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COP21 Policies And Abrupt Climate Change: Political Economy of Hawking's Irreversibility

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Abstract

Climate and earth scientists have convinced a large majority of people that climate change occurs today. And the new theory of abrupt climate change entails that huge feedback loops will change the Earth already within the next one or two decades. Yet, this information is only half the story, as the pragmatical side is also part of climate change: will the COP21 promise of global decarbonisation be fulfilled? It requires global coordination by states or government, which is very hard to achieve. The COP process by the UNFCCC and the IPCC never speaks about it. The aim of this paper is to emphasize that global decarbonisation can only be accomplished by global state coordination, which reduces the probability of COP21 success considerably.

Keywords: elimination of coal and charcoal, solar power plants, carbon capture, abrupt climate change theory, methane spike



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INTRODUCTION

Global government coordination has come so far that the UN has enacted the policy objective of almost complete decarbonisation in this century at the COP21 reunion in Paris 2015. But how is this formidable objective to be managed? Can the increase in GHGs be stopped before the so-called Hawking irreversible point, where climate chaos become unstoppable? To ponder about the question, so fatal for humanity, we need a social or economic theory about the increase in GHGs. Why do people continue to increase these dangerous externalities?

Thus, far, the COP21 project involves a halt to the increase in CO₂ emissions by 2020, a 30% reduction in CO₂s by 2030 (absolutely or relatively?) and more or less total decarbonisation by 2075. But the means to these gigantic goals? It is all about managing policies of energy transformation, as the augmentation of GHGs stems from human use of energy resources.

As we get more and more dire predictions about the nature of climate change and its probable consequences, it becomes more and more urgent to clarify what the COP project can and must accomplish. Climate change could be halted by a sharp reduction in the use of fossil fuels over night, but it would spell large scale economic crisis with mass unemployment and social upheaval.

Many climate experts now claim that we are heading for more than a + 2 Celsius increase in global warming as well as already a + 2 Celsius augmentation is a threat to human survival due to the many positive feedback loops started by such an increase. As the doomsday scenarios gather strength, it becomes absolutely vital to stick to the COP project and explore what can be achieved and how. It is a matter of Arctic ice meltdown and methane emissions from the permafrost that may bring temperatures much higher than the COP21 Treaty aimed at with uncertain disastrous consequences for both Mother Earth and mankind. Lots of natural science research still remains to be done in order to reduce the large uncertainties about temperature rise and its consequences for a number of vital outcomes for humanity, but it is now time for political and economic coordination to start global decarbonisation. Time is tight.

POLICY IMPLEMENTATION ENTAILS MANAGEMENT

Climate experts and earth scientists talk “abrupt climate change” as well as the “methane bomb”, widening the set of GHGs to focus upon methane, emerging chaotically from the melting permafrost in the Northern most part of the hemisphere or from melting ice containing frozen methane at the seabed in the Arctic. The potential amount of methane to be released in the worst case scenario is so large that global warming would quickly move beyond the Hawking irreversible point, spelling doom for mankind. The time span for the methane bomb is uncertain, from 50-200 years. What to do? At this point in time, global coordination against climate change can only intensify its efforts at decarbonisation during the 21st century. The COP21 project has to be pursued and fulfilled in an improved version with quicker actions, complemented by other activities like carbon sequestration or Geo-engineering, if workable. Hopefully, the US will reenter this common pool regime later.

The overall objective of the COP21 project from Paris 2015 is to start decarbonisation by 2020 and finish it by 2075. A necessary condition is that states conduct energy policies that eliminate coal and start solar power parks. This requires enormous management skills by individual governments with huge support from global coordination agencies or committees. A drastic

policy tool is carbon sequestration or capture, but it is hardly viable at the moment. Climate engineering may add to the basic means: abolition of coal and big solar power parks.

Theory: The basic hypothesis is the strong link between CO₂ emissions and global temperature – Keeling’ curve. Only by halting CO₂ emissions first and then start reducing them can global warming be stopped and the methane bomb avoided. This is the foundation of the COP21 project and the possibility of geo-engineering may be an option as time goes by.

Implementors: The COP21 secretariat comprises some 450 persons, planning new global reunions, and monitoring the development of the country engagement for the Treaty as well as negotiating the promised reductions in CO₂s. It could be turned into a management agency assisting countries cut CO₂s on the basis of interaction the Intergovernmental Panel for Climate Change (IPCC), working with concrete project implementation towards decarbonisation globally through the promised Super Fund.

Management tasks: Each country needs to develop a decarbonisation strategy, involving the crucial steps in the necessarily giant energy transformation from fossil fuels to renewables, given the most recent information available about energy and its presuppositions. The COP21 secretariat could be helpful in designing the best projects economically and come up with cheap international funding avenues, guaranteeing loans below market rates. It could make recommendation about carbon tax and renewable energy subsidies, mixing market and administrative steering mechanisms.

Competences: A reinforced COP21 developing into the management of global decarbonisation would act as an agency of first the UNFCCC and second as the agent of the principals of the UN, viz. the member states. Its tools of management would be persuasion, oversight, recommendations, negotiations, but not authority or interference, given public international law. Yet, some control mechanisms would be necessary

THE NEW CLIMATE DEBATE: “Already too late”

Starting from the nature of public international law (PIL), the COP21 Treaty is based on voluntary emissions reductions, involving a COP secretariat with mostly information gathering tasks. The principle of state sovereignty permeates all of PIL. The suggested speed of decarbonisation is slow: the COP21 policies involve *a halt to the increase* in CO₂ emissions by 2020, a 30% reduction in CO₂s by 2030 (absolutely or relatively?) and more or less total decarbonisation by 2075. But what are the means to these gigantic energy transformation goals? Basically, it is all about managing energy transformation, as the augmentation of GHGs stems from human use of energy resources.

