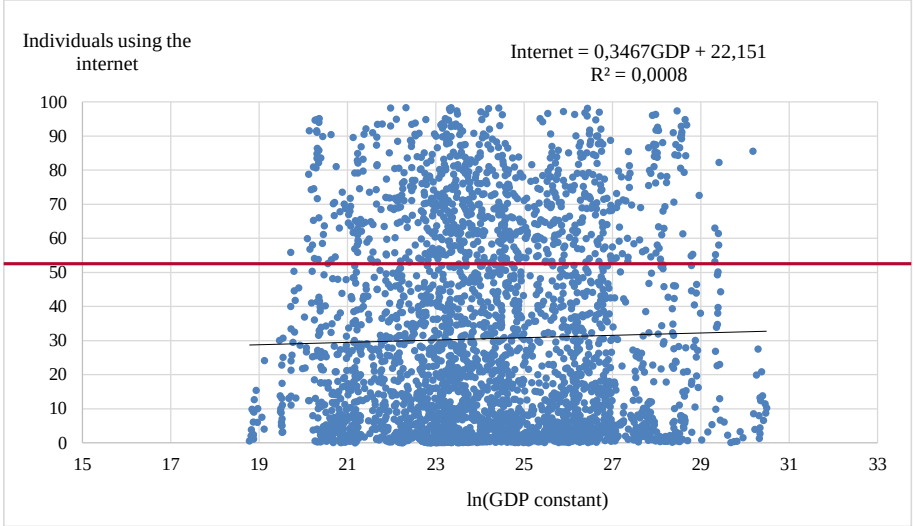
The Average Percentage of Individuals using the internet (% of population) by the Demographic Dividend Typology: World 2001–2017



Source: World Bank (2021) (Author's compilation).

Figure 5

Access to electricity (% of population) and Individuals using the internet (% of population): World 2001–2017

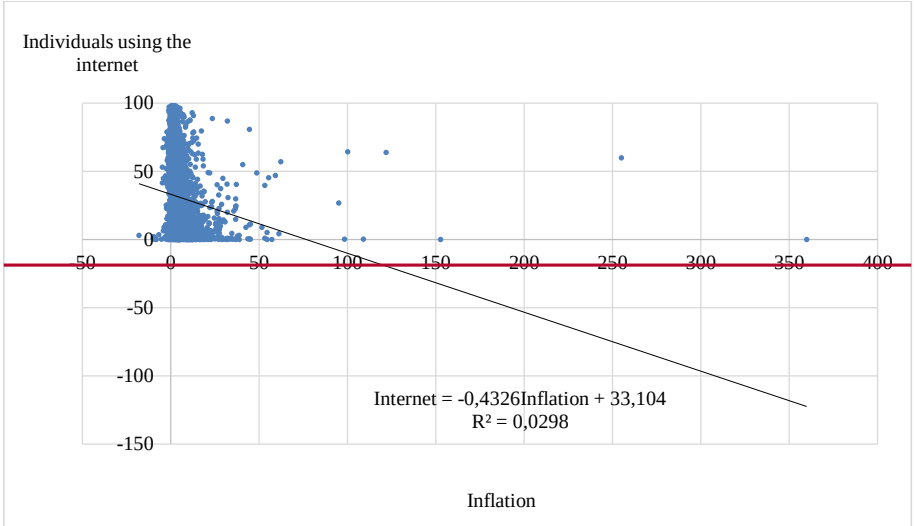


Source: World Bank (2021) (Author's compilation).

Figure 6

ln(GDP constant) and Individuals using the internet (% of population): World 2001–2017

Figure 7 indicates that there was a negative relationship between inflation and internet use. An increase of one percent in inflation was related with a decline of about 0.43% in the individuals using the internet. The coefficient of determination was 0.029 indicating that 2.9% of the variation in the individuals using the internet can be explained by the variation in inflation.

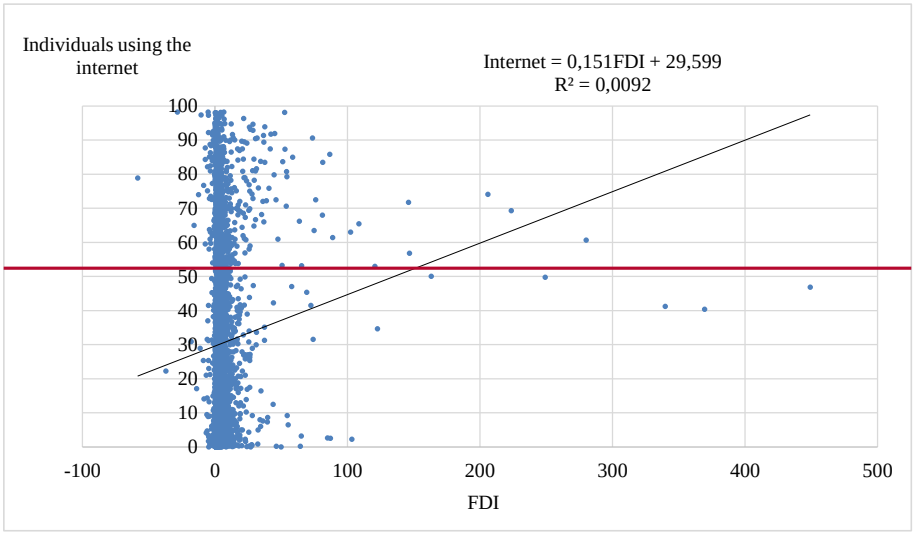


Source: World Bank (2021) (Author's compilation).

Figure 7

Inflation (% annual) and Individuals using the internet (% of population): World 2001-2017

Figure 8 shows that there was a positive relationship between FDI and internet use. An increase of one percent in FDI was correlated with an increase of about 0.009 in the individuals using the internet. The coefficient of determination was 0.009 suggesting that the variation in FDI can explain the variation in the individuals using the internet by 0.9%.

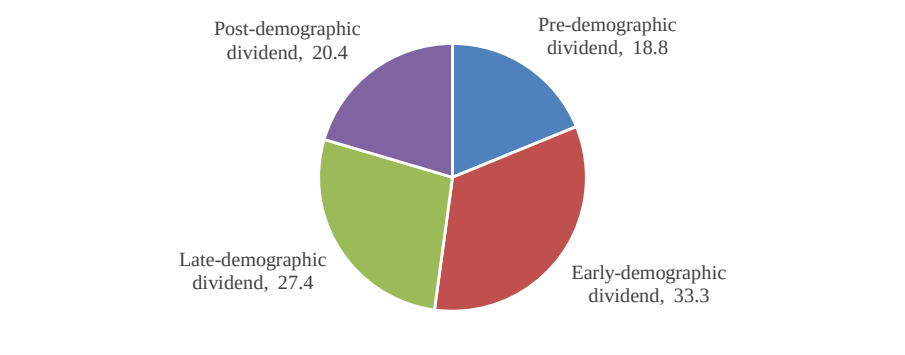


~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 8~~

~~Foreign direct investment (net inflows, % of GDP) and Individuals using the internet (% of population): World 2001–2017~~

It can be seen from Figure 1 the majority of countries in the world were in early-demographic dividend type (33.3%), followed by in late-demographic dividend type (27.4%), in post-demographic dividend type (20.4%), and in pre-demographic dividend type (18.8%). The majority of countries in early-demographic dividend type were African countries, such as Angola, Benin, Chad, Eritrea, Kenya, Niger, Sudan, Togo, Uganda, and Zambia (Appendix Table A). Meanwhile, most developed countries were in post-demographic dividend countries, such as Australia, Belgium, Canada, Denmark, Germany, Japan, Norway, Singapore, United Kingdom, and United States.



Source: World Bank (2021) (Author's compilation).

Figure 1

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

The number of observation and mean of variables used in the study both for full observations and by demographic dividend type was presented in Table 1. It can be seen that there was a significant variation in internet use across countries in the world and across demographic dividend types. The mean of individuals using the internet was 30.5% for full observations, lowest in pre-demographic dividend countries (only 5.5%), 18.3% in early-demographic dividend countries, 39.7% in late-demographic dividend countries, and highest in post-demographic dividend countries (61.4%). Other variables also show disparities in demographic and economic features across countries and demographic dividend types that reflects better development achievement in more developed countries.

Table 1. Number of observations (*n*) and mean of variables in the study for full observation and by demographic dividend type.

	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
Variable	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Individuals using the internet (% of population)	3,162	30.5	595	5.5	1,054	18.3	867	39.7	646	61.4
Access to electricity (% of population)	3,162	78.3	595	31.4	1,054	75.7	867	97.5	646	99.9
GDP (constant 2010 US$)	3,162	3.47E+11	595	2.76E+10	1,054	1.34E+11	867	2.52E+11	646	1.12E+12
Inflation, consumer prices (annual %)	3,162	6.0	595	8.3	1,054	7.10	867	5.0	646	3.2
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	595	4.7	1,054	3.36	867	8.3	646	9.3
Death rate, crude (per 1,000 people)	3,162	8.3	595	10.9	1,054	7.00	867	7.4	646	9.1
Population density (people per sq. km of land area)	3,162	312.5	595	73.3	1,054	162.05	867	140.2	646	1,009.8

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Variable	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
	n	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Birth rate, crude (per 1,000 people)	3,162	22.4	595	39.7	1,054	25.50	867	15.3	646	10.7

Source: World Bank (2021) (Author's compilation).

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The results of diagnostic tests show that the residual approached normal distribution but statistically not normal (Jarque-Bera normality test was 52.24 and χ^2 = 4.5E-12). But, this assumption only applies for certain models. This assumption is not used if random effects regression, GMM, instrumental variables, and two-stage least squares (2SLS) are used.

The results of multicollinearity test show that there was no variance inflation factor (VIF) that was greater than 10. The mean of VIF was 2.650. In addition, there was no pairwise correlations that was greater than 0.5. It means there was no multicollinearity indication in the model.

There was heteroscedasticity in the model. χ^2 = 1,726.32 and Prob > χ^2 = 0.000. This problem was solved by using STATA application by making the model that improved standard errors (robust standard errors).

The results of Chow test show that fixed effects model was better than pooled least squares model (F(3, 3151) = 181.13, Prob > F = 0.000). In addition, the results of Hausman test show that fixed effects model was better than random effects model (χ^2 = 817.94 and Prob > χ^2 = 0.000). Further, the results of Breusch and Pagan Lagrangian multiplier test show that random effects model was better than pooled least squares model.

The results of fixed effect regression using income level group, regional group, and year as identifiers show that in general demographic dividend had significant positive association with internet use (Table 2). After controlling for the economic features, the percentage of individuals using the internet was, respectively 6.5%–21% higher and 15%–39% higher in late-demographic dividend and post-demographic dividend countries than in pre-demographic dividend countries. This finding supported the results of a study by Lera-López et al. (2011) and Myovella et al. (2021) that found the role of demographic factor in increasing internet use in the world. More favorable demographic features, including being a late- and post-

demographic dividend country, had been an important factor of better development that could enhance access to information and communication technology including internet use.

Table 2 Results of Fixed Effects Regression based on Identifier.

	Identifier		
Covariates	Income level group	Regional group	Year
Early-Demographic Dividend	0.317	1.398	4.409***
	(1.221)	(1.425)	(0.921)
Late-Demographic Dividend	6.507***	14.398***	21.101***
	(1.542)	(1.749)	(1.588)
Post-Demographic Dividend	15.142***	30.349***	39.005***
	(1.721)	(1.939)	(0.691)
Access to electricity (% of population)	0.216***	0.290***	0.161***
	(0.021)	(0.022)	(0.035)
Inflation, consumer prices (annual %)	-0.115***	-0.176***	-0.070
	(0.028)	(0.030)	(0.051)
log(gdpconstant2010us)	1.650***	1.958***	1.666***
	(0.166)	(0.183)	(0.059)
Foreign direct investment, net inflows (% of GDP)	0.017	0.048**	0.052***
	(0.018)	(0.019)	(0.015)
Constant	-30.610***	-49.345***	-37.480***
	(4.017)	(4.340)	(4.490)
Observations	3,162	3,162	3,162
R-squared	0.165	0.340	0.656
Fixed effects in income level group	Yes	No	No
Fixed effects in regional group	No	Yes	No
Fixed effects in year	No	No	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: World Bank (2021) (Author's compilation).

~~Before a multiple regression was conducted, the multi-collinearity between the variables in the model were checked. It was found that there was no collinearity between variables in the model, except between the demographic dividend typology and electricity where the Spearman correlation coefficient was slightly above 0.7 (0.71). However, this did not have serious effects on the results of the regression. The results of the multiple fixed effects regression are given in Table 2. These include the regression coefficient, standard errors, and *p* value for each covariate. All covariates in the model had significant effects on internet use statistically. The coefficient of variation was 0.540 implying that 54.0% of the variation in the internet use could be explained by the model with a significance level below 0.001.~~

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~~The demographic dividend typology was positively associated with the internet use. Late- and post-demographic dividend countries had higher percentage of individuals using the internet than pre-demographic dividend countries. After controlling for the effects of economic factors, the percentage of individuals using the internet was, respectively, 13.0% and 29.7% higher in the late- and post-demographic dividend countries than in the pre-demographic dividend countries. This result supports the finding by Lera-López et al. (2011) on the importance of demographic factors on internet use. Countries with more advanced demographic change, that is late- and post-demographic dividend typology had lower fertility levels and better economic development achievement so that individuals in these countries were more likely to have exposed to better development, including access internet than individuals in pre- and early-demographic dividend typology countries.~~

Access to electricity ~~was the strongest factor that affected~~ influenced internet use positively. The higher the percentage of population who had access to electricity, the higher the percentage of individuals using the internet. Other things being the same, an increase of one percent in the access to electricity was related to an increase of ~~0.27%~~ 0.161% – 0.290% in the internet use. This finding is in accordance with the finding by Myovella et al. (2021) ~~Salahuddin and Alam (2015)~~ that found the positive association between ~~internet use and~~ electricity consumption and internet use. Access to electricity can boost the electricity-based economic activity and in today's industrial internet of things era, it is a key factor of internet use since the internet cannot be used without electricity.

Economic growth ~~was~~ had ~~the second strongest factor of and had a~~ positive effect on the internet use. The higher the economic growth, the higher the percentage of internet use. Ceteris paribus, an increase of one percent in economic growth was associated with an increase of internet use by ~~4.6~~1.650% – 1.958%. This result supports the study result by Pradhan et al. (2017) and Amaluddin (2020) that found a positive relationship between economic growth and internet use. Economic growth allows a country to expand its economy that today heavily depends on the internet and hence increases internet use.

Inflation had a negative relationship with the percentage of individuals using the internet. The higher the inflation in a demographic dividend typology, the lower the percentage of individuals using the internet. After controlling for the effects of other factors, an increase of

one percent in inflation was associated with a decline of the percentage of individuals using the internet by 0.1~~8~~15% – 0.176%. This finding confirms the results of study by Yi & Choi (2005) that found a negative association between inflation and internet use. This is because ~~I~~inflation is a contributor of cost and price rise including internet cost that reduces internet use through the decline in people's purchasing power including purchasing the internet because of the price rise across the economies.

Foreign direct investment (FDI) had a positive influence on internet use. The higher the FDI, the higher the internet use. An increase of one percent in FDI was related with an increase of the percentage of individuals using the internet by 0.0485~~%~~–0.052% . This results strengthens the study finding by Gnangnon (2020) and Ramdan et al. (2020) that found a positive relationship between FDI and internet use through the capital ~~addition~~ accumulation in an economy that can increase individuals' access to the internet use.

The results of the above analyses also show that 16.5%–65.6% of variation in internet use was explained by demographic dividend type and economic features.

The above results still had heteroscedasticity and endogeneity effects problem. To obtain consistent and robust results, this study conducted robustness checks by employing other approaches and different sub-samples. The results were as follows.

This study presented the results of analyses employing fixed effects, random effects, and pooled least square model. The results of the three models gave consistent results that demographic dividend type had positive effects on internet use significantly. The percentage of individuals using internet was 13%–14% and around 30% higher in, respectively, late- and post-demographic dividend countries than in pre-demographic dividend countries (Table 3). In addition, higher percentage of individuals using internet was associated with higher percentage of access to electricity, economic growth, and FDI and associated with lower inflation. A one percent increase in, respectively, access to electricity, economic growth, FDI, and inflation was associated with, respectively, an increase of about 0.3%, 2%, and 0.05% individuals using internet and a decline of 0.2% individuals using internet.

Table 3. Comparison between the results of fixed effects, random effects, and pooled least square model.

Covariate	(1) Fixed Effects	(2) Random Effects	(3) Pooled Least Square
Early-Demographic Dividend	1.398	-0.917	-0.917
	(1.425)	(1.288)	(0.734)
Late-Demographic Dividend	14.398***	12.957***	12.957***
	(1.749)	(1.614)	(1.344)
Post-Demographic Dividend	30.349***	29.737***	29.737***
	(1.939)	(1.708)	(1.513)
Access to electricity (% of population)	0.290***	0.273***	0.273***
	(0.022)	(0.020)	(0.015)
Inflation, consumer prices (annual %)	-0.176***	-0.178***	-0.178**
	(0.030)	(0.030)	(0.079)
Log(gdpconstant2010us)	1.958***	2.010***	2.010***
	(0.183)	(0.179)	(0.181)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.051***	0.051**
	(0.019)	(0.019)	(0.025)
Constant	-49.345***	-47.954***	-47.954***
	(4.340)	(4.061)	(4.027)
Observations	3,162	3,162	3,162
R-squared	0.340		0.549
Number of id_regional	Yes	No	No

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 4, the results of analyses of fixed effects regressions for full observation and by income group were presented. It can be seen that the results were consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the effect of demographic dividend was largest in upper middle income countries and insignificant in high income countries.