Among some climate scientists, there is recently a new urgency. The melting of the North polar ice is advancing so quickly that all projections about temperature rise on the Earth must be revised upwards. Quicker warming sets in motion very positive feedbacks that threaten human survival. The goal of COP21 – limit global warming to + 2 degrees Celsius – is no longer achievable. Instead, climate chaos seems more likely. A few predict that mankind has no more than 10 years before things become unmanageable. When the North pole ice is gone, global warming goes much higher than + 2.

The theory that climate change is now becoming irreversible is based on new hypotheses concerning the consequences of global warming:

- sea level rise and Arctic ice meltdown is quicker than believed;
- climate refugees may rise to 100 million people;
- food and water shortages come earlier than believed;
- the + 2 degrees Celsius target is misplaced as the Earth warms differently at various regions, i.e. still much hotter at the poles;
- the release of methane from the permafrost and the frozen ice at the North pole will bring temperature rise to + 10 degrees Celsius;
- the COP21 policy is too slow and uncertain.

As CO₂s have risen too much since the industrial revolution, they must somehow be reduced in total. The COP strategy is to first halt the increase in CO₂s and then reduce them, first by 30 per cent and later completely, which is of course Utopian. Abrupt climate change makes this strategy obsolete, because it is too slow and ineffective. Besides, it is ambiguous:

- a) Yearly increase against total increase: the first goal of COP21 is to eliminate the yearly increases, but countries can still emit the same amount CO₂s. Since CO₂s stay in the atmosphere for 100 years, total CO₂s may still double up to 2050.
- b) Relative against total size of fossil fuels, especially coal: the big nations of the G20 plan for substantial augmentation of energy supply the coming decades; they will develop renewable energy and some of them atomic power plants, safer ones; so fossil fuel energy may be reduced relatively but still remain much too high absolutely for decarbonisation.
- c) No recognition of methane and feedback loops: the COP21 project has no recognition of the spike in methane emissions in the Arctic and it bypasses the lethal threats to humanity from evolving feedback loops changing the climate and oceans for hundreds of years.

Now, we inquire below whether the key countries are moving or planning to move in this decarbonisation direction? Each single country has its energy consumption pattern that must be taken into account in both domestic and international energy supply transformation. Country resilience is important but it must be complemented by economic policy coordination, including the Super Fund.

ENERGY AND ITS SOCIAL AND ECONOMIC IMPLICATIONS

I suggest we analyse energy in a wide sense. The need for energy is obvious – see Figure 1.

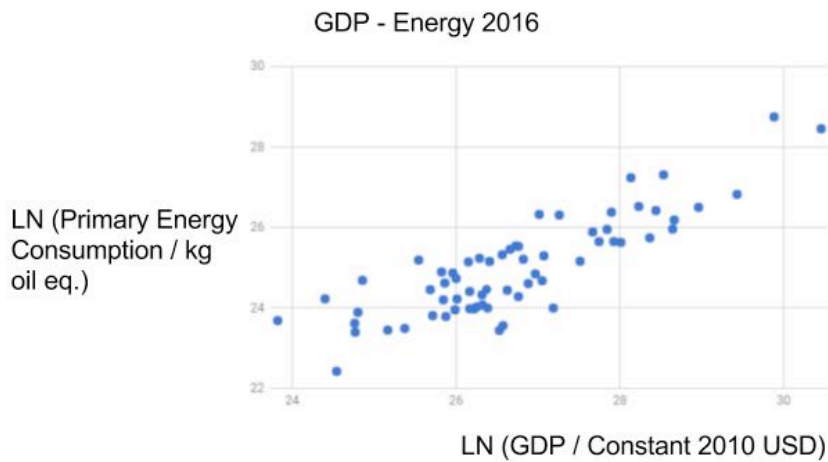


FIGURE 1. Energy and affluence globally

Energy is the capacity to do work. And work is the Adam Smith and J-B Say sources of human welfare. The growth in energy consumption since the industrial revolution and especially after the Second World War has been just immense, especially the supply of fossil fuels. In poor countries, the demand for energy is huge for economic development toward “catch-up”, whereas rich countries are heavily dependent of fossil fuels for economic growth. The majority of countries in the COP project are in poverty, as they need more energy. Thus, they can only decarbonise when renewable energy sources become available. This is the redistribution task of COP21: decarboisation against support for renewable energy by the Super Fund.

The living conditions in the poor countries in Latin America, Africa and Asia as well as the Pacific reflects the low level of energy employed. This basic fact determines life opportunities in a most dramatic fashion. The low access to energy has consequences for the environment and the life situation of people, including health, schooling, work, food and potable water.

For instance, African countries are poor because they have too little energy. Thus, they have much less GHGs than Asia. Yet, they need the COP project of the UNFCCC to renew their energy sources and move from fossil fuels and traditional renewables to solar power. Hydro power depends upon water availability that shrinks with global warming.

African energy deficit is conducive to a dire environment with enormous damages and risks. Consider the following global figures. Figure 2 shows how low energy leads to an unsafe environmental.

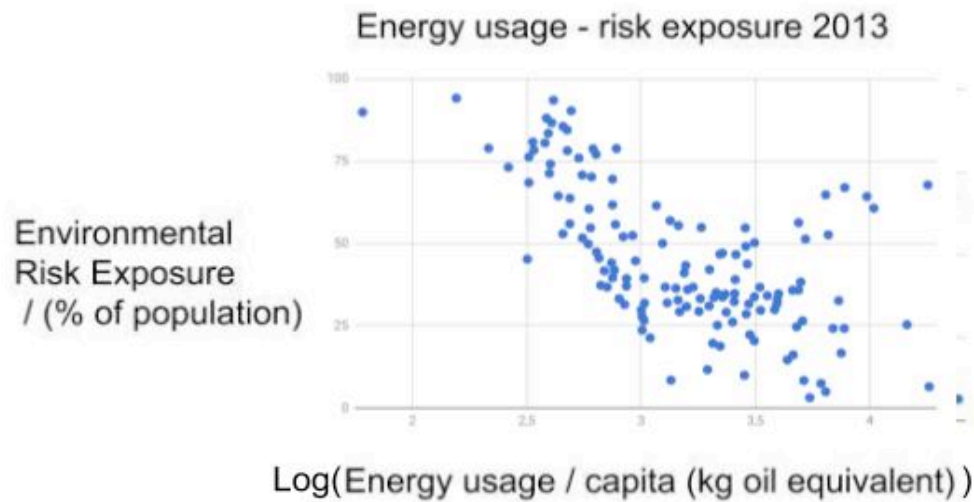


FIGURE 2: Energy and environmental risk exposure

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/inde>)

Low energy use leads to poverty, malnutrition, diseases, lack of potable water, insufficient sanitation, etc. Typical of many Latin American, African and Asian nations is the lack of stable electricity, which hampers everything and reduces environmental viability. Figure 3 has the global picture.

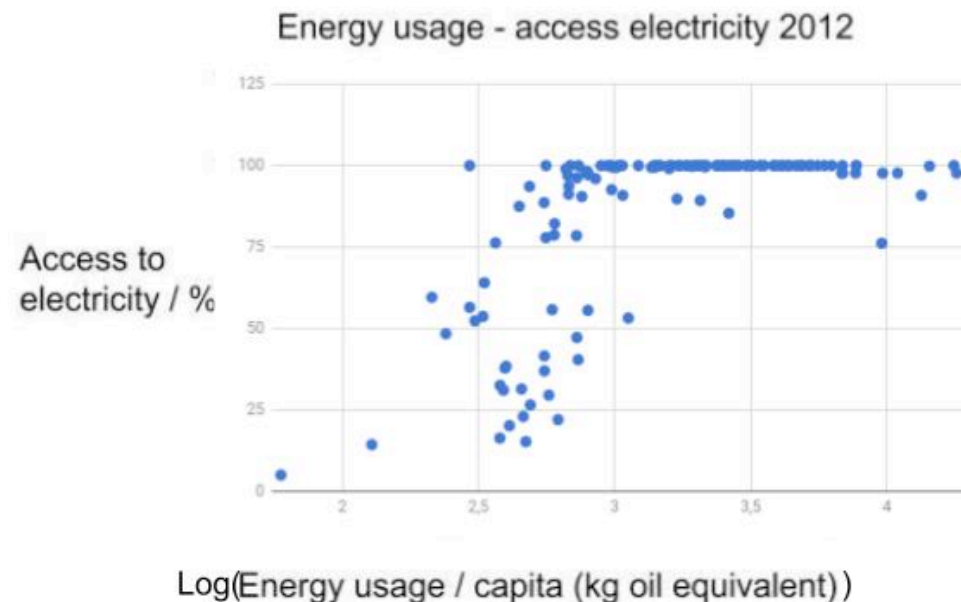


FIGURE 3. Energy and electricity access

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/inde>)

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation.

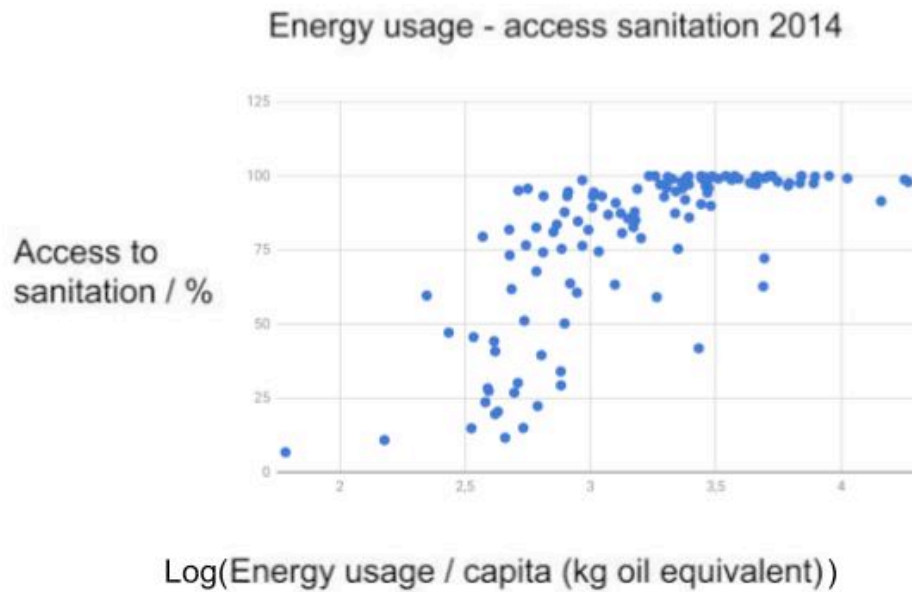


FIGURE 4. Sanitation and energy

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale.edu>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/index>)

Especially, the rapidly growing African, Latin American and Asian mega-cities lack entirely proper sewage plants. Thus, dirty water is put into the big rivers where other cities downstream take their potable water.