Table 4. Results of Fix Effects Regression for full observation and by income level.

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	1.398		-0.429	3.168**	11.689***
	(1.425)		(0.986)	(1.351)	(3.587)
Late-Demographic Dividend	14.398***	-0.635		6.025***	20.667***
	(1.749)	(3.713)		(1.942)	(3.846)

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	(1)	(2)	(3)	(4)	(5)
Covariate	Full Observation	High Income	Low Income	Lower Middle Income	Upper Middle Income
Post-Demographic Dividend	30.349***	4.907		4.133	15.432***
	(1.939)	(3.909)		(3.655)	(4.449)
Access to electricity (% of population)	0.290***	1.950***	0.201***	0.322***	0.717***
	(0.022)	(0.487)	(0.019)	(0.024)	(0.089)
Inflation, consumer prices (annual %)	-0.176***	-0.746***	-0.004	-0.086*	-0.093*
	(0.030)	(0.180)	(0.014)	(0.046)	(0.049)
lgdpconstant2010us	1.958***	1.524***	1.687***	0.438*	0.763**
	(0.183)	(0.423)	(0.252)	(0.245)	(0.323)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.018	0.027	0.014	-0.321***
	(0.019)	(0.024)	(0.027)	(0.089)	(0.119)
Constant	-49.345***	-174.760***	-38.590***	-20.003***	-70.770***
	(4.340)	(48.125)	(5.630)	(5.709)	(10.270)
Observations	3,162	1,020	442	833	867
R-squared	0.340	0.071	0.286	0.258	0.155
Number of id_regional	7	6	5	6	6

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table 5, the results of analyses of fixed effects regression for full observation and by year were presented. It can be seen that the results were also consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the percentage of individuals using internet was significantly higher in early-demographic dividend countries than in pre-demographic dividend countries in 2007–2012 and in 2013–2017 with an increasing effect.

Table 5. Results of Fixed Effects Regression for Full Observations and by Year.

	(1)	(2)	(3)	(4)
Covariate	All Observation	2001-2006	2007-2012	2013-2017
Early-Demographic Dividend	1.398	0.118	3.289*	6.819***
	(1.425)	(1.638)	(1.839)	(1.965)
Late-Demographic Dividend	14.398***	9.510***	19.678***	25.449***
	(1.749)	(2.046)	(2.267)	(2.387)
Post-Demographic Dividend	30.349***	28.334***	38.265***	37.249***
	(1.939)	(2.283)	(2.500)	(2.631)
Access to electricity (% of population)	0.290***	0.083***	0.212***	0.430***
	(0.022)	(0.025)	(0.030)	(0.035)

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Inflation, consumer prices (annual %)	-0.176***	-0.078***	-0.494***	-0.027
	(0.030)	(0.027)	(0.068)	(0.042)
lgdpconstant2010us	1.958***	1.418***	1.648***	1.782***
	(0.183)	(0.216)	(0.234)	(0.244)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.088***	0.028	0.093**
	(0.019)	(0.023)	(0.020)	(0.039)
Constant	-49.345***	-32.532***	-36.721***	-48.902***
	(4.340)	(5.022)	(5.601)	(6.037)
Observations	3,162	1,116	1,116	930
R-squared	0.340	0.407	0.502	0.535
Number of id- regional	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS model used CDR, population density, and CBR as instrumental variables. The results of diagnostic test for instrumental variable in 2SLS and GMM model show that F(1, 3154) = 69.68, which was greater than 10, and Prob > F = 0.0000, meaning that the models had strong instrumental variables. In addition, the results for first stage regression show that Sanderson-Windmeijer (SW) first-stage chi-squared and F statistic was significant, meaning that all instrument variables were relevant or valid to explain the endogeneous variable (demographic dividend type). The results of the first stage regression of 2SLS model were presented in Table 6.

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Table 6. The Results of First Stage Regression of 2SLS Model.

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
Death rate, crude (per 1,000 people)	-0.0447***	-0.00571**	0.0305***
	(0.00269)	(0.00246)	(0.00187)
Population density (people per sq. km of land area)	-2.33E-05***	-4.35E-05***	5.07E-05***
	(5.24E-06)	(4.80E-06)	(3.64E-06)
Birth rate, crude (per 1,000 people)	0.0137***	-0.0152***	-0.0213***
	(0.00145)	(0.00133)	(0.00101)
Access to electricity (% of population)	0.00213***	0.00244***	-0.00227***
	(0.000547)	(0.000501)	(0.000380)
Inflation, consumer prices (annual %)	0.00278***	0.000831	-0.00246***
	(0.000687)	(0.000629)	(0.000477)
lgdpconstant2010us	-0.0215***	-0.0476***	0.0490***
	(0.00383)	(0.00351)	(0.00266)
Foreign direct investment, net inflows (% of GDP)	-0.00216***	0.000313	0.000781***
	(0.000432)	(0.000396)	(0.000300)
Constant	0.755***	1.629***	-0.586***

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
	(0.125)	(0.115)	(0.0871)
Observations	3,162	3,162	3,162

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of second stage regression for full observations and based on income group were given in Table 7. It can be seen that the 2SLS method results for full observations were also consistent with the previous results. The percentage individuals using the internet was significantly higher in early-, late-, and post-demographic dividend countries than in pre-demographic dividend countries, but with much higher percentages than in the previous models. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI. By income group, demographic dividend type had significant positive effects on internet use in low and high income countries.

Table 7. The Results of Second Stage Regression for Full Observations and based on Income Group

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	33.32***		7.684***	-4.024	266.7
	(5.728)		(1.429)	(3.523)	(495.7)
Late-Demographic Dividend	34.63***	58.57***		10.17	83.94
	(4.269)	(11.17)		(9.063)	(115.5)
Post-Demographic Dividend	60.09***	49.14***		-5.432	390.4
	(5.328)	(7.119)		(10.67)	(720.7)
Access to electricity (% of population)	0.0335	-0.772	0.0599***	0.242***	1.181
	(0.0357)	(0.715)	(0.0177)	(0.0431)	(1.712)
Inflation, consumer prices (annual %)	-0.180***	-1.225***	-0.00716	-0.107**	-0.877
	(0.0350)	(0.232)	(0.0160)	(0.0500)	(1.596)
lgdpconstant2010us	2.134***	4.411***	1.267***	0.179	5.844
	(0.332)	(0.764)	(0.291)	(0.268)	(9.764)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.0319	0.0416	-0.0174	4.808
	(0.0232)	(0.0274)	(0.0305)	(0.133)	(10.14)
Constant	-55.96***	-22.53	-27.04***	-4.932	-433.5

	(6.753)	(57.65)	(6.542)	(7.799)	(765.6)
Observations	3,162	1,020	442	833	867
R-squared	0.422	-0.064	0.193	0.259	-25.924

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2

The Coefficients, Standard Error, and *p*-value of multiple regression of the determinants of individuals using the internet: World 2001–2017

Individuals using the internet (% of population)	Coefficient (95% CI)	Standard error	*p*-value
Demographic dividend typology			
Pre-	Reference		
Early-	-0.917 (-3.442, 1.608)	1.288	0.476
Late-	12.957 (9.793, 16.121)	1.614	< 0.001
Post-	29.738 (26.389, 33.087)	1.708	< 0.001
Access to electricity (% of population)	0.273 (0.234, 0.311)	0.020	< 0.001
ln(GDP constant)	4.627 (3.819, 5.435)	0.412	< 0.001
Inflation, (annual %)	-0.178 (-0.238, -0.118)	0.030	< 0.001
Foreign direct investment, net inflows (current US$)	0.051 (0.014, 0.089)	0.019	0.008
Constant	-48.992 (-56.945, -41.039)	4.056	< 0.001

In this study, the comparison between the results of fixed-effects regression and 2SLS method based on G20 and non-G20 group was also carried out. The results were presented in Table 8. It can be seen that the results were consistent with the previous results that demographic dividend type had significant positive influence on internet use both in non-G20 and G20 countries.

Table 8. The Results of Second Stage Regression based on G20 Country Group.

	(2)	(3)	(4)	(5)
	Non-G20 countries		G20-countries	
Covariate	Fixed Effects	2SLS	Fixed Effects	2SLS
Early-Demographic Dividend	29.82***	1.945		
	(5.812)	(1.935)		
Late-Demographic Dividend	32.61***	15.23**	0.0687	0.105
	(3.882)	(4.467)	(9.069)	(2.700)
Post-Demographic Dividend	56.73***	28.52***	37.58***	31.35**
	(5.297)	(4.097)	(4.276)	(11.99)
Access to electricity (% of population)	0.0490	0.284**	0.934***	1.936*
	(0.0335)	(0.0806)	(0.164)	(0.898)
Inflation, consumer prices (annual %)	-0.163***	-0.162	-0.620***	-0.619*
	(0.0346)	(0.140)	(0.235)	(0.317)
lgdpconstant2010us	2.635***	2.367*	-0.742	0.926

	(2)	(3)	(4)	(5)
	Non-G20 countries		G20-countries	
Covariate	Fixed Effects	2SLS	Fixed Effects	2SLS
	(0.304)	(0.930)	(1.743)	(2.186)
Foreign direct investment, net inflows (% of GDP)	0.0752***	0.0528	-0.135	-0.334
	(0.0227)	(0.0502)	(0.681)	(0.470)
Constant	-66.32***	-58.68**	-35.65	-176.3
	(6.717)	(20.34)	(52.39)	(96.33)
Observations	2,839	2,839	323	323
R-squared	0.414	0.317	0.598	0.480
Number of id_regional		6		7

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS method by year was also done. The results were presented in Table 9. It can be seen that the results were also consistent with the previous results that demographic dividend type had significant positive influence on internet use in all years. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI in all years.

Table 9. The Results of Second Stage Regression by Year.

	(1)	(2)	(3)	(4)
Covariate	Full observation	2001-2006	2007-2012	2013-2017
Early-Demographic Dividend	33.32***	14.754***	31.418***	50.229***
	(5.728)	(4.870)	(7.580)	(10.606)
Late-Demographic Dividend	34.63***	19.456***	37.989***	52.855***
	(4.269)	(4.548)	(5.539)	(7.230)
Post-Demographic Dividend	60.09***	41.210***	60.701***	76.687***
	(5.328)	(4.867)	(6.973)	(10.030)
Access to electricity (% of population)	0.0335	-0.014	0.023	0.014
	(0.0357)	(0.034)	(0.048)	(0.075)
Inflation, consumer prices (annual %)	-0.180***	-0.060**	-0.623***	-0.079
	(0.0350)	(0.030)	(0.085)	(0.064)
lgdpconstant2010us	2.134***	1.750***	2.132***	1.914***
	(0.332)	(0.397)	(0.429)	(0.503)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.101***	0.062**	0.135**
	(0.0232)	(0.026)	(0.025)	(0.060)
Constant	-55.96***	-43.695***	-52.040***	-47.861***
	(6.753)	(8.003)	(8.643)	(10.402)

Observations	3,162	1,116	1,116	930
R-squared	0.422	0.548	0.613	0.518

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

~~Source: World Bank (2021) (Author's compilation). Note: CI = confidence interval.~~

~~4.~~5. Conclusions

In this study the nexus between demographic and economic features with internet use in countries during 2001–2017 was investigated. A fixed effects regression model using income level group, regional group, and year as identifiers was employed to study the association between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use. Robustness checks were also carried out using the static generalized method of moment between the type of demographic dividend and instrument variables (crude death rate, population density, and crude birth rate) in the first stage regression and between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use in the second stage regression.

The results of this study confirms the previous studies on the nexus between demographic and economic features with internet use (e.g. Filippova and Turutina (2015); Sharma et al. (2015); Baumann et al. (2017); Pradhan et al. (2017); Scheerder et al. (2017); ~~Wang et al. (2019);~~ Singh et al. (2020); Bianchini et al. (2021); Myovella et al. (2021); Yesuf (2021)). It was found that internet use was higher in countries from late- and post-demographic dividend type. Meanwhile, access to electricity, economic growth, and foreign direct investment had a positive association with internet use and inflation was negatively associated with internet use.

Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries, in particular countries in the pre- and early-demographic dividend type, should manage its demographic features to the more favorable ones, i.e. lower fertility and mortality. In addition, the window of opportunity due to the decline of fertility and mortality should be capitalized in order to reap the demographic dividend of economic growth and family welfare acceleration by improving access to quality health, education, and employment opportunity. Regarding economic features, in order to

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foster internet use, government of countries should improve access to electricity, raise economic growth, reduce inflation, and enhance foreign direct investment.

Limitations

A limitation of this study is that the demographic dividend type was a time invariant variable, while other variables were time variant. However, this limitation should not significantly affect the findings and this study still provides an essential contribution to the study of internet usage. So, it is suggested that further research on the determinants of internet usage should employ time variant demographic change variable.

~~5. The results of this study confirms the previous studies on the nexus between demographic change and economic features with internet use. Countries from post-demographic dividend typology with better access to electricity, higher economic growth, lower inflation, and higher foreign direct investment had higher internet use. Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries should manage its demographic change, increase access to electricity, improve economic growth, reduce inflation, and enhance foreign direct investment.~~

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Appendix

Table A

Countries in the Study by Demographic Dividend ~~Country~~Type

No	Pre-Demographic Dividend	Early-Demographic Dividend	Late-Demographic Dividend	Post-Demogr~~p~~aphic Dividend
1	Afghanistan	Algeria	Albania	Antigua and Barbuda
2	Angola	Argentina	Armenia	Australia
3	Benin	Bahrain	Aruba	Austria
4	Burkina Faso	Bangladesh	Azerbaijan	Barbados
5	Burundi	Belize	Bahamas, The	Belarus
6	Cameroon	Bhutan	Brazil	Belgium
7	Central African Republic	Bolivia	Brunei Darussalam	Bosnia and Herzegovina
8	Chad	Botswana	Chile	Bulgaria
9	Comoros	Cabo Verde	China	Canada
10	Congo, Dem. Rep.	Cambodia	Colombia	Croatia
11	Congo, Rep.	Djibouti	Costa Rica	Cuba
12	Cote d'Ivoire	Dominican Republic	Cyprus	Czech Republic
13	Equatorial Guinea	Ecuador	Estonia	Denmark
14	Eritrea	Egypt, Arab Rep.	Fiji	Finland
15	Gambia, The	El Salvador	Georgia	France
16	Guinea	Eswatini	Guam	Germany
17	Guinea-Bissau	Ethiopia	Guyana	Greece
18	Iraq	Gabon	Iceland	Hong Kong SAR, China
19	Kenya	Ghana	Ireland	Hungary
20	Liberia	Grenada	Jamaica	Italy
21	Madagascar	Guatemala	Kazakhstan	Japan
22	Malawi	Haiti	Kuwait	Korea, Rep.
23	Mali	Honduras	Kyrgyz Republic	Lithuania
24	Mauritania	India	Latvia	Luxembourg
25	Mozambique	Indonesia	Lebanon	Macao SAR, China
26	Niger	Iran, Islamic Rep.	Malaysia	Malta
27	Nigeria	Israel	Mauritius	Netherlands
28	Senegal	Jordan	Moldova	New Zealand
29	Sierra Leone	Kiribati	Mongolia	Norway
30	Sudan	Lao PDR	Montenegro	Portugal
31	Tanzania	Lesotho	Morocco	Singapore
32	Timor-Leste	Libya	North Macedonia	Slovenia
33	Togo	Maldives	Oman	Spain
34	Uganda	Mexico	Poland	Sweden
35	Zambia	Micronesia, Fed. Sts.	Puerto Rico	Switzerland
36		Myanmar	Qatar	Ukraine
37		Namibia	Romania	United Kingdom
38		Nepal	Russian Federation	United States
39		Nicaragua	Serbia	
40		Pakistan	Seychelles	
41		Panama	Slovak Republic	
42		Papua New Guinea	Sri Lanka	
43		Paraguay	St. Lucia	
44		Peru	St. Vincent and the Grenadines	
45		Philippines	Thailand	
46		Rwanda	Trinidad and Tobago	
47		Samoa	Tunisia	

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48		Saudi Arabia	United Arab Emirates	
49		Solomon Islands	Uruguay	
50		South Africa	Vietnam	
51		Suriname	Virgin Islands (U.S.)	
52		Syrian Arab Republic		
53		Tajikistan		
54		Tonga		
55		Turkey		
56		Turkmenistan		
57		Uzbekistan		
58		Vanuatu		
59		Venezuela, RB		
60		West Bank and Gaza		
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Date: Sep 07, 2022

To: "Wilson Rajagukguk" wrajagukguk@yahoo.com

From: "Heliyon" info@heliyon.com

Subject: Decision on submission HELIYON-D-21-11053R2 to Heliyon

Ms. No.: HELIYON-D-21-11053R2
Title: The Demographic and Economic Features: The Nexus with Internet Use
Journal: Heliyon

Dear Dr. Rajagukguk,

Thank you for submitting your manuscript to Heliyon.

We have now received all of the editor and reviewer comments on your recent submission to Heliyon. Your paper will become acceptable for publication after implementation of minor formatting and/or administrative changes outlined below. To avoid unnecessary delays in the publication of your manuscript, please do not make any other additional changes during this revision.

Please reference all numbered tables in text. Currently, table [6] in the manuscript have not been cited in text.