The access to safe and stable electricity is crucial for health, schools, food, water, etc. Figure 4 links energy with proper sanitation.

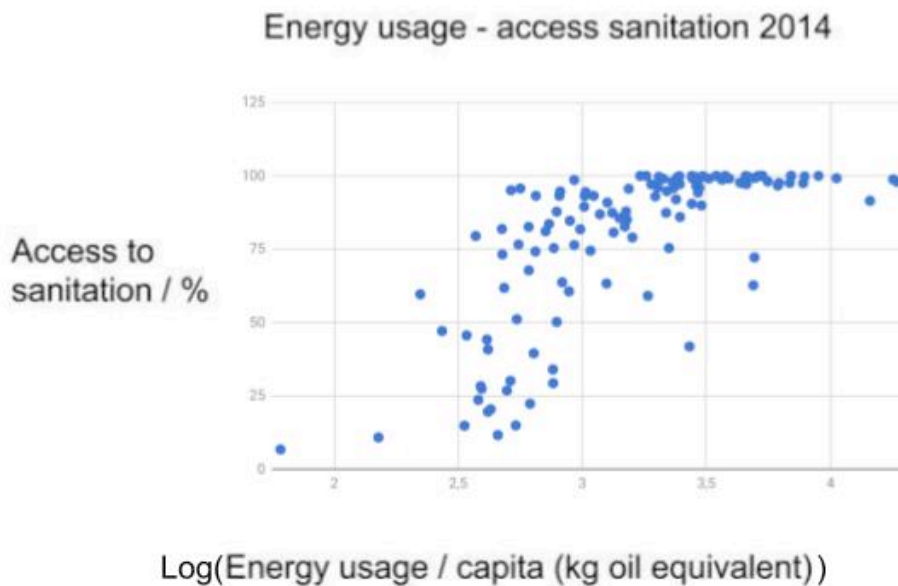


FIGURE 4. Sanitation and energy

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale.edu>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/inde>)

The necessity of more energy in poor countries for proper sanitation, without which the life of humans is "salle", must be emphasized, especially when global warming diminishes clean water. Air quality too depends upon energy access (Figure 5(-

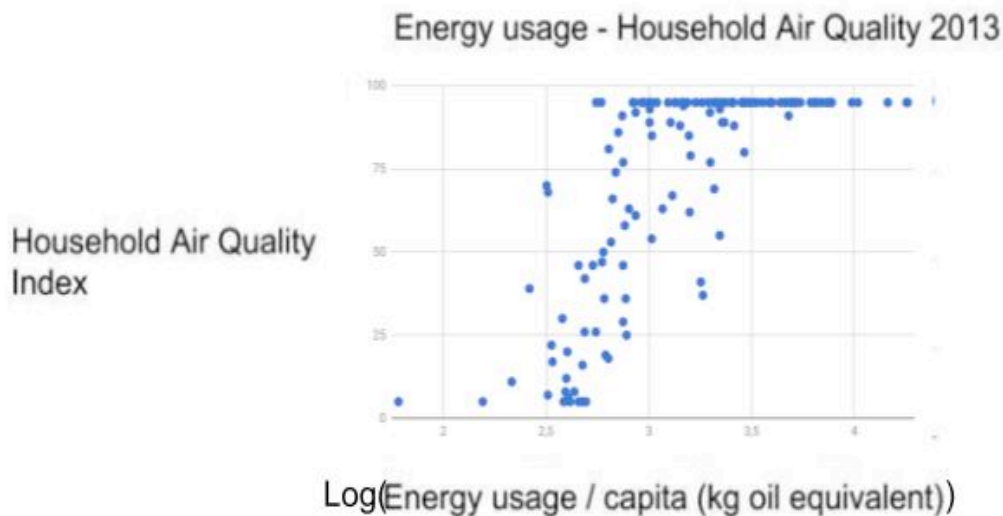


FIGURE 5. Energy and air quality

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale.edu/>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/index>)

Typical of many poor nations – Latin America, Africa, Asia - is the lack of predictable access to safe electricity, which hampers work and reduces environmental viability. The access to safe electricity is, it must be emphasized, absolutely central for health, schools, food, potable water, etc. Given the lack of enough energy in poor countries being conducive to the above bad living conditions, one understands the hopes of the poor countries for help with energy transformation leading to better access to just energy!

If, as we believe, energy consumption is behind global warming, the set of poor countries face a most difficult dilemma. On the one hand, they can demand much more energy like fossil fuels, but they then contribute much to climate change, On the other hand, global warming while fabricated by the rich nations and a few very populous poor nations, will have very negative consequences for poor nations. The only way out of this dilemma is that all countries contribute to halting global warming by turning to renewables, especially the set of rich countries.

Thus, energy consumption is closely related to country affluence. The poor countries can only improve living condition by increase energy supply. Their energy demand can only go up, because energy supply is highly skewed to the advantage of the rich countries – see Figure 6.