To submit your revised manuscript, please log in as an author at https://www.editorialmanager.com/heliyon/, and navigate to the "Submissions Needing Revision" folder under the Author Main Menu. When submitting your revised manuscript, please ensure that you upload your most recent document with the "Revised manuscript file - highlighting revisions made" item type.

Kind regards,

Yating Zhang
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Reviewer's Responses to Questions

Note: In order to effectively convey your recommendations for improvement to the author(s), and help editors make well-informed and efficient decisions, we ask you to answer the following specific questions about the manuscript and provide additional suggestions where appropriate.

1. Are the objectives and the rationale of the study clearly stated?

Please provide suggestions to the author(s) on how to improve the clarity of the objectives and rationale of the study. Please number each suggestion so that author(s) can more easily respond.

Reviewer #6: Yes

Reviewer #8: The objectives are now clearly stated.

Reviewer #9: yes, clearly stated.

---

2. If applicable, is the application/theory/method/study reported in sufficient detail to allow for its replicability and/or reproducibility?

Please provide suggestions to the author(s) on how to improve the replicability/reproducibility of their study. Please number each suggestion so that the author(s) can more easily respond.

Reviewer #6: Mark as appropriate with an X:
Yes [] No [] N/A []
Provide further comments here:
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Reviewer #8: Mark as appropriate with an X:
Yes [x] No [] N/A []
Provide further comments here: The application of the theory and method reported are sufficient.

Reviewer #9: Mark as appropriate with an X:
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Provide further comments here:
yes

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3. If applicable, are statistical analyses, controls, sampling mechanism, and statistical reporting (e.g., P-values, CIs, effect sizes) appropriate and well described?

Please clearly indicate if the manuscript requires additional peer review by a statistician. Kindly provide suggestions to the author(s) on how to improve the statistical analyses, controls, sampling mechanism, or statistical reporting. Please number each suggestion so that the author(s) can more easily respond.

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Provide further comments here:
Yes

Reviewer #8: Mark as appropriate with an X:
Yes [x] No [] N/A []
Provide further comments here: The statistical analyses, controls, sampling mechanism, and statistical are well described.

Reviewer #9: Mark as appropriate with an X:
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yes

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4. Could the manuscript benefit from additional tables or figures, or from improving or removing (some of the) existing ones?

Please provide specific suggestions for improvements, removals, or additions of figures or tables. Please number each suggestion so that author(s) can more easily respond.

Reviewer #6: No

Reviewer #8: The listed Tables in the manuscript are adequate and well explained.

Reviewer #9: fair enough

---

5. If applicable, are the interpretation of results and study conclusions supported by the data?

Please provide suggestions (if needed) to the author(s) on how to improve, tone down, or expand the study interpretations/conclusions. Please number each suggestion so that the author(s) can more easily

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Reviewer #8: Mark as appropriate with an X:
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Reviewer #9: Mark as appropriate with an X:
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6. Have the authors clearly emphasized the strengths of their study/theory/methods/argument?

Please provide suggestions to the author(s) on how to better emphasize the strengths of their study. Please number each suggestion so that the author(s) can more easily respond.

Reviewer #6: Yes

Reviewer #8: The author has emphasized the strengths of the study/theory/methods/argument.

Reviewer #9: yes

---

7. Have the authors clearly stated the limitations of their study/theory/methods/argument?

Please list the limitations that the author(s) need to add or emphasize. Please number each limitation so that author(s) can more easily respond.

Reviewer #6: Yes

Reviewer #8: The author has clearly stated the theory applied, methods and argument.

Reviewer #9: yes

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8. Does the manuscript structure, flow or writing need improving (e.g., the addition of subheadings, shortening of text, reorganization of sections, or moving details from one section to another)?

Please provide suggestions to the author(s) on how to improve the manuscript structure and flow. Please number each suggestion so that author(s) can more easily respond.

Reviewer #6: No

Reviewer #8: The structure of the manuscript, flow of writing and reorganisation are adequately written.

Reviewer #9: fair enough

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9. Could the manuscript benefit from language editing?

Reviewer #6: No

Reviewer #8: No

Reviewer #9: Yes

Reviewer #6: This field is optional. If you have any additional suggestions beyond those relevant to the questions above, please number and list them here.

Reviewer #8: This field is optional. If you have any additional suggestions beyond those relevant to the questions above, please number and list them here.

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Reviewer #9: This field is optional. If you have any additional suggestions beyond those relevant to the questions above, please number and list them here.

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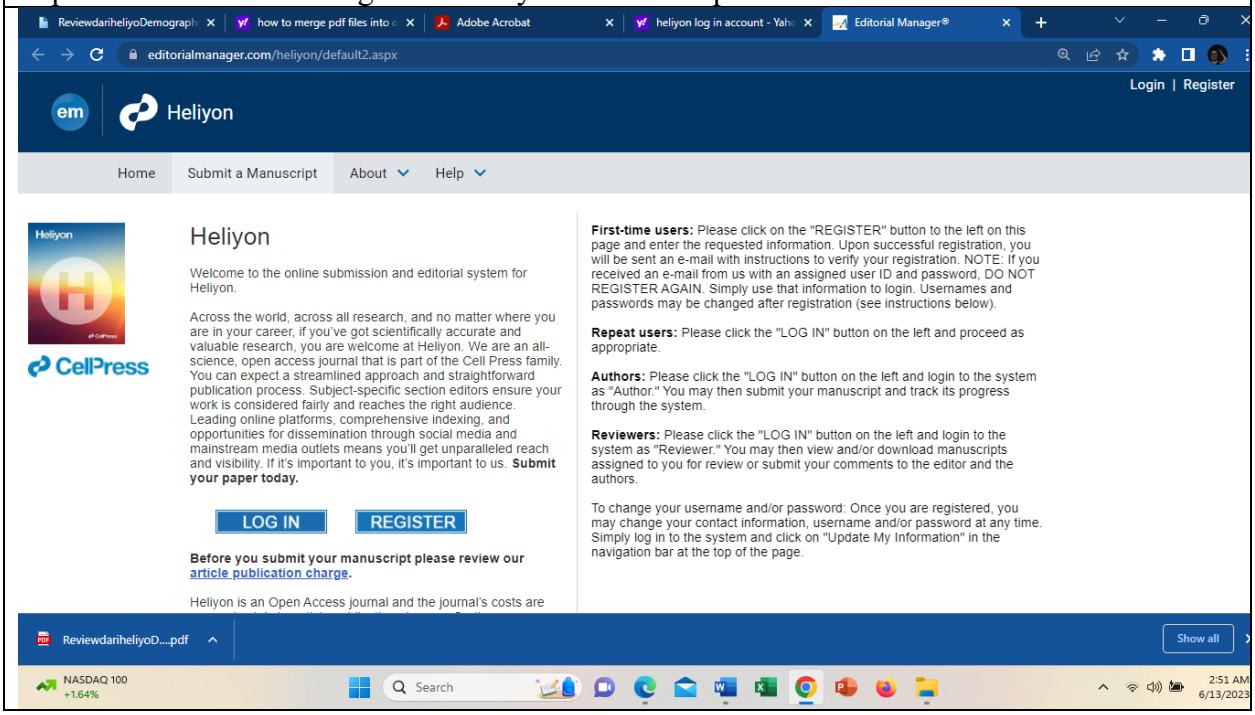

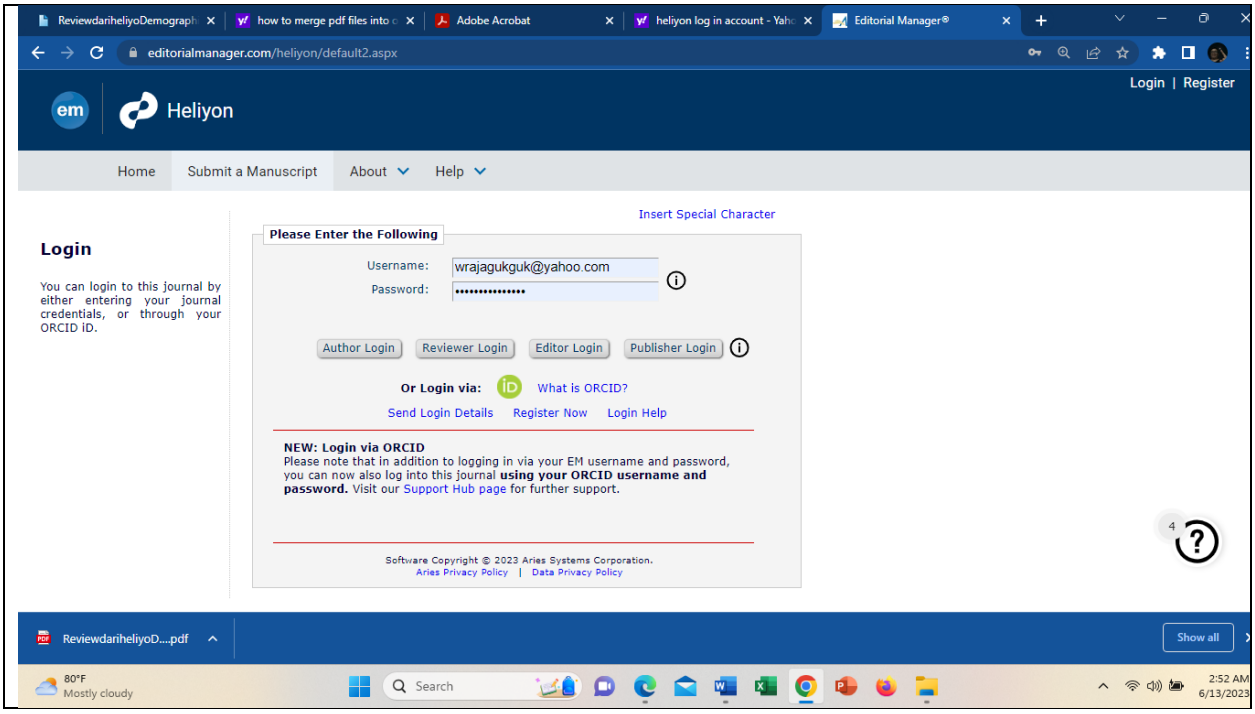

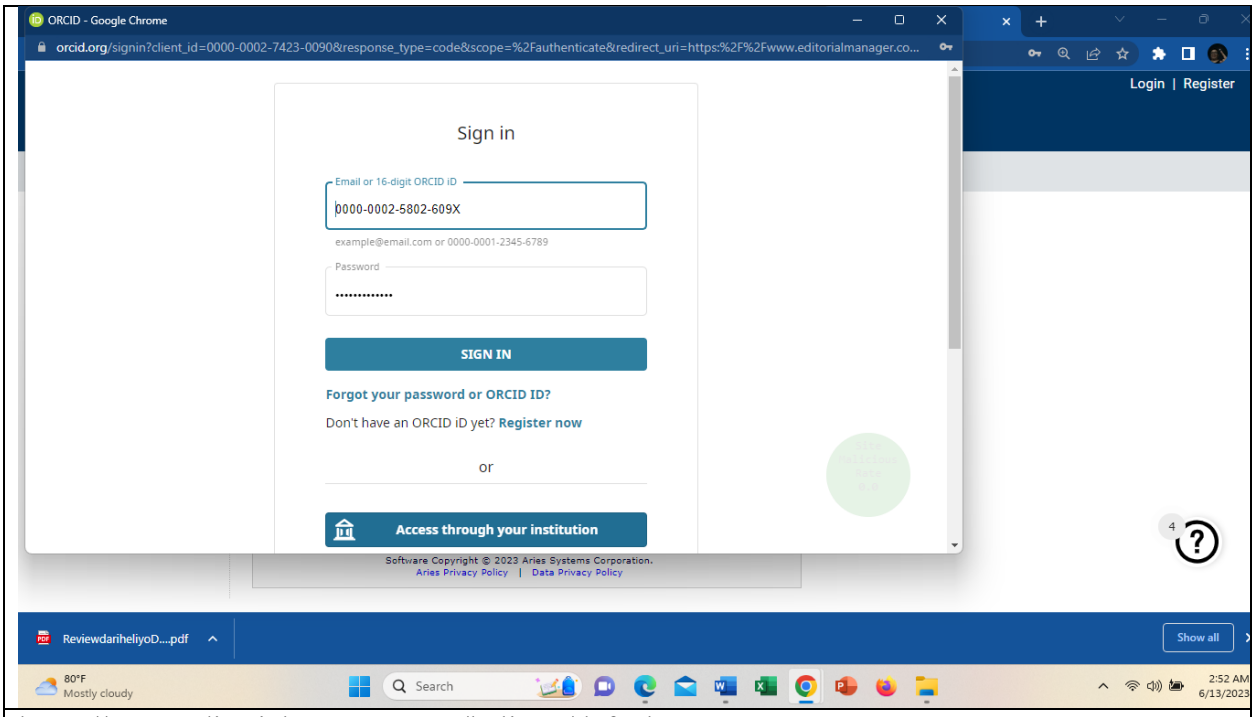

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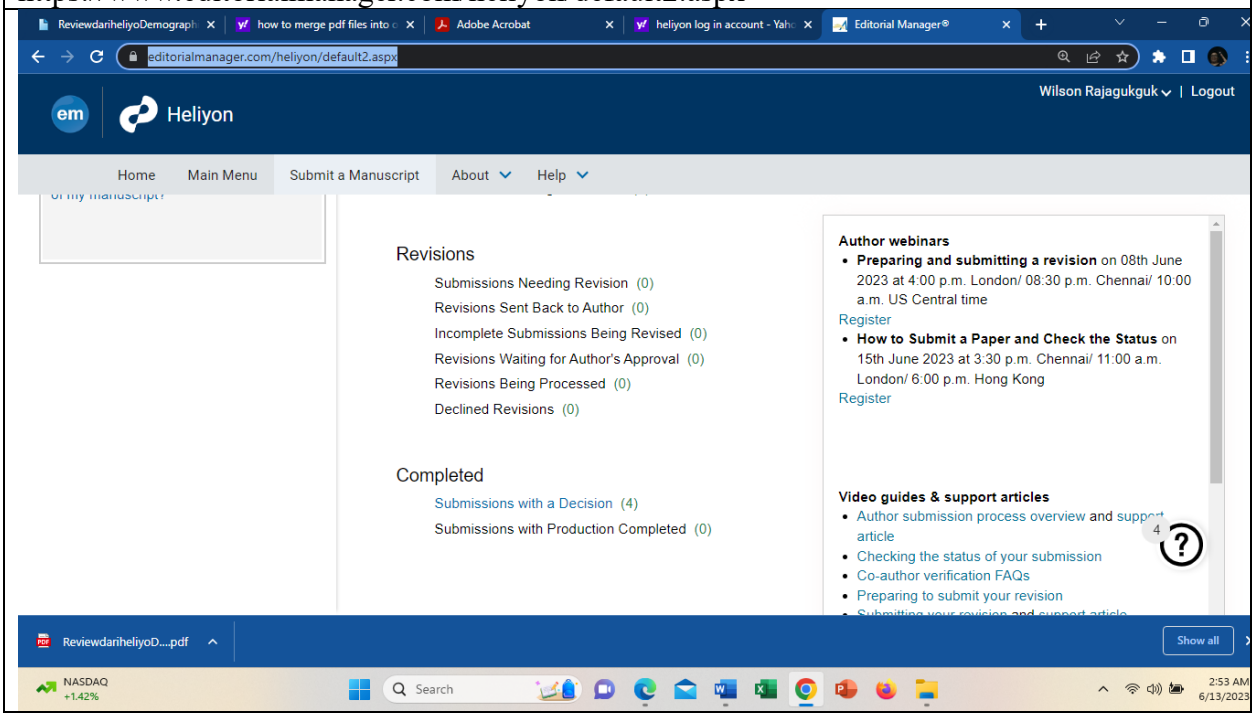