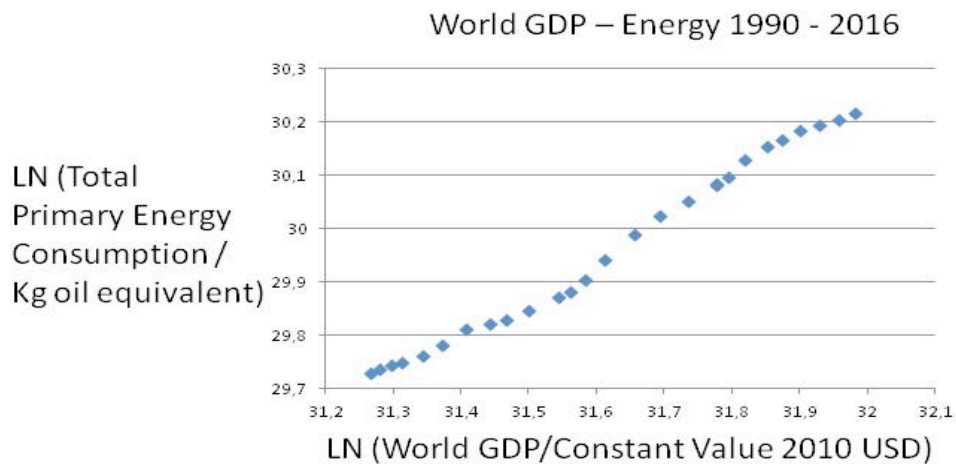


FIGURE 8. Global Energy Consumption 1990^- 2016

Poor countries need much more energy, but of a new kind. They need assistance to move to modern renewables, as they will give up fossil fuel only if there is compensation by other new energy sources. The enormous demand for more and more of energy comes with a major drawback, namely the GHG emissions. Figure 7 has the picture for the CO₂s.

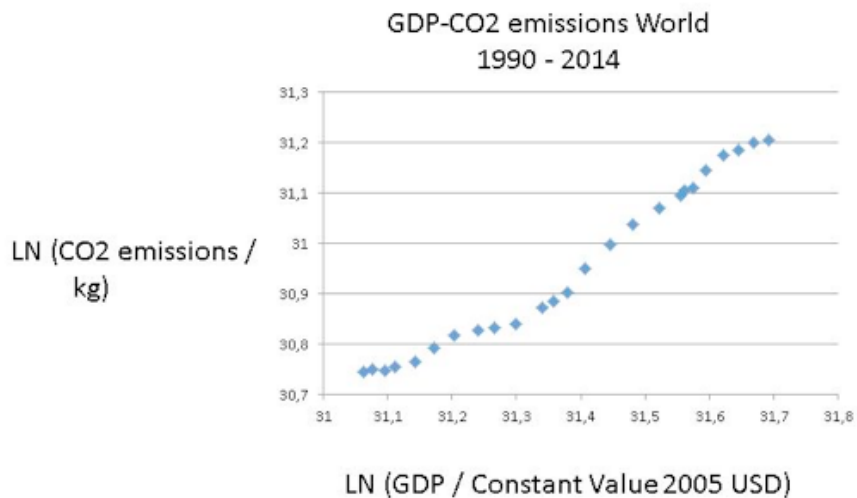


FIGURE 7. Energy and CO₂s 1990-2016

It must be underlined that GHG emissions like CO₂s are a function of GDP and population. Only very big poor countries have huge GHG emissions, like India, Brazil and Indonesia. Small poor nations have little GHGs, as they lack energy in great quantity. Yet, poor countries wish to participate in saving the planet from the dangers of climate change on the condition of financial assistance from the COP project and its Super Fund.

In terms of GHGs, rich countries have much higher levels of yearly emissions compared with poor countries, holding population constant. Only when a poor nation is huge, does it have enormous CO₂s. Strict linear relation holds between GDP, energy consumption and GHGs, both on a per capita basis and on an aggregate country level. I will show one more picture (Figure 8)

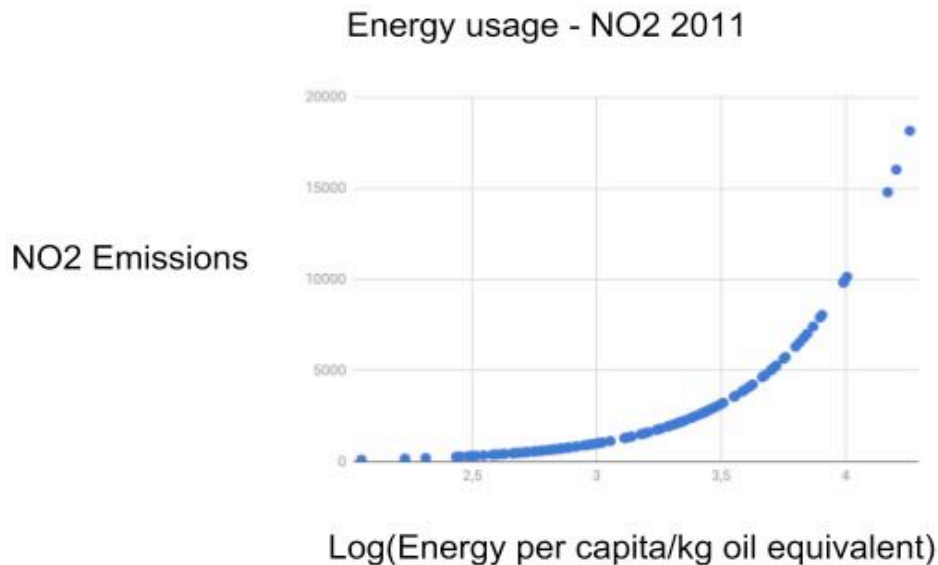


FIGURE 8. Nitrous oxide and energy

Source: Environmental Performance Index, Yale University, <https://epi.envirocenter.yale.edu/>. IEA Statistics © OECD/IEA 2014 (<http://www.iea.org/stats/inde>)

While the UNFCCC has mainly concentrated upon the CO₂s, the GHGs comprise several gases, one of which is the nitrogen oxide. Production of nitrous oxide stems from microbial activity in soils and in the ocean. Human sources of nitrous oxide are combustion of fossil fuels, biomass burning, industrial production of nitric acid, and fertilizers. Nitrous oxide enhances the greenhouse effect just as carbon dioxide does by capturing reradiated infrared radiation from the Earth's surface and subsequently warming the troposphere. It stays in the troposphere for about 120 years before moving into the stratosphere where it is conducive to the destruction of stratospheric ozone.