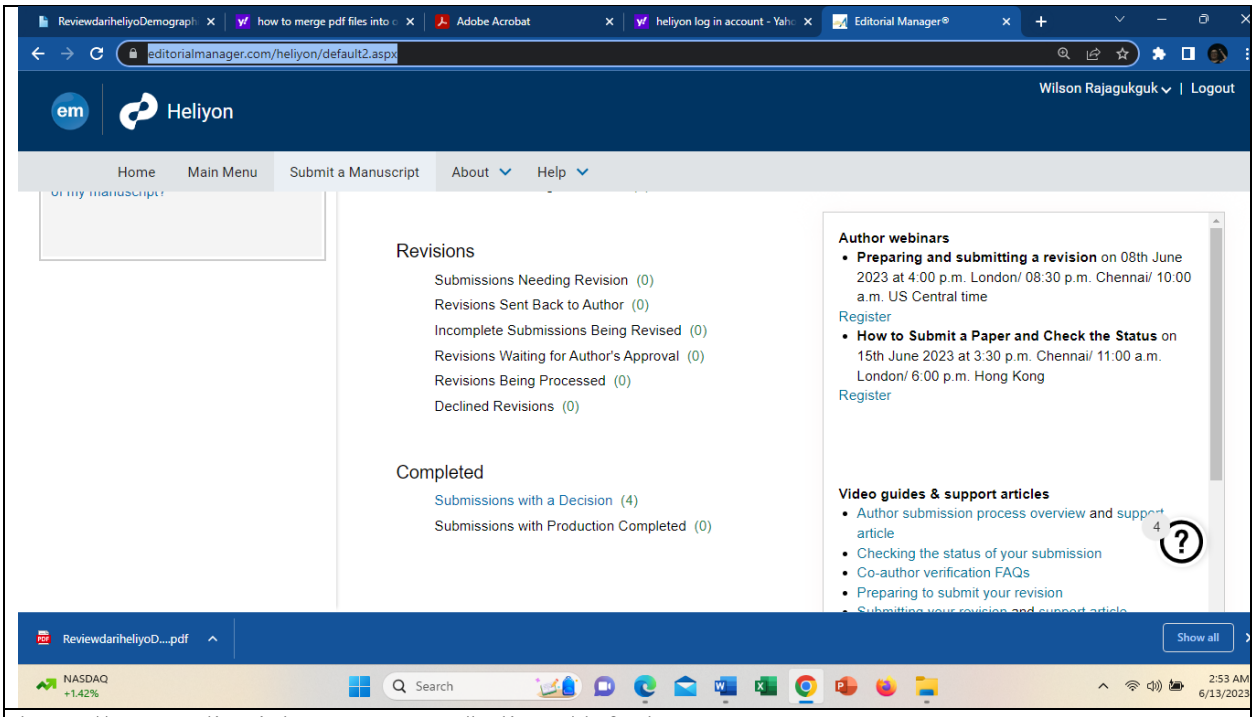

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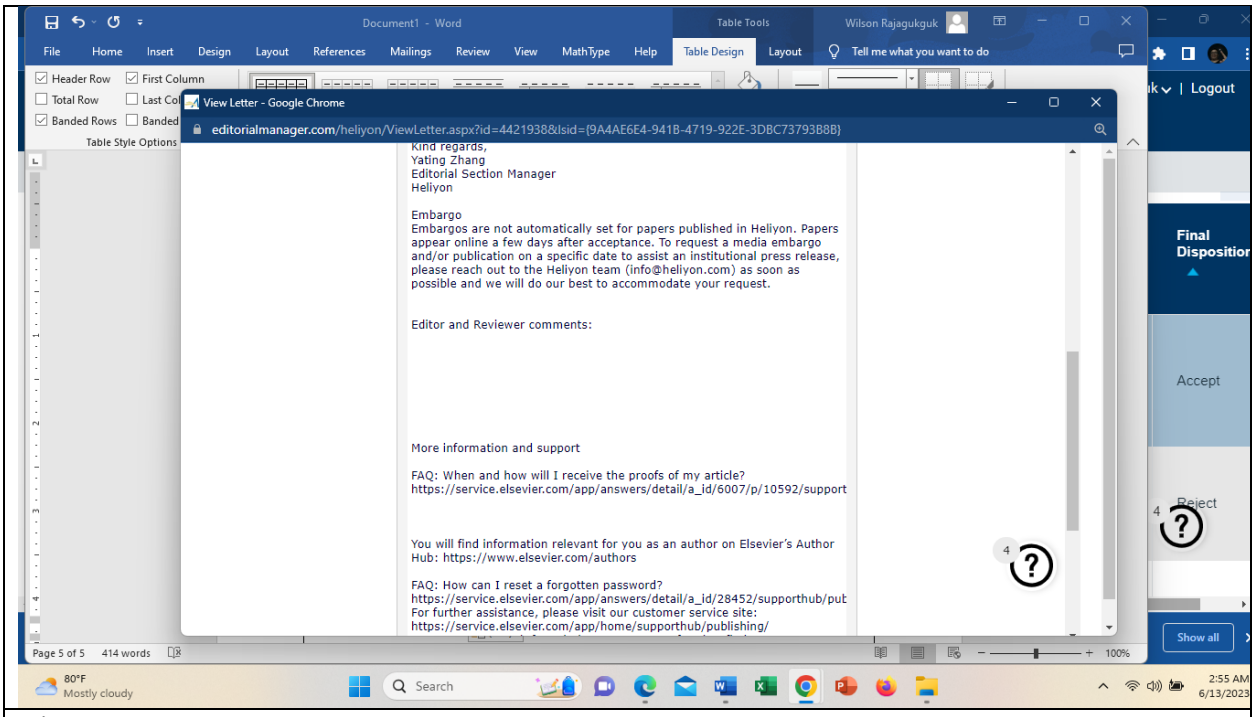

View Letter
Date: Sep 13, 2022
To: "Wilson Rajagukguk" wrajagukguk@yahoo.com
From: "Heliyon" info@heliyon.com
Subject: Decision on submission to Heliyon
Manuscript Number: HELIYON-D-21-11053R3
Title: The Demographic and Economic Features: The Nexus with Internet Use
Journal: Heliyon

Dear Dr. Rajagukguk,

Thank you for submitting your manuscript to Heliyon.

I am pleased to inform you that your manuscript has been accepted for publication.

Your accepted manuscript will now be transferred to our production department. We will create a proof which you will be asked to check, and you will also be asked to complete a number of online forms required for publication. If we need additional information from you during the production process, we will contact you directly.

We appreciate and value your contribution to Heliyon. We regularly invite authors of recently published manuscript to participate in the peer review process. If you were not already part of the journal's reviewer pool, you have now been added to it. We look forward to your continued participation in our journal, and we hope you will consider us again for future submissions.

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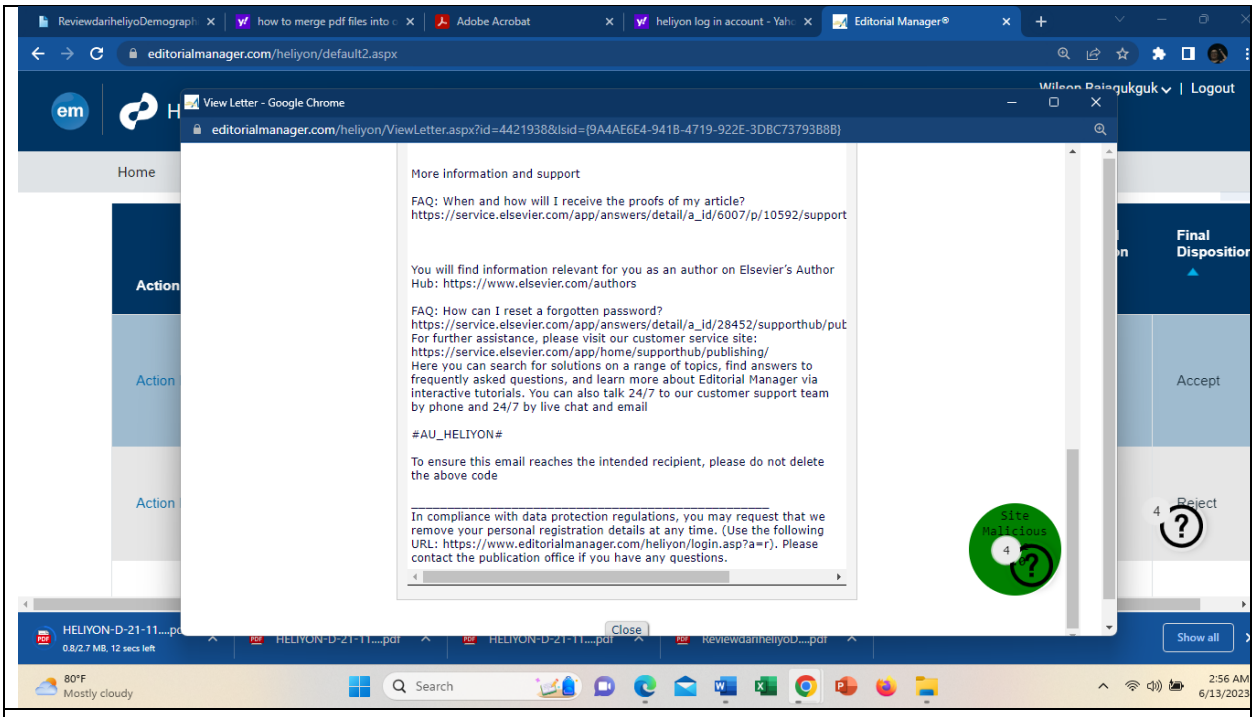
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The Demographic ~~Change~~ and Economic Features: The Nexus with Internet Use

Wilson Rajagukguk

Faculty of Economic and Business, Universitas Kristen Indonesia

Email: wrajagukguk@yahoo.com

Abstract

The goal of this study was to examine the nexus between demographic ~~change~~ dividend type and economic features with internet use. The data source was from the World Development Indicator of the World Bank. The unit analysis was country. The ~~P~~panel data analysis method~~s~~ were used for the examination, employing fixed effects regression models using country income level, country regional group, and year as identifiers~~, random effects regression, and pooled least square models~~. ~~The unit analysis was country.~~ The random effects regression model, pooled least square model, and static generalized method of moments ~~and two stage least square~~ were utilized ~~as~~ for ~~the~~ robustness checks. The dependent variable was the percentage of population using the internet. The independent variables consisted of demographic and economic variables. The demographic variable was the demographic dividend typ~~ology~~e, while the economic variables were access to electricity, GDP, inflation rate, and foreign direct investment. The results of fixed effects regression indicate that ~~using country income level, country regional group, and year as identifiers and~~ after controlling for the economic features, higher internet use in a country was associated with late- and post-demographic dividend ~~typology~~type. Higher internet use was also associated with higher access to electricity, higher GDP, lower inflation rate, and higher foreign direct investment inflow. ~~The r~~Robustness checks using random-effects and pooled least square models, using fixed-effects model by country income level, using two-stage least square, and using second stage regression by G20 and non-G20 country group division and year, similarly gave consistent results. The association of internet use with the demographic and economic features may imply that population-based and economic development program should be enhanced toward the favorable ones that increase internet usage among the population.

Key words: Demographic dividend typ~~ology~~e, economic determinants, internet use, fixed effects.

1. Introduction

The world is marked by a considerable inequality in human development achievement. The United Nations Development Programme (UNDP) reported that in 2019 the human development index (HDI) varied greatly from a lowest of 0.394 in Niger to a highest of 0.957 in Norway (UNDP, 2020). This disparity could be attributed to the inequity in access to digital technology, including broadband internet.

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Widespread access to broadband internet is a key driver of human development. Improving access to the internet is also identified as an instrument to achieve the Sustainable Development Goals (SDGs) in goal 4 (Quality education), goal 9 (Industry, innovation, and infrastructure), and goal 17 (Partnership for the Goals). Internet allows people to be connected, work, shop, and study especially during the COVID-19 pandemic lockdowns (United Nations, 2021).

Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.

The World Bank (2022) estimated that increasing internet penetration from 35% to 75% of the population in all developing countries could increase about US$2 trillion to their joined gross domestic product and generate more than 140 million works around the world. However, there wasere a great inequality in the internet access across the world.

The World Bank (2021) reported that in 2019, among 174 countries in the world where the data was available, this access varied greatly across countries, lowest in Burundi (5.2%) and almost universal in Bahrain (99.7%).

Information and communication technology (ICT), in particular internet, is a most developed business and business product in this century. The study of ICT encounters economists and demographers with two sides, as consumers and producers. ~~As it can be seen from Figure 1,~~ tThere was a rapid increase of internet consumers in the world. The percentage of internet users in the world from 1990–2018 increased from 0% in 1990 to 51% in 2018 only in 28 years. The time trends of the percentage of internet users was not the linear one, but the power one. Therefore, the internet business is a promising one.

~~Improving access to the internet is also identified as an instrument to achieve the Sustainable Development Goals (SDGs) in goal 4 (Quality education), goal 9 (Industry, innovation, and infrastructure), and goal 17 (Partnership for the Goals). Internet allows people to be connected, work, shop, and study especially during the COVID-19 pandemic lockdowns (United Nations 21). However, there were a great inequality in the internet access across the world.~~

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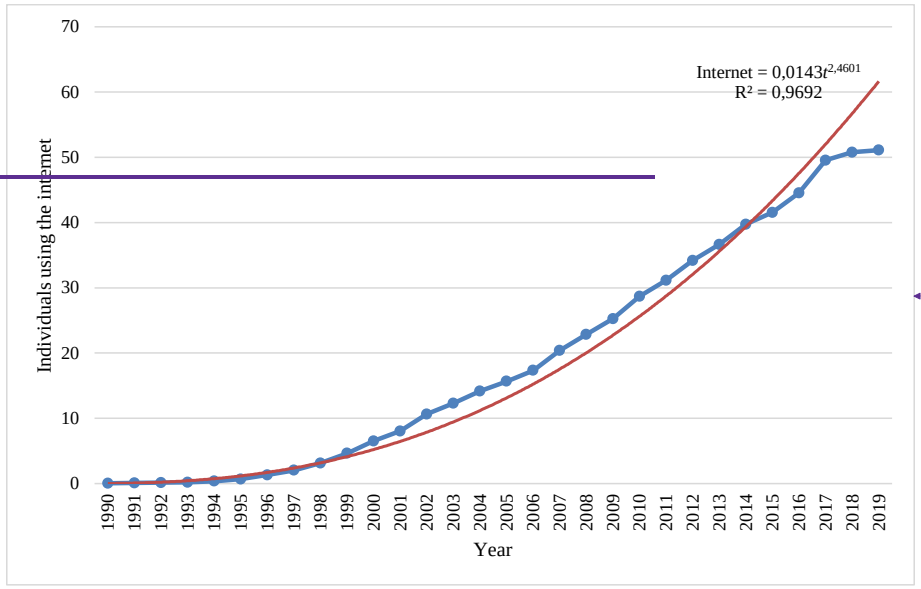

~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 1~~

~~Individuals Using the Internet (% of population): World 1990-2018~~

On the other hand, decline in fertility and mortality level and change in migration patterns have caused countries to experience demographic change that has been related to demographic dividend. Demographic dividend is economic growth as the results of changes in age structure in a country due to the decline in family size and longer life that cause increase in the percentage of productive age population aged 15–64 years old. As a result, lower investment is needed for young population aged 0–14 years old. At the same time, productive age population increases that open the window of opportunity to accelerate economic growth and family welfare. At micro level, this demographic transition can result in family living standard improvement and higher income. At macro level, demographic transition can affect economic development in a country.

It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including economic and information and communication technology development. Demographic change of fertility and mortality decline could help create a period

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of sustainable economic growth as happened in some East Asian economies (e.g. Bloom et al., 2020; Amornkitvikai, Y. et al., 2022, Hosan et al., 2022, Liu and McKibbin, 2022). The mechanism of growth that is the policy area is through public health, family planning, economic policy that promote labor market flexibility, trade openness, and saving. The government of countries has window of opportunity to capitalize productive age population to reap the demographic dividend of economic growth and family welfare acceleration. This economic growth then enables countries to enlarge their heavily internet-based economies and consequently rises internet usage (Pradhan et al., 2017; Anuj, et al. 2018; Amaluddin 2020).

~~Bonus demografi adalah pertumbuhan ekonomi yang merupakan hasil dari perbuahan struktur umur sebuah negara, perubahan dari sebuah keluarga yang besar berumur pendek menjadi keluarga kecil dan berumur berumur lebih panjang.~~

~~Karena perubahan dalam distwribusi umur, diperlukan investasi yang lebih sedikit untuk membangun penduduk kelompok usia mudda dan kemudian sumberdaya yang lebih besar digunakan untuk pembangunan (economic gift). Berbarengan dengan hal tersebut, Angkatan kerja bertumbuh lebih cepat (more rapidly) dibandingkan dengan penduduk yang tergantung padanya menciptakan sebuah jendela kesempatan percepatan pertumbuhan ekonomi dan kesejahteaan keluarga. Dalam skala mikro, transisi ini dapat berbuahkan dalam perbaikan standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.~~

-Ahmed et al. (2016) grouped countries into four demographic dividend ~~typology~~ type based on the demographic change and economic development achievement. The demographic dividend typology is classified as the pre-, early-, late-, and post-demographic dividend. Countries with a fertility level above four children per woman, increasing percentage of working age population (15–64 years), and low income level are categorized as the pre-demographic dividend countries. Meanwhile, countries with a fertility level between 2.1 and four children per woman, increasing percentage of working age population, and low-middle and middle-high income level are categorized as the early-demographic dividend countries. Further, countries with a fertility level below 2.1 children per woman, increasing percentage of working age population, and high income level are also categorized as the early-demographic

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dividend countries. Furthermore, countries with a fertility level between 2.1 children and four per woman, declining percentage of working age population, and low, low-middle, and middle-high income level are categorized as the late-demographic dividend countries. Lastly, countries with a fertility level below 2.1 children per woman, decreasing percentage of working age population, and high income level are categorized as the post-demographic dividend countries.

~~It is proposed that demographic change can have a positive contribution to development (e.g. Ahmed et al. 2016), including information and communication technology development. As it can be seen from Figure 2, t~~There wa~~i~~s a significant difference in the percentage of internet users and its trends across the demographic dividend typologies. The percentage of internet users was consistently highest in the post-demographic dividend countries, followed by in the late- and early-demographic dividend countries, and lowest in the pre-demographic dividend countries. ~~It also can be seen that during 1990–2018 t~~The percentage of internet users during 1990–2018 increased more rapidly in more developed countries, the post-demographic dividend typology countries.