COUNTRY MANAGEMENT IN LINE WITH COP21 GOALS?

India

In Indian energy policies, it is emphasized that developmental goals take precedence over climate change considerations. Thus, all Indian households must have access to electricity and only sustained rapid economic growth can reduce poverty. India has a "take-off" economy that delivers affluence for the first time since independence. But it is based on fossil fuels. India looks into other sources of energy, as long as socio-economic development is not hindered. Figure 9 shows the main features of future planning.

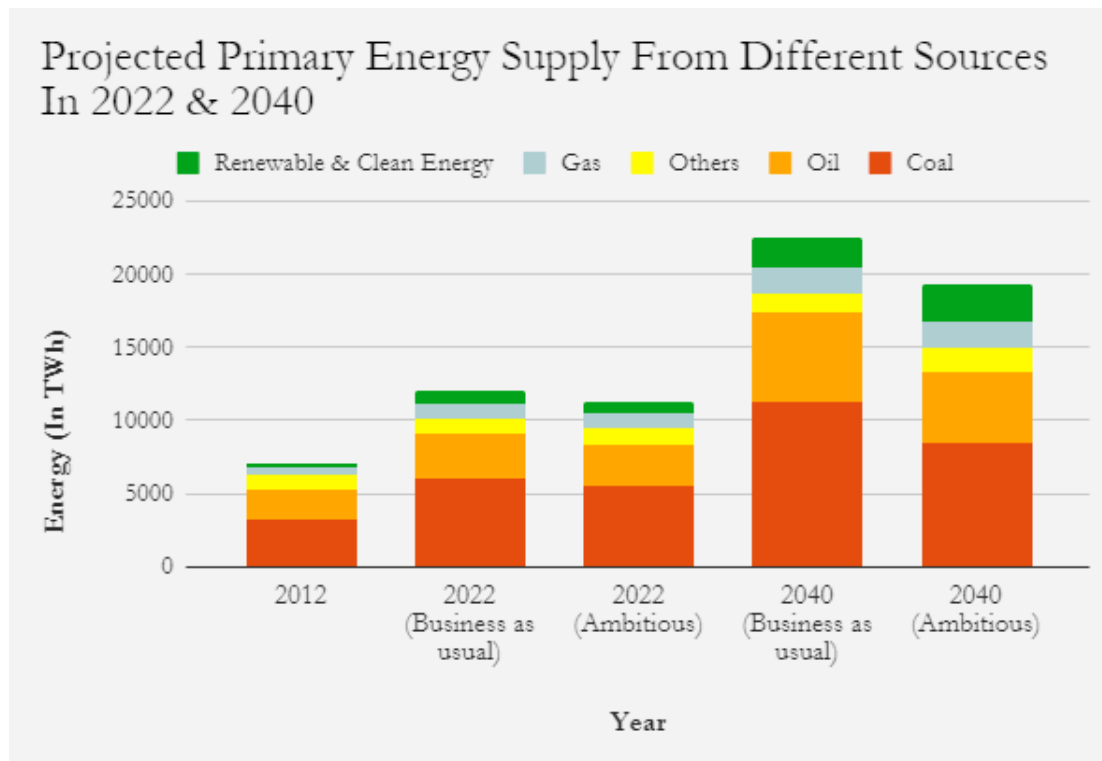


FIGURE 9. India's energy future

Source: <https://scroll.in/article/843981/indias-new-energy-policy-draft-projects-coal-fired-capacity-will-double-by-2040-is-that-feasible>

India has rapidly become a major CO₂ emitter due to its high growth rates since 1990. It uses lots of coal, stone or wood. Charcoal is bad for households and results in forest destruction. India tries to broaden its energy supply to modern renewables, like solar, wind and hydro power. Yet, it will remain stuck with fossil fuels for decades. It needs assistance from the COP21 project, especially for solar power parks. Building more dams is very risky, as global warming reduces water assets. Figure 9 indicates the India cannot meet its COP21 promises, as Ramesh (2015) underlines.

Brazil

Brazil is a "catch-up" with its "take-off" point long ago in the 20th century.. Compared with India, but it never really succeeds to close the gap to North America, tumbling now and then into dictatorship or recession. Figure 10 shows its stylised energy plans – are they in agreement with COP21 hopes of decarbonisation?