The determinants of internet use have been proposed (e.g. Scheerder et al. 2017). These include demographic and socioeconomic factors. The association between demographic and economic features and information and communication technology has also been studied (e.g. Bianchini et al. 2021; Yesuf, -2021; Singh et al. 2020; Baumann et al. 2017). However, a summary of the reviewed literature revealed that no study on demographic dividend type and internet use had been carried out. In order to address the gap indicated above, in general this study sought to

~~➔~~

~~Bonus demografi adalah pertumbuhan ekonomi yang merupakan hasil dari perbuahan struktur umur sebuah negara, perubahan dari sebuah keluarga yang besar berumur pendek menjadi keluarga kecil dan berumur berumur lebih panjang.~~

~~Karena perubahan dalam distwribusi umur, diperlukan investasi yang lebih sedikit untuk membangun penduduk kelompok usia mudda dan kemudian sumberdaya yang lebih besar digunakan untuk pembangunan (economic gift). Berbarengan dengan hal tersebut, Angkatan kerja bertumbuh lebih cepat (more rapidly) dibandingkan dengan penduduk yang tergantung padanya menciptakan sebuah jendela kesempatan percepatan pertumbuhan ekonomi dan kesejahteaan keluarga. Dalam skala mikro, transisi ini dapat berbuahkan dalam perbaikan~~

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~~standar hidup keluarga dan pendapatan yang lebih tinggi. Dalam tingkat makro hal ini dapat mempengaruhi perekmbangan ekonomi sebuah negara.~~

~~Espinoza Bianchini, G., Navia, P., & Ulriksen Lira, C. (2021) melakukan studi tentang dampak umur, identifikasi ideological pada pemakaian jaringan sosial on line untuk mendapatkan informasi politik. Indikator sosio demographic dan indentifikasi ideologikal, akses serta pemakaiaan jaringan sosial ditemukan mempengaruhi keterlibatan demokratik. Di negara-negara di mana digital divide (akses ke internet) dan digital inequality (penggunaan internet) terjadi berdampingan (Coexist), dampak indikator sosio demografis lebih kuat, karena mereka yang memiliki lebih sedikit alat dan sumber daya mepunyai lebih sedikit akses dan lebih sedikit menggunakan jejaring sosial. untuk keterlibatan demokratis.~~

~~Yesuf, K. A. (2021) melakukan studi untuk menginvestigasi determinan sosiodemographic internet dan dampaknya pada perilaku keluarga berencana diantara laki-laki muda (young male) di Ethiopia menggunakan data dari Ethiopia health and demographic survey 2016. Besarnya penggunaan internet di Ethiopia (magnitude of internet use) sebesar 14% berasosiasi dengan dengan pemakaian internet adalah umur 20-24 tahun, tingkat Pendidikan yang tinggi, hidup pada region kota administrative, menggunakan mobile phone, responden yang dapat membaca seluruh kalimat, dan responden yang mempunyai computer dirumah. Responden dengan pekerjaan di sector pertanian dan pekerja manual kurang cenderung menggunakan internet.~~

~~Singh, S., Sahni, M. M., & Kovid, R. K. (2020). Melakukan studi bahwa kegunaan yang dirasakan (Perceived usefulness) dan Pengaruh social (social influence) merupakan determinan~~

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~~kunci niat perilaku menggunakan layanan Fintech. Selanjutnya ditemukan bahwa digital behavior serta karakteristik demografi (umur dan gender) memperkuat hubungan tersebut~~

~~Filippova, I., & Turutina, E. (2015) menggunakan sampel yang merupakan representasi seluruh penduduk Rusia melakukan studi mengukur secara empiris penggunakan internet dalam proses Pendidikan di Rusia. Perbedaan umur dan gender, finansial status, dan tingkat Pendidikan merupakan determinan penggunakan internet untuk tujuan pendidikan.~~

~~Online health information seeking behavior (OHISB) is currently a widespread and common behavior that has been described as an important prerequisite of empowerment and health literacy. Baumann, E., Czerwinski, F., & Reifegerste, D. (2017). Ditemukan bahwa factor demografi seperti status sosio ekonomi, umur, gender merupakan determinan penting untuk OHISB. Wang, J., Xiu, C., & Shahzad, F. (2019) selain faktor kunci untuk OHISB seperti self-efficacy, Internet experience, and perceived ease of use, membagi determinan OHISB ke dalam empat kategori yakni demographic characteristic factors, cognitive factors, internal factors, and external factors.~~

~~Sharma, S. K., Govindaluri, S. M., & al Balushi, S. M. (2015) melakukan riset mengekplorasi determinan utama dari pemakai internet banking. Menggunakan Two staged regression ditemukan bawah service qualitu, trust, perceived usefulness, perceive ease of use, attitude and demographic variabels merupakan dterminan internet banking users.~~

~~==>~~

~~Pertumbuhan ekonomi dipengaruhi secara signifikan oleh digitalisaai dan transisi demographi (Zaman, K. A. U. and T. Sarker., 2021). Menggunakan Bangladesh sebagai sebuah case study, Zaman dn Sarker mengadopsi model three-stage least square menganalisis bagaimana digitalisasi, dan transisi demographi mempercepat pertumbuhan ekonomi di Bangladesh.~~

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~~Setiap kenaikan 1% jumlah pengguna internat, GDP akan meningkat sebesar 0,11%, ceteris paribus. Sementara itu setiap penurunan 10 basis poin dalam dependency ratio akan meningkatkan GDP sebesr 1.2%. Faktor kunci untuk digitalisasi adalah labor participation rate, produktivitas pekerja, dan mobil pentration. Urbanisasi secara bolak-balik mempengaruhi peningkatan pemakai internet. Skor Human Development Index (HDI) dan angka urbanisasi secara negative signifikan berpengaruh pada angka ketergantungan, sementara itu partisipasi perempuan dalam Angkatan kerja mempunyai pengaruh positif.~~

~~Zaman, K. A. U. and T. Sarker. 2021. Demographic Dividend, Digital Innovation, and Economic Growth: Bangladesh Experience. ADBI Working Paper 1237. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/demographicdividend-digital-innovation-economic-growth-bangladesh~~

~~Bonus demografi memainkan peran penting sehubungan dengan hampir 850 Juta pelanggan langganan seluler (4 kali penetrasi Internet yang mencapai sekitar 205 Juta) di India (Burragoni, V.,2017). Pasca liberasisasi ekonomi India, pengembangan system perbankan mengalami pertumbuhan yang sama dengan penduduk. Seriring dengan pertumbuhan penduduk, permintaan dan tantangan juga meningkat dalam perkembangan system perbankan dan pembayaran. Untuk mengangani permsalahan ini pemrintah India mendisain sangat banyak strategi untuk meningkatkan ekonomi massa di India. Pemerintah India memulai program inklusi keiangan untuk mendapatkan pertumbuhan yang berkesinambungan melalui isu sosial seperti pengentasan kemiskinan (removing poverty), pendidikan untuk semua, dan well balance society melalui sitem keuangan dapat diperkuat. Seknario ini berbuah banyak (fruitful) karena India mempunyai advantage of demographic advantage, technological advandement, dan financial literacy, penignkatan penetration of Internet technology, dan juga pentration of mobil technology melalui smartphone. Demographic dividden memainkan sebuah peranan krusial. Hal ini mendorong perkembangan dan sebuah kompetisis yang lebih ketat dalam system pembayaran diluar insitusi.~~

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Myovella, G., Karacuka, M., & Haucap, J. (2021) melakukan studi tentang determinants of digitalization and digital divide in Sub-Saharan African economies. Hasil temuannya adalah bahwa GDP per capita, gross capital formation, political stability, regulatory efficacy and electricity infrastructure secara langsung mempengaruhi digital divide. Juga ditemukan bahwa GDP per capita, population growth, government consumption, trade openness, and electricity infrastructure secara tidak langsung mempengaruhi digital divide melalui efek spillover (spillover effects)

Pertanian merupakan sebuah sector kunci dalam mendorong pertumbuhan eknomi dan pengentasan kemiskiman di Vietnam (Giang, M. H., Xuan, T. D., Trung, B. H., & Que, M. T. ,2019). Produktivitas diukur sebagai Total Factor Productivity. Determinan dari TFT di Vietnam termasuk size and age, share of state and foreign ownership, export, accessibility to Internet and bank loan of firms.

Teknologi internet telah menjadi perangkat teknologikal esensial untuk individu, organisasi, dan pendorong pertumbuhan serta kemakmuran negara (Isaac, O., Abdullah, Z., Ramayah, T., & Mutahar, A. M.,2018). Negara seperti Yaman dimana terdapat pemakaian internet yang sangat rendah kita lihat mempunyai kemajuan ekonomi, sosial dan kultural yang rendah.

Pererturnbuhan ekonomi melalui internet kepada keluarga

Inovasi dan kewirausahaan merupakan factor pendorong penting untuk pertumbuhan ekonomi, dan internet memainkan sebuah peranakan oenting dalam aktivitas kewirausahaan. Menngunakan dataset dari China Family Panel Studies (CFPS) dataset in 2014 and 2016, Tan, Y., & Li, X. (2022) melakukan studi dan menemukan bahwa internet mempunyai pengaruh signifikan dan positif pad kewirausahaan di China. Juga ditemukan bahwa intenet mendorong (promote) kewirausahaan dan menolong pengusaha memperoleh pendanaan informal.

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~~Slazus, B. J., & Bick, G. (2022). Factors that Influence FinTech Adoption in South Africa: A Study of Consumer Behaviour towards Branchless Mobile Banking. *Athens Journal of Business & Economics*, *8*(1). https://doi.org/10.30958/ajbe.8-1-3~~

~~Pemakaian luas mobile phot dan pertumbuhan penetrasi internet telah menciptakan sebuah kesempatan unit untuk meningkatkan pelayanan keuangan. Perusaaann Financial Technology (FinTech) dan mobile banking (m-banking) membedayakan konsumen menggunakn platform digital menggunakan jasa finansial tanpa dipelukan akses fisik sebagaimana yang terjadi pada bank tradisional (Slazus, B. J., & Bick, G. ,2022). Pertumbuhan FinTech berdampak pada pertumbuhan ekonomi keluarga dan sebuah bangsa.~~

~~Teknologi ingernet telah memecahkan batas-batas ruang geographical tradisional, mempersingkat jarak tempuh antar wilayah, memaksimisasi integrasi berbagai sumberdaya. Dalam era teknologo digital, perkembangan jaringan internet yang cepat, dapat menghemat pemakaian dan konsumsi energi (Ren, S., Hao, Y., Xu, L., Wu, H., & Ba, N. ,2021).terjadi hbubungan negatif antara pengebangan internet dengan struktur konsumsi energi melalui pertumbuhan ekonomi, investasi R&D, human capital, financial development dan struktur industrial di China.~~

~~Wu, S., Wang, P., & Sun, B. (2022) menggunakan city-level data from China for the period 2003–15 menemukan bahwa internet mempengartuhi disparitas ekonomi antar kota di Chian melalui dampak heterogeneous pada pertumbuhan ekonomi. Internet memperlebar disparitas ekonomi antar kota dengan angka penetrasi internet yang rendah dan kota dengan angka penetrasi internet yang tinggid.~~

investigate the relationship between demographic and economic features and internet use. Specifically, the objectives of this study were to examine the differentials in internet use by demographic and economic features and to analyze the effects of demographic and economic features on internet use. It is hoped that the findings of this study will contribute to the

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understanding of the association between demographic change and economic features and internet usage. In addition, it is hoped that the recommendation from this study will support the government of countries in order to improve internet usage in their countries in order to accelerate their development.

This paper consists of five sections. In Section 2 the related literature was reviewed. Data and methods used in this study were discussed in Section 3. The results of analyses were presented in Section 4. Conclusion of the study was given in Section 5.

2. Literature Review

Bianchini et al. (2021) studied the impacts of age and ideological identification on the use online social network to obtain political information. They found that socio-demographic factors had strong impacts on internet use. Meanwhile, a study in Ethiopia by Yesuf (2021) found higher internet use among those who were aged 20–24 years, had higher education, lived in urban areas, had a mobile phone, literate, had a personal computer, and worked in formal sectors. Further, a study by Singh et al. (2020) found that perceived usefulness and social influence were the key determinants of the use of Fintech services. They also found that age and gender also influenced this behaviour.

The importance of demographic and socioeconomic factors on internet use for health purposes were also found. Studies by Baumann et al. (2017) ~~and Wang et al. (2019)~~ found age, gender, and socioeconomic factors were important determinants of online health information-seeking behaviour.

Studies also found the significance of demographic and socioeconomic determinants in internet use for financial purposes. A study in Russia by Filippova and Turutina (2015) found that age, gender, financial status, and education level were the determinants of internet use for education

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purposes. Meanwhile, Sharma et al. (2015) found the importance of demographic variables in internet use for banking purposes.

A study by Burragoni (2017) found that demographic dividend played an important role in 850 million cellular subscriptions in India. In the post-economic liberalization, banking system development grew together with the population. Together with economic growth, demand and challenges in banking and payment system development also grew.

Myovella et al. (2021) studied the effects of demographic and economic features on digitalization and digital divide in Sub-Saharan African economies. They found that GDP per capita, gross capital formation, trade openness, population growth, and electricity infrastructure influenced digital divide. Meanwhile, low internet use was found related to low economic, social, and cultural development. A study in Yaman by Isaac et al. (2018) found that low internet use was associated with low economic, social, and cultural development. Another study in Indonesia also found the importance of access to electricity in internet use (Amaluddin, 2020).

➔

~~Mungkin salah satu pertanyaan dan yang menyita banyak perhatian dalam literatur ekonomi adalah : mengapa sejumlah negara lebih kaya dibandingkan dengan negara lain" (Solow, 1956). Solow suggested bahwa perbedaan dalam angka pertumbuhan pada akumulasi kapital dapat mengakibatkan perbedaan dalam output per kapital. Selanjutnya Lucas (1988), disparitas dalam human capital merupakan central role dalam analisis pertumbuhan dan perkembangan. Selanjutnya Klenow dan Rodriguez-Clare (1997), Hall and Jones (1999), Parente dan Prescott (2000) dan kemudian Bils dan Klenow (2000) berargumen bahwa perbedaan output per pekerja tidak diakibatkan oleh perbedaan dalam human capital (atau physical capital) tetapi oleh perbedaan dalam sebuah residual yang dinamakan Total Factor Productivity (TFT)~~

~~Total factor productivity (TFP) kemudian merupakan sebuah ukuran produktivitas dihitung dengan membagi total produkis dengan rata-rata tertimbang dair input, yakni tenaga labor dan capital. Human capital diperkaya dengan internet dan internet merupakan physical capital yang sangat berkembang pada revolusi Industri 4.0.~~

~~Pertumbuhan internet namoaknya memainkan peran yang lebih penting dalam meningkatkan produktivitas factor hijau di Cina (Li, T., Han, D., Ding, Y., & Shi, Z.,2020). Green Total Factor Productivity merupakan pilihan yang tak terelakkan untuk secara berkesu¬inambungan menignkatkan kualitas ekonomi China, dan juga promote global development. Sejumlah factor seperti Internet development, human capital, urbanization, energy efficiency, and external dependence all exert a positive influence on China's green total factor productivity~~

~~Song, Y., & Liu, H. (2020) menunjukkan bahwa internet memperbaiki TFT di sejumlah pelabuhan Sungai Yangtze. Juga ditemukan bahwa pengembangan internet pada area dengan tingkat perkembangan ekonomi yang lebih rendah memperbaiki TFT. Pengembangan internet relevan untuk pembangunan ekonomi.~~

~~Zelenyuk, V. (2014) mengembangkan sebuah kerangka kerja menguji dan mendapat signifikansi dari dampak teknologi informasi dan komunikasi pada distribusi produktivitas tenaga kerja pada negara berkembang pada tahun 1980-1995. Internet of Things (IoT) merupakan sebuah innovational complemetary pada ICT dan berimplikasi pada pertumbuhan Total Factor Productivity (Edquist, H., Goodridge, P., & Haskel, J. ,2021).~~

~~Jika internet merupakan factor pertumbuhan eknomi, maka studi ini memeplajari factor-faktor yang memperngaruhi pertumbuhan dan pemakaian internet.~~

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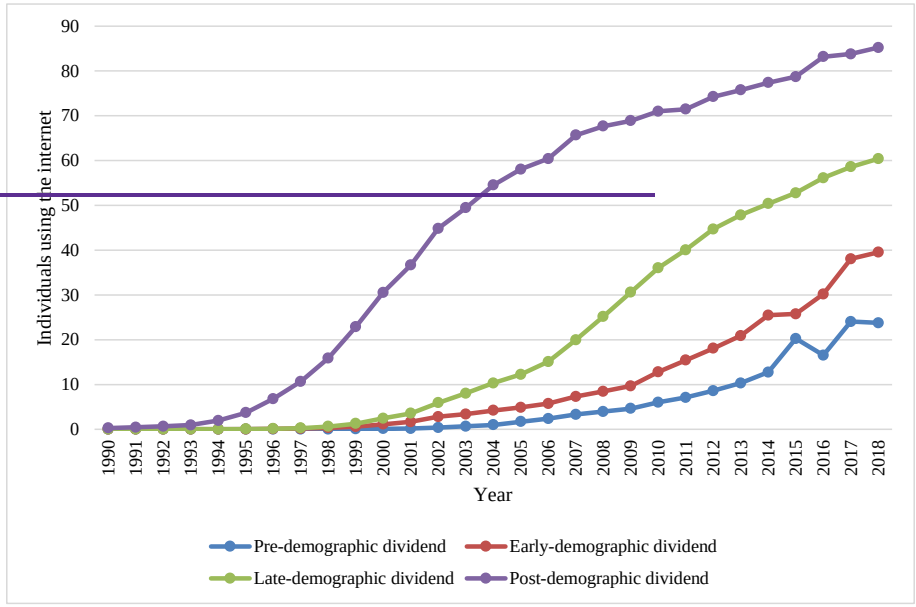

~~Source: World Bank (2021) (Author's compilation).~~

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~~Figure 2~~

~~Individuals Using the Internet (% of population) by the Demographic Dividend Typology~~

~~Internet can be used as an instrument to develop an economy and to pursue a more developed economy. Adelore and Itasanmi (2016) argued that internet increases the participation and motivates illiteracy alleviation. Internet is also an effective means in adult literacy program. Further, study by Kouton (2019) found that the use of internet reduced energy demand used for heating and transportation. This saving allowed the government to allocate energy generator budget to other sectors.~~

~~The use of internet and access to digital devices are continuously increasing in all parts of the world (Horn & Rennie 2018). For example, in Sarawak in Borneo island, Malaysia, a number of remote villages were lack of infrastructure, such as asphalt road and electricity network. But, a number of people had a mobile phone and internet access.~~

Salahuddin and Alam (2015) studied the association between the internet usage ~~, electricity consumption,~~ and economic growth in Australia. They found ~~that~~ bidirectional causal link

between ~~higher electricity consumption was associated with higher electricity consumption~~internet usage and economic growth.

Stork et al. (2013) analyzed internet access and use trends in some African countries in 2007/2008 and 2011/2012. They found that the use of internet increased very significantly in these countries despite of some barriers, such as large-scale computers and expensive connectivity costs. In addition, mobile phone had been used as key entry point to internet use. As a result, the internet penetration increased by 11.5% in these countries from 2007/2008 to 2011/2012.

Meanwhile, Nigeria experienced economic growth as an impact of ICT business and telecommunication liberalization during the 2000s (Akinwale et al. 2018). There was a co-integration between ICT and economic growth in the long run. In the short run, only with secure internet server per 1 million and mobile cellular subscription per 100 people resulted in positive and significant impact on economic growth.

Gholizadeh et al. (2014) studied the relationship between gross domestic product (GDP) and internet use in some ASEAN countries during 1996–2011. They found that there was a positive and significant association between internet use and GDP, although there were differences between those ASEAN countries. Meanwhile, a study by Bahrini & Qaffas (2019) in the Middle East and North Africa (MENA) and Sub-saharan Africa (SSA) found that ICT, i.e. mobile phone, internet usage, and broadband adoption were the main driver of economic growth during 2007–2016.

Internet fosters economic growth (Jiménez et al. 2014). An increase of 10% in internet connectivity was found to boost up GDP growth by 1.38% in the world. In OECD countries, high internet access generated GDP by 2%.

Meanwhile, Salahuddin et al. (2016) studied the effects of internet and real GDP on social capital creation measured by trust in Australia during 1985–2013. They found that internet increased social capital in the short run, but reduced social capital in the long run. In addition, there was a short and long run positive relationship between internet and GDP per capita.

Not only in developing countries that internet affects economic growth. Amiri & Reif (2013) in their study in Nordic region found that in countries with highest internet penetration there was an association between highest internet penetration and highest GDP per capita in the world.

Internet penetration is determined by a number of factors. Feng (2015) studied the factors influencing internet penetration in China. It was found that internet penetration was mainly affected by internet access cost, internet content, and GDP per capita.

Meanwhile, a study by Lera-Löpez et al. (2011) found that socioeconomic, demographic, and regional factors influenced internet use. The use of internet was primarily associated with education, age, occupation, employment in service sector, nationality, living in urban areas, and regional GDP per capita. They also found that internet use was positively related with broadband connection and education, while internet skill was influenced by gender and population size.

The relationship between inflation and internet use has also been studied. Yi & Choi (2005) found that internet improved productivity and reduced inflation. An increase of 1% in the ratio of the internet users to total population reduced inflation from 0.04264% point to 0.13193% point. Subsequently, inflation has a positive effect on internet demand.

The new economic theory proposed that humankind is entering an era with high output growth, low unemployment, and low inflation (Meijers, 2006). It is described that inflation suppresses internet growth and on the other side, internet will increase inflation in the long run. Sharma et al. (2014) studied the relationship between inflation and internet use through online shopping in India. They found that inflation had an indirect effect on internet growth.

Choi (2003) investigated the effects of internet on the volume of inward foreign direct investment (FDI). Internet was assumed to boost up higher FDI through productivity improvement. Using 53 FDI recipient country data and FDI gravity equation it was found that when the number of hosts and internet users in a country increased by 10%, FDI inflow increased by more than 2%.

The international community supports developing countries by building up digital infrastructure and regulation in order to be able to participate in international trade, in particular through larger diversification series in export. The study by Gnangnon (2020) using panel data from 131 countries during 1995–2014 found that greater internet access was positively associated with export diversification in particular both in less developed and developed countries. Internet access creates innovation level of a country, merchandise export including its concentration export products, and the size of inflow FDI. The results of this study emphasized the need of digital infrastructure development and regulation that facilitate access to the internet.

Pradhan et al. (2017) also studied the association between FDI, economic growth, and use of communication technology in 21 Asian countries during 1965–2012. Communication technology included fixed telephone, mobile phone, and internet use and service including fixed broadband. The results of the study show that there was a positive association between FDI, economic growth, and communication technology. Using the Granger causality analysis, these three variables were positively related.

A study on the association between FDI and internet use in 10 ASEAN countries had been carried out (Ramdan et al. 2020). It was found that higher internet use was associated with higher FDI. A 1% increase in FDI was associated with a 0.0681 increase in internet use.

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Based on the above literature review, ~~this study aims to investigate the association between demographic and economic factors with internet use in the world. I~~it is hypothesized that higher internet use is associated with higher demographic dividend typ~~ology~~e, higher access to electricity, higher GDP, lower inflation, and higher FDI.

~~2.~~3. Data and Methods

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This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The countries and study period were selected based on the availability of data on variables used in the study. In addition, the selected countries were classified by demographic dividend type by the World Bank (Appendix Table A).

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The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the type of demographic dividend (TDD) which was a categorical variable (=0 if pre, =1 if early, =2 if late, and =3 if post). Therefore, there were three (3) dummy variables for TDD, that is *EarlyDD* (=1 if early, =0 otherwise), *LateDD* (=1 if late, =0 otherwise), and *PostDD* (=1 if post, =0 otherwise), and pre-demographic dividend was the reference category. Meanwhile, the economic variables included access to electricity (% of population, *Electric*), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

This study employed panel data analyses. The econometric model used was a fixed effects regression model using income level group, regional group, and year as identifiers. This model was also carried out based on G20 country group and income level group. The proposed model in this study was as follows.

$$Internet_{it} = \beta_0 + \beta_{11} EarlyDD_{it} + \beta_{12} LateDD_{it} + \beta_{13} PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

This fixed effects regression model still had endogeneity problem and measurement errors in the variables used. The demographic dividend type can influence internet use and on the other hand internet use can affect the demographic dividend type. In addition, the demographic dividend type is endogenous, that is a variable that is influenced by other variables. Therefore, other approaches were employed as robustness checks using the static generalized method of moment (GMM). This GMM is a simultaneous model between an endogenous variable and instrument or exogenous variables in the first stage regression and an endogenous model between the dependent variable and independent variables in the second stage regression. The instrument variables used consisted of crude death rate (deaths per 1,000 people, CDR), population density (population per km^2, Density), and crude birth rate (births per 1,000 people, CBR).

The first stage regression model was as follows.

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$$TDD_{it} = \alpha_0 + \alpha_{11}CDR_{it} + \alpha_{12}Density_{it} + \alpha_{13}CBR_{it} + \alpha_2 Electric_{it} + \alpha_3 \ln(GDP)_{it} + \alpha_4 Inflation_{it} + \alpha_5 FDI_{it} + \varepsilon$$

The second stage regression model was as follows.

$$Internet_{it} = \beta_0 + \beta_{11}EarlyDD_{it} + \beta_{12}LateDD_{it} + \beta_{13}PostDD_{it} + \beta_2 Electric_{it} + \beta_3 \ln(GDP)_{it} + \beta_4 Inflation_{it} + \beta_5 FDI_{it} + \varepsilon$$

The endogenity problem can result in biased and inconsistent estimates when there is lag in dependent variable. This problem can be solved by employing the dynamic panel GMM model. Arellano and Bond (1991) proposed the GMM approach. There are two reasons of applying GMM approach. First, GMM is a common estimator that gives a framework for comparison and evaluation. Second, GMM gives simple alternative to other estimators in particular maximum likelihood.

However, GMM estimators also have some limitations. First, GMM estimator is asymptotically efficient if the sample size is large, but inefficient if the sample size is finite. Second, the estimator sometimes needs a number of programming implementation so that it needs software that can support GMM approach application.

There are three estimation methods that are commonly used in GMM framework, that is first-differences GMM (FD-GMM) or Arellano-Bond GMM (AB-GMM), system GMM (SYS-GMM), and "difference" and "system" GMM dynamic panel estimator. This study employed "difference" and "system" GMM dynamic panel estimator to analyze the estimators. This model was selected because the demographic dividend type was time invariant and the model can solve this problem.

~~This study used data from the World Bank (2021). The unit of analysis was country, covering 186 countries in the world. The study period was from 2001 through 2017. Therefore, there were 3,162 observations in this study. The dependent variable was the information technology, that is the individuals using the internet (% of population). The independent variables were the demographic variable and economic variables. The demographic variable was the typology of demographic dividend that consisted of pre-, early- (*EarlyDD*), late- (*LateDD*), and post-demographic dividend (*PostDD*) with pre-demographic dividend typology as the reference category. Meanwhile, the economic variables included access to electricity (% of population,~~

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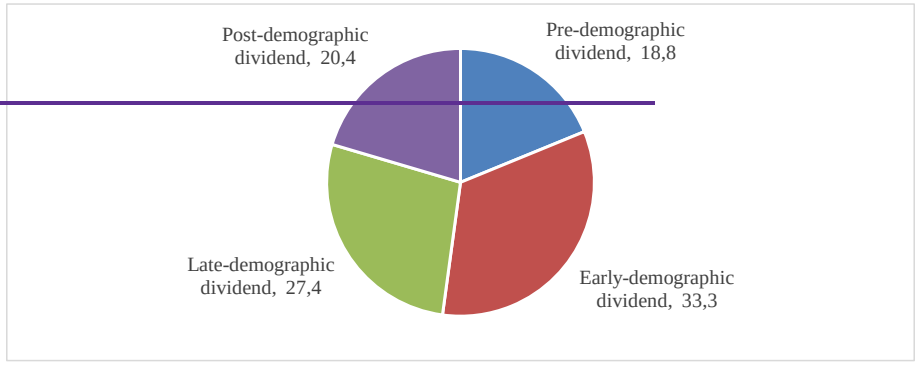
Electric), gross domestic product (constant 2010 US$, *GDP*), inflation, consumer prices (annual %) (*Inflation*), and foreign direct investment (*FDI*), net inflows (% of GDP).

Data in this study were analyzed using univariate, bivariate, and multivariate analyses. For the univariate analysis, the percentage distribution of countries by the demographic dividend typology and the summary statistics (the number of observations, the mean, standard deviation, minimum, and maximum) of the continuous variables in the model were given. For the bivariate analysis, the average percentage of individuals using the internet by the demographic dividend typology and simple regression analyses between the internet use and economic variables were performed. For the multivariate analysis, a multiple regression with random effects was carried out to investigate the demographic and economic determinants of internet use in countries in the world during 2001–2017. The model was as follows.

$$Internet = \beta_0 + \beta_{11} EarlyDD + \beta_{12} LateDD + \beta_{13} PostDD + \beta_2 Electric + \beta_3 \ln(GDP) + \beta_4 Inflation + \beta_5 FDI + \varepsilon$$

3.4. Results

The results of univariate analysis are presented in Figure 3 and Table 1. It can be seen from Figure 3 that the majority of countries in the world were in early demographic dividend typology (33.3%), followed by in late demographic dividend typology (27.4%), in post-demographic dividend typology (20.4%), and in pre-demographic dividend typology (18.8%). Meanwhile, it can be seen from Table 1, the percentage of individuals using the internet ranged from none in Timor-Leste in 2001 to almost universal of 98.3% in Iceland in 2017 and the percentage of population with access to electricity varied from a low of 0.53% in Liberia in 2001 to universal, 100%, in Iceland in 2017. Further, the GDP constant ranged between US$143.2 thousand in Kiribati in 2001 and US$17.4 trillion in the United States in 2017, the annual inflation (consumer prices) varied from a low of -18.1% in Bhutan in 2004 to a high of 359.9% in the Democratic Republic of Congo in 2001, and the current net inflows foreign direct investment differed from -58.2% in Luxembourg in 2007 to 56.5% in Malta in 2007.



Source: World Bank (2021) (Author's compilation).

Figure 3

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

Table 1

Summary Statistics of Variables in the Model: Number of Observation, Mean, Standard Deviation, Minimum, and Maximum

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Individuals using the Internet (% of population)	3,162	30.5	28.3	0.0	98.3
Access to electricity (% of population)	3,162	78.3	30.6	0.53	100.00
GDP (constant 2010 US$)	3,162	347.0 billion	1,334.6 billion	143.2 thousand	17.4 trillion
Inflation, consumer prices (annual %)	3,162	6.0	11.3	-18.1	359.9
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	18.0	-58.2	56.5

Source: World Bank (2021) (Author's compilation).

The results of bivariate analysis are displayed in Figure 4 – Figure 8. These are the average percentage of individuals using the internet by the demographic dividend typology (Figure 4) and the scatter diagrams, simple regression equations and lines, and coefficient determinations between each independent variable in the model and the dependent variable (Figure 5–8). It can be seen from Figure 4 that the average percentage of individuals using the internet was

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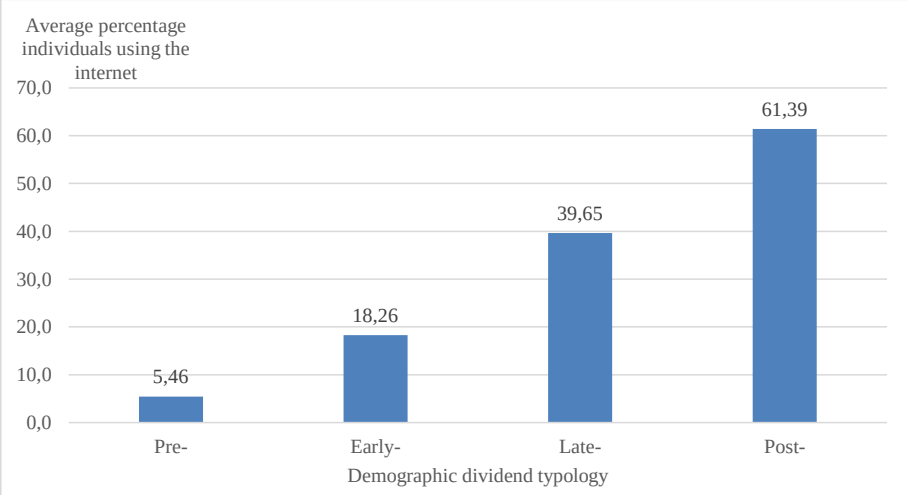
lowest in pre-demographic dividend typology countries (5.5%) and highest in post-demographic dividend typology countries (61.5%).

Figure 5 shows that there was a positive relationship between access to electricity and internet use. An increase of one percent in population with electricity was related with an increase of about 0.56% in the individuals using the internet. The coefficient of determination was 0.366 indicating that 37% of the variation in the individuals using the internet can be explained by the variation in the access to electricity.

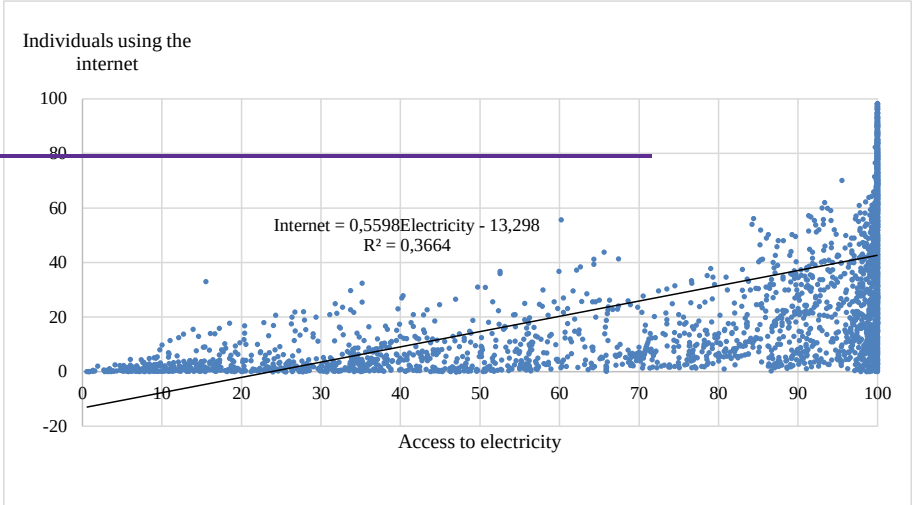
Figure 6 shows that there was a positive relationship between ln(GDP) and internet use. An increase of one percent in economic growth (GDP constant 2010) was correlated with an increase of about 0.35% in the individuals using the internet. The coefficient of determination was 0.0008 suggesting that ln(GDP) can explain the variation in the individuals using the internet by 0.08%.



Source: World Bank (2021) (Author's compilation).