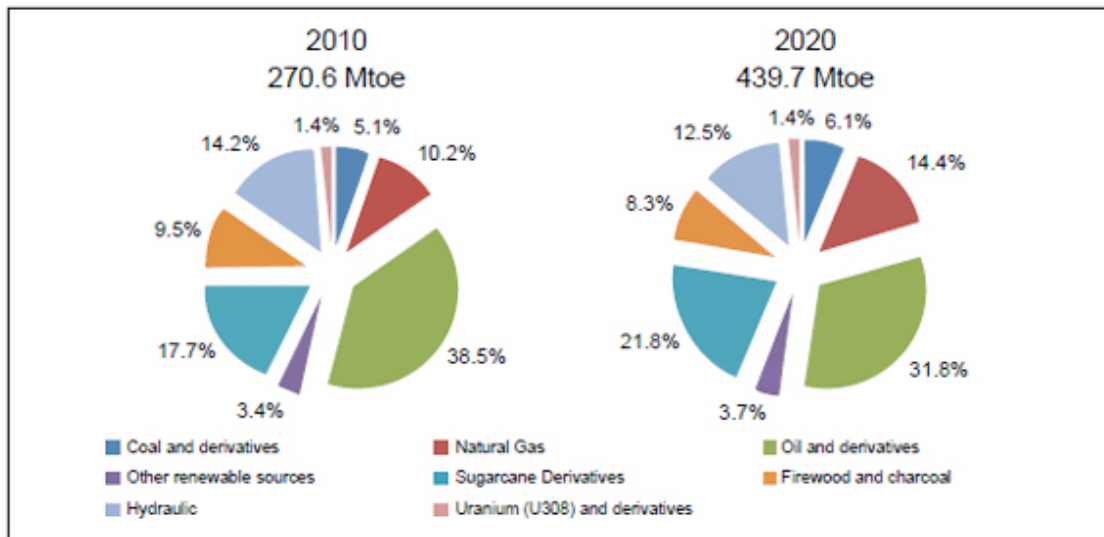


Figure1–Evolution of the total primary energy supply

FIGURE 10. Energy plans in Brazil

Source:http://www.scielo.br/scielo.php?pid=S0103-40142012000100017&script=sci_arttext&tlng=en

Brazil has already a diversified supply of energy. However, since the country plans to almost double its energy supply, its dependence upon fossil fuel will grow, also upon coal. It dreams about building many more dams in the Amazons, but future water shortages due to climate change may make these plans unrealistic. The country needs COP21 assistance to turn to solar power massively, in order to eliminate first and foremost coal and charcoal. The rain forest is part of Brazil' s emission picture where burning and logging reduce its carbon uptake.

Indonesia

Indonesia is like India a “takee-off” country, enjoying rapid economic growth with attending augmentation in energy consumption. The outcome is that this giant nation has quickly become a major GHG emitter. What make the situation worse is the burning down of the rain forest in parts of Indoneasia.

Such a phenomenal augmentation of energy is out of line with the aim of global decarbonisation.

INDONESIA'S NEW & RENEWABLE ENERGY TARGET

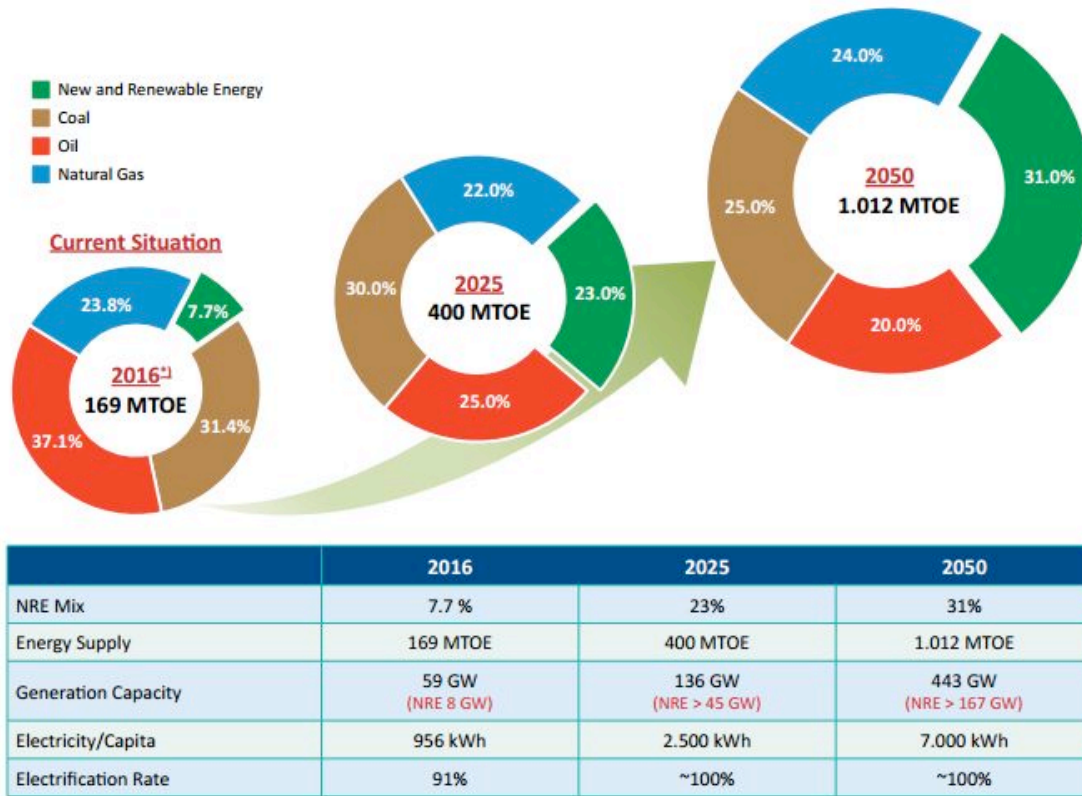


FIGURE 11. Energy future for Indonesia

USA

The US has reduced its CO₂ emissions during the last years, mainly by a shift to natural gas. Actually, several mature economies have been able to halt the rise of CO₂ emissions, either by more energy efficiency or a shift to natural gas or renewables. Figure 12 captures some features in US energy plans.