Figure 4

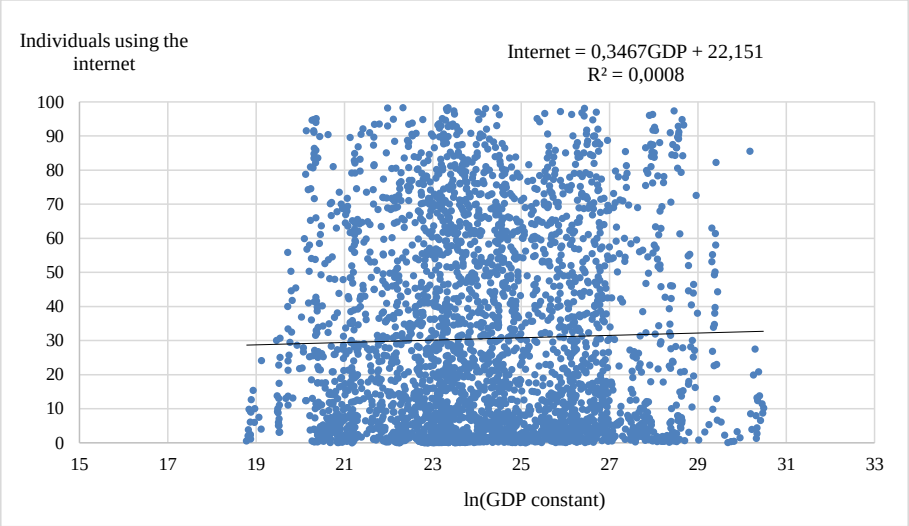
The Average Percentage of Individuals using the internet (% of population) by the Demographic Dividend Typology: World 2001–2017



Source: World Bank (2021) (Author's compilation).

Figure 5

Access to electricity (% of population) and Individuals using the internet (% of population): World 2001–2017

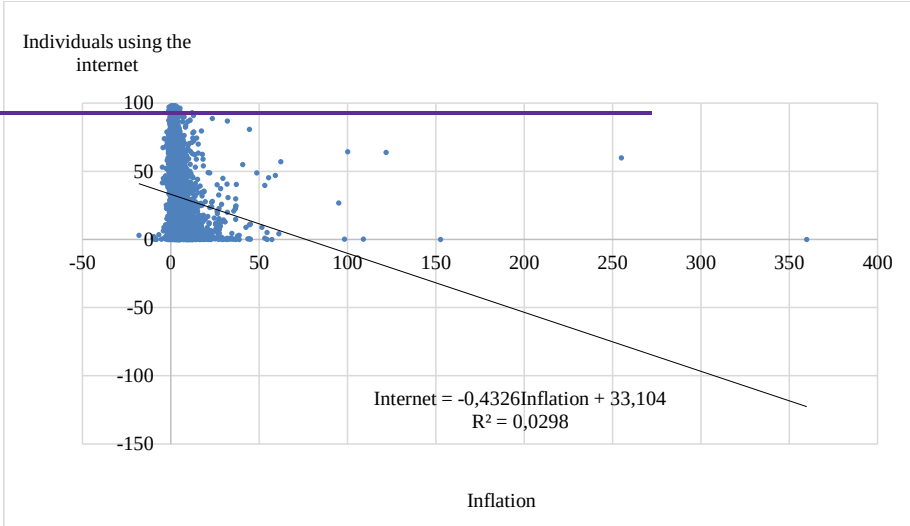


Source: World Bank (2021) (Author's compilation).

Figure 6

ln(GDP constant) and Individuals using the internet (% of population): World 2001–2017

Figure 7 indicates that there was a negative relationship between inflation and internet use. An increase of one percent in inflation was related with a decline of about 0.43% in the individuals using the internet. The coefficient of determination was 0.029 indicating that 2.9% of the variation in the individuals using the internet can be explained by the variation in inflation.

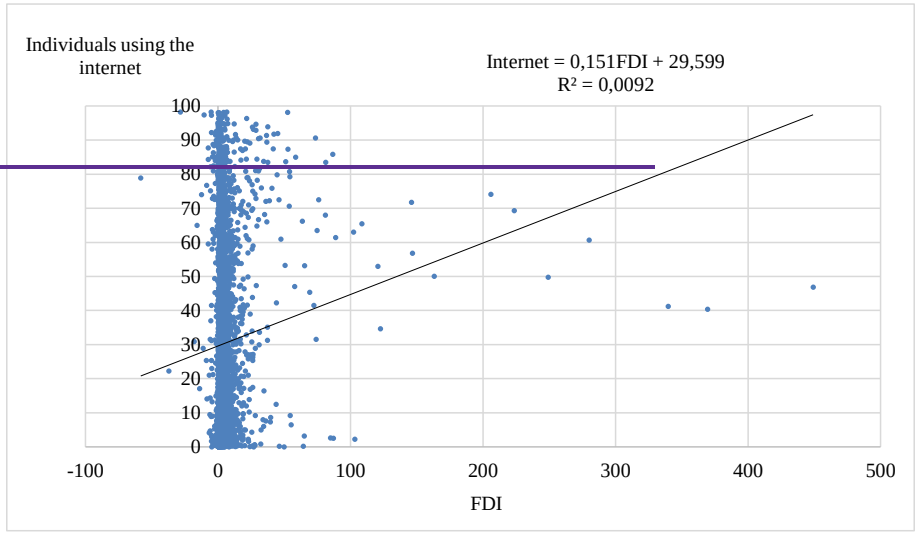


Source: World Bank (2021) (Author's compilation).

Figure 7

Inflation (% annual) and Individuals using the internet (% of population): World 2001–2017

Figure 8 shows that there was a positive relationship between FDI and internet use. An increase of one percent in FDI was correlated with an increase of about 0.009 in the individuals using the internet. The coefficient of determination was 0.009 suggesting that the variation in FDI can explain the variation in the individuals using the internet by 0.9%.

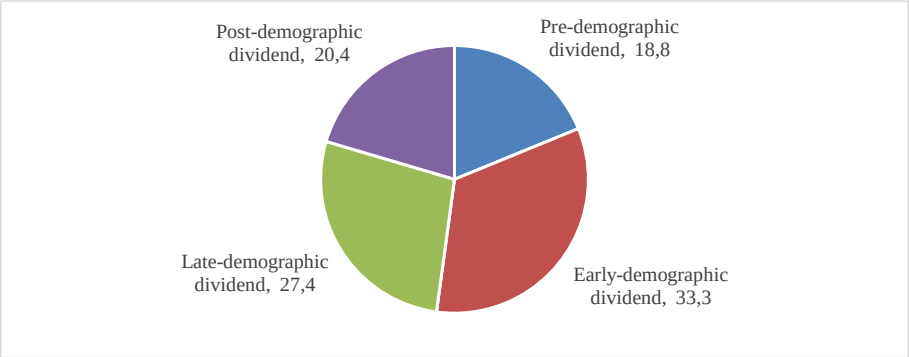


~~Source: World Bank (2021) (Author's compilation).~~

~~Figure 8~~

~~Foreign direct investment (net inflows, % of GDP) and Individuals using the internet (% of population): World 2001–2017~~

It can be seen from Figure 1 the majority of countries in the world were in early-demographic dividend type (33.3%), followed by in late-demographic dividend type (27.4%), in post-demographic dividend type (20.4%), and in pre-demographic dividend type (18.8%). The majority of countries in early-demographic dividend type were African countries, such as Angola, Benin, Chad, Eritrea, Kenya, Niger, Sudan, Togo, Uganda, and Zambia (Appendix Table A). Meanwhile, most developed countries were in post-demographic dividend countries, such as Australia, Belgium, Canada, Denmark, Germany, Japan, Norway, Singapore, United Kingdom, and United States.



Source: World Bank (2021) (Author's compilation).

Figure 1

Percentage distribution of countries by demographic dividend typology (%): World 2001–2017

The number of observation and mean of variables used in the study both for full observations and by demographic dividend type was presented in Table 1. It can be seen that there was a significant variation in internet use across countries in the world and across demographic dividend types. The mean of individuals using the internet was 30.5% for full observations, lowest in pre-demographic dividend countries (only 5.5%), 18.3% in early-demographic dividend countries, 39.7% in late-demographic dividend countries, and highest in post-demographic dividend countries (61.4%). Other variables also show disparities in demographic and economic features across countries and demographic dividend types that reflects better development achievement in more developed countries.

Table 1. Number of observations (*n*) and mean of variables in the study for full observation and by demographic dividend type.

	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
Variable	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Individuals using the internet (% of population)	3,162	30.5	595	5.5	1,054	18.3	867	39.7	646	61.4
Access to electricity (% of population)	3,162	78.3	595	31.4	1,054	75.7	867	97.5	646	99.9
GDP (constant 2010 US$)	3,162	3.47E+11	595	2.76E+10	1,054	1.34E+11	867	2.52E+11	646	1.12E+12
Inflation, consumer prices (annual %)	3,162	6.0	595	8.3	1,054	7.10	867	5.0	646	3.2
Foreign direct investment, net inflows (% of GDP)	3,162	6.2	595	4.7	1,054	3.36	867	8.3	646	9.3
Death rate, crude (per 1,000 people)	3,162	8.3	595	10.9	1,054	7.00	867	7.4	646	9.1
Population density (people per sq. km of land area)	3,162	312.5	595	73.3	1,054	162.05	867	140.2	646	1,009.8

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Variable	Full Observation		Pre-Demographic Dividend		Early-Demographic Dividend		Late-Demographic Dividend		Post-Demographic Dividend	
	n	Mean	*n*	Mean	*n*	Mean	*n*	Mean	*n*	Mean
Birth rate, crude (per 1,000 people)	3,162	22.4	595	39.7	1,054	25.50	867	15.3	646	10.7

Source: World Bank (2021) (Author's compilation).

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The results of diagnostic tests show that the residual approached normal distribution but statistically not normal (Jarque-Bera normality test was 52.24 and χ^2 = 4.5E-12). But, this assumption only applies for certain models. This assumption is not used if random effects regression, GMM, instrumental variables, and two-stage least squares (2SLS) are used.

The results of multicollinearity test show that there was no variance inflation factor (VIF) that was greater than 10. The mean of VIF was 2.650. In addition, there was no pairwise correlations that was greater than 0.5. It means there was no multicollinearity indication in the model.

There was heteroscedasticity in the model. χ^2 = 1,726.32 and Prob > χ^2 = 0.000. This problem was solved by using STATA application by making the model that improved standard errors (robust standard errors).

The results of Chow test show that fixed effects model was better than pooled least squares model (F(3, 3151) = 181.13, Prob > F = 0.000). In addition, the results of Hausman test show that fixed effects model was better than random effects model (χ^2 = 817.94 and Prob > χ^2 = 0.000). Further, the results of Breusch and Pagan Lagrangian multiplier test show that random effects model was better than pooled least squares model.

The results of fixed effect regression using income level group, regional group, and year as identifiers show that in general demographic dividend had significant positive association with internet use (Table 2). After controlling for the economic features, the percentage of individuals using the internet was, respectively 6.5%–21% higher and 15%–39% higher in late-demographic dividend and post-demographic dividend countries than in pre-demographic dividend countries. This finding supported the results of a study by Lera-López et al. (2011) and Myovella et al. (2021) that found the role of demographic factor in increasing internet use in the world. More favorable demographic features, including being a late- and post-

demographic dividend country, had been an important factor of better development that could enhance access to information and communication technology including internet use.

Table 2 Results of Fixed Effects Regression based on Identifier.

	Identifier		
Covariates	Income level group	Regional group	Year
Early-Demographic Dividend	0.317	1.398	4.409***
	(1.221)	(1.425)	(0.921)
Late-Demographic Dividend	6.507***	14.398***	21.101***
	(1.542)	(1.749)	(1.588)
Post-Demographic Dividend	15.142***	30.349***	39.005***
	(1.721)	(1.939)	(0.691)
Access to electricity (% of population)	0.216***	0.290***	0.161***
	(0.021)	(0.022)	(0.035)
Inflation, consumer prices (annual %)	-0.115***	-0.176***	-0.070
	(0.028)	(0.030)	(0.051)
log(gdpconstant2010us)	1.650***	1.958***	1.666***
	(0.166)	(0.183)	(0.059)
Foreign direct investment, net inflows (% of GDP)	0.017	0.048**	0.052***
	(0.018)	(0.019)	(0.015)
Constant	-30.610***	-49.345***	-37.480***
	(4.017)	(4.340)	(4.490)
Observations	3,162	3,162	3,162
R-squared	0.165	0.340	0.656
Fixed effects in income level group	Yes	No	No
Fixed effects in regional group	No	Yes	No
Fixed effects in year	No	No	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: World Bank (2021) (Author's compilation).

~~Before a multiple regression was conducted, the multi-collinearity between the variables in the model were checked. It was found that there was no collinearity between variables in the model, except between the demographic dividend typology and electricity where the Spearman correlation coefficient was slightly above 0.7 (0.71). However, this did not have serious effects on the results of the regression. The results of the multiple fixed effects regression are given in Table 2. These include the regression coefficient, standard errors, and *p* value for each covariate. All covariates in the model had significant effects on internet use statistically. The coefficient of variation was 0.540 implying that 54.0% of the variation in the internet use could be explained by the model with a significance level below 0.001.~~

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~~The demographic dividend typology was positively associated with the internet use. Late- and post-demographic dividend countries had higher percentage of individuals using the internet than pre-demographic dividend countries. After controlling for the effects of economic factors, the percentage of individuals using the internet was, respectively, 13.0% and 29.7% higher in the late- and post-demographic dividend countries than in the pre-demographic dividend countries. This result supports the finding by Lera-López et al. (2011) on the importance of demographic factors on internet use. Countries with more advanced demographic change, that is late- and post-demographic dividend typology had lower fertility levels and better economic development achievement so that individuals in these countries were more likely to have exposed to better development, including access internet than individuals in pre- and early-demographic dividend typology countries.~~

Access to electricity ~~was the strongest factor that affected~~ influenced internet use positively. The higher the percentage of population who had access to electricity, the higher the percentage of individuals using the internet. Other things being the same, an increase of one percent in the access to electricity was related to an increase of ~~0.27%~~ 0.161% – 0.290% in the internet use. This finding is in accordance with the finding by Myovella et al. (2021) ~~Salahuddin and Alam (2015)~~ that found the positive association between ~~internet use and~~ electricity consumption and internet use. Access to electricity can boost the electricity-based economic activity and in today's industrial internet of things era, it is a key factor of internet use since the internet cannot be used without electricity.

Economic growth ~~was~~ had ~~the second strongest factor of and had a~~ positive effect on the internet use. The higher the economic growth, the higher the percentage of internet use. Ceteris paribus, an increase of one percent in economic growth was associated with an increase of internet use by ~~4.6~~1.650% – 1.958%. This result supports the study result by Pradhan et al. (2017) and Amaluddin (2020) that found a positive relationship between economic growth and internet use. Economic growth allows a country to expand its economy that today heavily depends on the internet and hence increases internet use.

Inflation had a negative relationship with the percentage of individuals using the internet. The higher the inflation in a demographic dividend typology, the lower the percentage of individuals using the internet. After controlling for the effects of other factors, an increase of

one percent in inflation was associated with a decline of the percentage of individuals using the internet by 0.1~~8~~15% – 0.176%. This finding confirms the results of study by Yi & Choi (2005) that found a negative association between inflation and internet use. This is because ~~I~~inflation is a contributor of cost and price rise including internet cost that reduces internet use through the decline in people's purchasing power including purchasing the internet because of the price rise across the economies.

Foreign direct investment (FDI) had a positive influence on internet use. The higher the FDI, the higher the internet use. An increase of one percent in FDI was related with an increase of the percentage of individuals using the internet by 0.0485%–0.052% . This results strengthens the study finding by Gnangnon (2020) and Ramdan et al. (2020) that found a positive relationship between FDI and internet use through the capital ~~addition~~ accumulation in an economy that can increase individuals' access to the internet use.

The results of the above analyses also show that 16.5%–65.6% of variation in internet use was explained by demographic dividend type and economic features.

The above results still had heteroscedasticity and endogeneity effects problem. To obtain consistent and robust results, this study conducted robustness checks by employing other approaches and different sub-samples. The results were as follows.

This study presented the results of analyses employing fixed effects, random effects, and pooled least square model. The results of the three models gave consistent results that demographic dividend type had positive effects on internet use significantly. The percentage of individuals using internet was 13%–14% and around 30% higher in, respectively, late- and post-demographic dividend countries than in pre-demographic dividend countries (Table 3). In addition, higher percentage of individuals using internet was associated with higher percentage of access to electricity, economic growth, and FDI and associated with lower inflation. A one percent increase in, respectively, access to electricity, economic growth, FDI, and inflation was associated with, respectively, an increase of about 0.3%, 2%, and 0.05% individuals using internet and a decline of 0.2% individuals using internet.

Table 3. Comparison between the results of fixed effects, random effects, and pooled least square model.

Covariate	(1) Fixed Effects	(2) Random Effects	(3) Pooled Least Square
Early-Demographic Dividend	1.398	-0.917	-0.917
	(1.425)	(1.288)	(0.734)
Late-Demographic Dividend	14.398***	12.957***	12.957***
	(1.749)	(1.614)	(1.344)
Post-Demographic Dividend	30.349***	29.737***	29.737***
	(1.939)	(1.708)	(1.513)
Access to electricity (% of population)	0.290***	0.273***	0.273***
	(0.022)	(0.020)	(0.015)
Inflation, consumer prices (annual %)	-0.176***	-0.178***	-0.178**
	(0.030)	(0.030)	(0.079)
Log(gdpconstant2010us)	1.958***	2.010***	2.010***
	(0.183)	(0.179)	(0.181)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.051***	0.051**
	(0.019)	(0.019)	(0.025)
Constant	-49.345***	-47.954***	-47.954***
	(4.340)	(4.061)	(4.027)
Observations	3,162	3,162	3,162
R-squared	0.340		0.549
Number of id_regional	Yes	No	No

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 4, the results of analyses of fixed effects regressions for full observation and by income group were presented. It can be seen that the results were consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the effect of demographic dividend was largest in upper middle income countries and insignificant in high income countries.

Table 4. Results of Fix Effects Regression for full observation and by income level.

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	1.398		-0.429	3.168**	11.689***
	(1.425)		(0.986)	(1.351)	(3.587)
Late-Demographic Dividend	14.398***	-0.635		6.025***	20.667***
	(1.749)	(3.713)		(1.942)	(3.846)

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	(1)	(2)	(3)	(4)	(5)
Covariate	Full Observation	High Income	Low Income	Lower Middle Income	Upper Middle Income
Post-Demographic Dividend	30.349***	4.907		4.133	15.432***
	(1.939)	(3.909)		(3.655)	(4.449)
Access to electricity (% of population)	0.290***	1.950***	0.201***	0.322***	0.717***
	(0.022)	(0.487)	(0.019)	(0.024)	(0.089)
Inflation, consumer prices (annual %)	-0.176***	-0.746***	-0.004	-0.086*	-0.093*
	(0.030)	(0.180)	(0.014)	(0.046)	(0.049)
lgdpconstant2010us	1.958***	1.524***	1.687***	0.438*	0.763**
	(0.183)	(0.423)	(0.252)	(0.245)	(0.323)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.018	0.027	0.014	-0.321***
	(0.019)	(0.024)	(0.027)	(0.089)	(0.119)
Constant	-49.345***	-174.760***	-38.590***	-20.003***	-70.770***
	(4.340)	(48.125)	(5.630)	(5.709)	(10.270)
Observations	3,162	1,020	442	833	867
R-squared	0.340	0.071	0.286	0.258	0.155
Number of id_regional	7	6	5	6	6

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table 5, the results of analyses of fixed effects regression for full observation and by year were presented. It can be seen that the results were also consistent with the previous results of the positive association between demographic dividend type, electricity, economic growth, and FDI with internet use and negative association between inflation and internet use. In addition, the percentage of individuals using internet was significantly higher in early-demographic dividend countries than in pre-demographic dividend countries in 2007–2012 and in 2013–2017 with an increasing effect.

Table 5. Results of Fixed Effects Regression for Full Observations and by Year.

	(1)	(2)	(3)	(4)
Covariate	All Observation	2001-2006	2007-2012	2013-2017
Early-Demographic Dividend	1.398	0.118	3.289*	6.819***
	(1.425)	(1.638)	(1.839)	(1.965)
Late-Demographic Dividend	14.398***	9.510***	19.678***	25.449***
	(1.749)	(2.046)	(2.267)	(2.387)
Post-Demographic Dividend	30.349***	28.334***	38.265***	37.249***
	(1.939)	(2.283)	(2.500)	(2.631)
Access to electricity (% of population)	0.290***	0.083***	0.212***	0.430***
	(0.022)	(0.025)	(0.030)	(0.035)

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Inflation, consumer prices (annual %)	-0.176***	-0.078***	-0.494***	-0.027
	(0.030)	(0.027)	(0.068)	(0.042)
lgdpconstant2010us	1.958***	1.418***	1.648***	1.782***
	(0.183)	(0.216)	(0.234)	(0.244)
Foreign direct investment, net inflows (% of GDP)	0.048**	0.088***	0.028	0.093**
	(0.019)	(0.023)	(0.020)	(0.039)
Constant	-49.345***	-32.532***	-36.721***	-48.902***
	(4.340)	(5.022)	(5.601)	(6.037)
Observations	3,162	1,116	1,116	930
R-squared	0.340	0.407	0.502	0.535
Number of id-_ regional	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS model used CDR, population density, and CBR as instrumental variables. The results of diagnostic test for instrumental variable in 2SLS and GMM model show that F(1, 3154) = 69.68, which was greater than 10, and Prob > F = 0.0000, meaning that the models had strong instrumental variables. In addition, the results for first stage regression show that Sanderson-Windmeijer (SW) first-stage chi-squared and F statistic was significant, meaning that all instrument variables were relevant or valid to explain the endogeneous variable (demographic dividend type). The results of the first stage regression of 2SLS model were presented in Table 6.

Table 6. The Results of First Stage Regression of 2SLS Model.

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
Death rate, crude (per 1,000 people)	-0.0447***	-0.00571**	0.0305***
	(0.00269)	(0.00246)	(0.00187)
Population density (people per sq. km of land area)	-2.33E-05***	-4.35E-05***	5.07E-05***
	(5.24E-06)	(4.80E-06)	(3.64E-06)
Birth rate, crude (per 1,000 people)	0.0137***	-0.0152***	-0.0213***
	(0.00145)	(0.00133)	(0.00101)
Access to electricity (% of population)	0.00213***	0.00244***	-0.00227***
	(0.000547)	(0.000501)	(0.000380)
Inflation, consumer prices (annual %)	0.00278***	0.000831	-0.00246***
	(0.000687)	(0.000629)	(0.000477)
lgdpconstant2010us	-0.0215***	-0.0476***	0.0490***
	(0.00383)	(0.00351)	(0.00266)
Foreign direct investment, net inflows (% of GDP)	-0.00216***	0.000313	0.000781***
	(0.000432)	(0.000396)	(0.000300)
Constant	0.755***	1.629***	-0.586***

Covariate	(1) Early-Demographic Dividend	(2) Late -Demographic Dividend	(3) Post-Demographic Dividend
	(0.125)	(0.115)	(0.0871)
Observations	3,162	3,162	3,162

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of second stage regression for full observations and based on income group were given in Table 7. It can be seen that the 2SLS method results for full observations were also consistent with the previous results. The percentage individuals using the internet was significantly higher in early-, late-, and post-demographic dividend countries than in pre-demographic dividend countries, but with much higher percentages than in the previous models. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI. By income group, demographic dividend type had significant positive effects on internet use in low and high income countries.

Table 7. The Results of Second Stage Regression for Full Observations and based on Income Group

Covariate	(1) Full Observation	(2) High Income	(3) Low Income	(4) Lower Middle Income	(5) Upper Middle Income
Early-Demographic Dividend	33.32***		7.684***	-4.024	266.7
	(5.728)		(1.429)	(3.523)	(495.7)
Late-Demographic Dividend	34.63***	58.57***		10.17	83.94
	(4.269)	(11.17)		(9.063)	(115.5)
Post-Demographic Dividend	60.09***	49.14***		-5.432	390.4
	(5.328)	(7.119)		(10.67)	(720.7)
Access to electricity (% of population)	0.0335	-0.772	0.0599***	0.242***	1.181
	(0.0357)	(0.715)	(0.0177)	(0.0431)	(1.712)
Inflation, consumer prices (annual %)	-0.180***	-1.225***	-0.00716	-0.107**	-0.877
	(0.0350)	(0.232)	(0.0160)	(0.0500)	(1.596)
lgdpconstant2010us	2.134***	4.411***	1.267***	0.179	5.844
	(0.332)	(0.764)	(0.291)	(0.268)	(9.764)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.0319	0.0416	-0.0174	4.808
	(0.0232)	(0.0274)	(0.0305)	(0.133)	(10.14)
Constant	-55.96***	-22.53	-27.04***	-4.932	-433.5

	(6.753)	(57.65)	(6.542)	(7.799)	(765.6)
Observations	3,162	1,020	442	833	867
R-squared	0.422	-0.064	0.193	0.259	-25.924

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2

The Coefficients, Standard Error, and *p*-value of multiple regression of the determinants of individuals using the internet: World 2001–2017

Individuals using the internet (% of population)	Coefficient (95% CI)	Standard error	*p* value
Demographic dividend typology			
Pre-	Reference		
Early-	-0.917 (-3.442, 1.608)	1.288	0.476
Late-	12.957 (9.793, 16.121)	1.614	< 0.001
Post-	29.738 (26.389, 33.087)	1.708	< 0.001
Access to electricity (% of population)	0.273 (0.234, 0.311)	0.020	< 0.001
ln(GDP constant)	4.627 (3.819, 5.435)	0.412	< 0.001
Inflation, (annual %)	-0.178 (-0.238, -0.118)	0.030	< 0.001
Foreign direct investment, net inflows (current US$)	0.051 (0.014, 0.089)	0.019	0.008
Constant	-48.992 (-56.945, -41.039)	4.056	< 0.001

In this study, the comparison between the results of fixed-effects regression and 2SLS method based on G20 and non-G20 group was also carried out. The results were presented in Table 8. It can be seen that the results were consistent with the previous results that demographic dividend type had significant positive influence on internet use both in non-G20 and G20 countries.

Table 8. The Results of Second Stage Regression based on G20 Country Group.

	(2)	(3)	(4)	(5)
	Non-G20 countries		G20-countries	
Covariate	Fixed Effects	2SLS	Fixed Effects	2SLS
Early-Demographic Dividend	29.82***	1.945		
	(5.812)	(1.935)		
Late-Demographic Dividend	32.61***	15.23**	0.0687	0.105
	(3.882)	(4.467)	(9.069)	(2.700)
Post-Demographic Dividend	56.73***	28.52***	37.58***	31.35**
	(5.297)	(4.097)	(4.276)	(11.99)
Access to electricity (% of population)	0.0490	0.284**	0.934***	1.936*
	(0.0335)	(0.0806)	(0.164)	(0.898)
Inflation, consumer prices (annual %)	-0.163***	-0.162	-0.620***	-0.619*
	(0.0346)	(0.140)	(0.235)	(0.317)
lgdpconstant2010us	2.635***	2.367*	-0.742	0.926

Covariate	(2) Non-G20 countries Fixed Effects	(3) Non-G20 countries 2SLS	(4) G20-countries Fixed Effects	(5) G20-countries 2SLS
	(0.304)	(0.930)	(1.743)	(2.186)
Foreign direct investment, net inflows (% of GDP)	0.0752***	0.0528	-0.135	-0.334
	(0.0227)	(0.0502)	(0.681)	(0.470)
Constant	-66.32***	-58.68**	-35.65	-176.3
	(6.717)	(20.34)	(52.39)	(96.33)
Observations	2,839	2,839	323	323
R-squared	0.414	0.317	0.598	0.480
Number of id_regional		6		7

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The 2SLS method by year was also done. The results were presented in Table 9. It can be seen that the results were also consistent with the previous results that demographic dividend type had significant positive influence on internet use in all years. In addition, the percentage individuals using the internet was also significantly higher in countries with lower inflation and higher economic growth and FDI in all years.

Table 9. The Results of Second Stage Regression by Year.

Covariate	(1) Full observation	(2) 2001-2006	(3) 2007-2012	(4) 2013-2017
Early-Demographic Dividend	33.32***	14.754***	31.418***	50.229***
	(5.728)	(4.870)	(7.580)	(10.606)
Late-Demographic Dividend	34.63***	19.456***	37.989***	52.855***
	(4.269)	(4.548)	(5.539)	(7.230)
Post-Demographic Dividend	60.09***	41.210***	60.701***	76.687***
	(5.328)	(4.867)	(6.973)	(10.030)
Access to electricity (% of population)	0.0335	-0.014	0.023	0.014
	(0.0357)	(0.034)	(0.048)	(0.075)
Inflation, consumer prices (annual %)	-0.180***	-0.060**	-0.623***	-0.079
	(0.0350)	(0.030)	(0.085)	(0.064)
lgdpconstant2010us	2.134***	1.750***	2.132***	1.914***
	(0.332)	(0.397)	(0.429)	(0.503)
Foreign direct investment, net inflows (% of GDP)	0.0797***	0.101***	0.062**	0.135**
	(0.0232)	(0.026)	(0.025)	(0.060)
Constant	-55.96***	-43.695***	-52.040***	-47.861***
	(6.753)	(8.003)	(8.643)	(10.402)

Observations	3,162	1,116	1,116	930
R-squared	0.422	0.548	0.613	0.518

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

~~Source: World Bank (2021) (Author's compilation). Note: CI = confidence interval.~~

~~4.~~5. Conclusions

In this study the nexus between demographic and economic features with internet use in countries during 2001–2017 was investigated. A fixed effects regression model using income level group, regional group, and year as identifiers was employed to study the association between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use. Robustness checks were also carried out using the static generalized method of moment between the type of demographic dividend and instrument variables (crude death rate, population density, and crude birth rate) in the first stage regression and between the type of demographic dividend, access to electricity, gross domestic product, inflation, and foreign direct investment and internet use in the second stage regression.

The results of this study confirms the previous studies on the nexus between demographic and economic features with internet use (e.g. Filippova and Turutina (2015); Sharma et al. (2015); Baumann et al. (2017); Pradhan et al. (2017); Scheerder et al. (2017); ~~Wang et al. (2019);~~ Singh et al. (2020); Bianchini et al. (2021); Myovella et al. (2021); Yesuf (2021)). It was found that internet use was higher in countries from late- and post-demographic dividend type. Meanwhile, access to electricity, economic growth, and foreign direct investment had a positive association with internet use and inflation was negatively associated with internet use.

Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries, in particular countries in the pre- and early-demographic dividend type, should manage its demographic features to the more favorable ones, i.e. lower fertility and mortality. In addition, the window of opportunity due to the decline of fertility and mortality should be capitalized in order to reap the demographic dividend of economic growth and family welfare acceleration by improving access to quality health, education, and employment opportunity. Regarding economic features, in order to

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foster internet use, government of countries should improve access to electricity, raise economic growth, reduce inflation, and enhance foreign direct investment.

Limitations

A limitation of this study is that the demographic dividend type was a time invariant variable, while other variables were time variant. However, this limitation should not significantly affect the findings and this study still provides an essential contribution to the study of internet usage. So, it is suggested that further research on the determinants of internet usage should employ time variant demographic change variable.

~~5. The results of this study confirms the previous studies on the nexus between demographic change and economic features with internet use. Countries from post-demographic dividend typology with better access to electricity, higher economic growth, lower inflation, and higher foreign direct investment had higher internet use. Therefore, it is recommended that in order to boost up internet use, which is essential for better development achievement, government of countries should manage its demographic change, increase access to electricity, improve economic growth, reduce inflation, and enhance foreign direct investment.~~

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Appendix

Table A

Countries in the Study by Demographic Dividend ~~Country~~Type

No	Pre-Demographic Dividend	Early-Demographic Dividend	Late-Demographic Dividend	Post-Demographic Dividend
1	Afghanistan	Algeria	Albania	Antigua and Barbuda
2	Angola	Argentina	Armenia	Australia
3	Benin	Bahrain	Aruba	Austria
4	Burkina Faso	Bangladesh	Azerbaijan	Barbados
5	Burundi	Belize	Bahamas, The	Belarus
6	Cameroon	Bhutan	Brazil	Belgium
7	Central African Republic	Bolivia	Brunei Darussalam	Bosnia and Herzegovina
8	Chad	Botswana	Chile	Bulgaria
9	Comoros	Cabo Verde	China	Canada
10	Congo, Dem. Rep.	Cambodia	Colombia	Croatia
11	Congo, Rep.	Djibouti	Costa Rica	Cuba
12	Cote d'Ivoire	Dominican Republic	Cyprus	Czech Republic
13	Equatorial Guinea	Ecuador	Estonia	Denmark
14	Eritrea	Egypt, Arab Rep.	Fiji	Finland
15	Gambia, The	El Salvador	Georgia	France
16	Guinea	Eswatini	Guam	Germany
17	Guinea-Bissau	Ethiopia	Guyana	Greece
18	Iraq	Gabon	Iceland	Hong Kong SAR, China
19	Kenya	Ghana	Ireland	Hungary
20	Liberia	Grenada	Jamaica	Italy
21	Madagascar	Guatemala	Kazakhstan	Japan
22	Malawi	Haiti	Kuwait	Korea, Rep.
23	Mali	Honduras	Kyrgyz Republic	Lithuania
24	Mauritania	India	Latvia	Luxembourg
25	Mozambique	Indonesia	Lebanon	Macao SAR, China
26	Niger	Iran, Islamic Rep.	Malaysia	Malta
27	Nigeria	Israel	Mauritius	Netherlands
28	Senegal	Jordan	Moldova	New Zealand
29	Sierra Leone	Kiribati	Mongolia	Norway
30	Sudan	Lao PDR	Montenegro	Portugal
31	Tanzania	Lesotho	Morocco	Singapore
32	Timor-Leste	Libya	North Macedonia	Slovenia
33	Togo	Maldives	Oman	Spain
34	Uganda	Mexico	Poland	Sweden
35	Zambia	Micronesia, Fed. Sts.	Puerto Rico	Switzerland
36		Myanmar	Qatar	Ukraine
37		Namibia	Romania	United Kingdom
38		Nepal	Russian Federation	United States
39		Nicaragua	Serbia	
40		Pakistan	Seychelles	
41		Panama	Slovak Republic	
42		Papua New Guinea	Sri Lanka	
43		Paraguay	St. Lucia	
44		Peru	St. Vincent and the Grenadines	
45		Philippines	Thailand	
46		Rwanda	Trinidad and Tobago	
47		Samoa	Tunisia	

48		Saudi Arabia	United Arab Emirates	
49		Solomon Islands	Uruguay	
50		South Africa	Vietnam	
51		Suriname	Virgin Islands (U.S.)	
52		Syrian Arab Republic		
53		Tajikistan		
54		Tonga		
55		Turkey		
56		Turkmenistan		
57		Uzbekistan		
58		Vanuatu		
59		Venezuela, RB		
60		West Bank and Gaza		
61		Yemen, Rep.		
62		Zimbabwe		

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