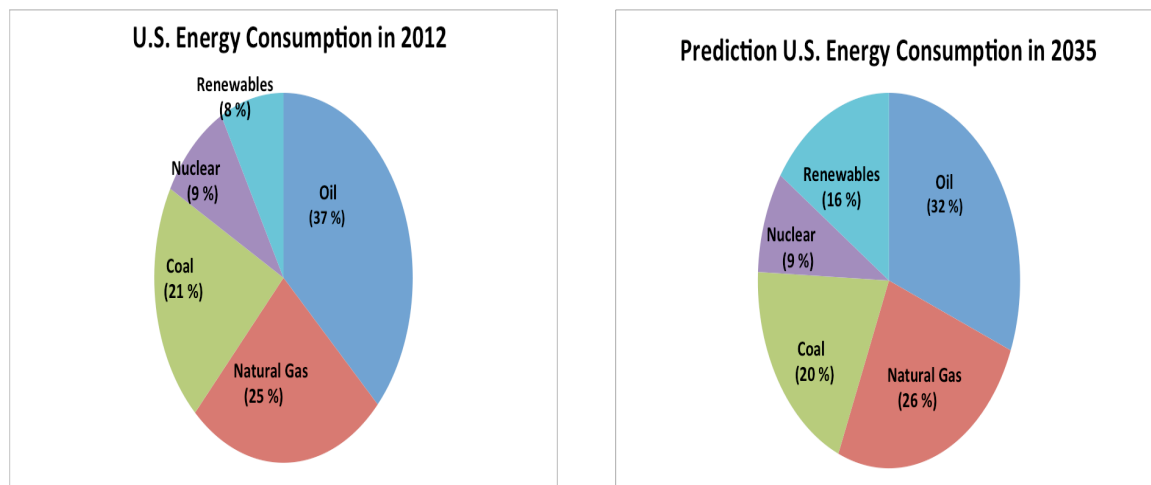


FIGURE 12. US energy future

Source: <https://www.e-education.psu.edu/egee102/node/1930>

Although the Figure 12 predicts a doubling of renewable energy, the dependency upon fossil fuels, including coal energy, will not be much reduced. We are talking here about relative numbers, but if the US increases total amount of energy supply – fracking!, then there may even be more fossil fuels. The reduction in CO₂s during recent years seems to be coming at a reduced rate. The hope is for economic growth without energy increases, but we are not there yet. And most countries demand more energy for the future.

China

China now enters the First World, as it has long passed its “take-off” point in time around 1980 and has pursued a successful “catch-up” policy for a few decades. Its energy consumption, especially fossil fuels, has skyrocketed with GDP, resulting in the largest CO₂ emission globally. Figure 13 has a projection for China.

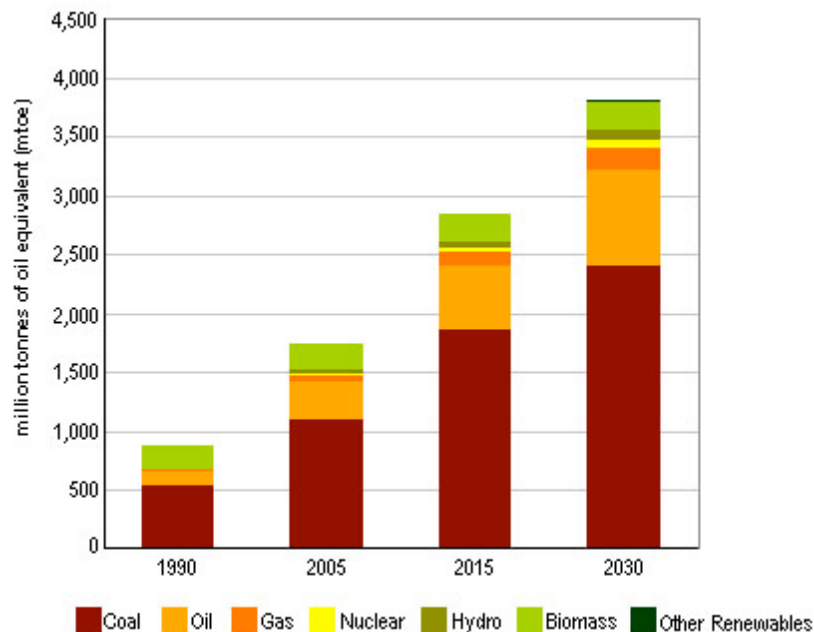


FIGURE 13. Energy projection for China

http://www.wrsc.org/attach_image/chinas-projected-energy-growth-fuel

Decarbonisation does not seem highly probable. Much hope was placed at a recent reduction in CO₂s, but water shortages forced China to revert to coal in 2017 with attending augmentation of CO₂s. China is investing in both renewables and atomic power, but it also plans for large energy increase in the coming decades with lots of energy consuming new projects.

POLICY RESPONSES TO ABRUPT CLIMATE CHANGE

As the potentially huge methane emissions enter the climate change debate, one fully understands the mounting pessimism. And the entire time scale for fighting global warming shrinks considerably, from 100 years to 50 years or even less.

Yet, only improved COP21 policy-making could help. The Keeling must be stabilised as soon as possible, having reached 412 recently. The release of methane depends upon that. Thus, one may outline a more radical COP21 policy and ask for its implementation to start now:

- 1) Close down of all coal power plants in 2020; replacement of charcoal in poor countries by mini gas stoves;
- 2) Massive investments in solar power parks – see below; subsidies for solar installations in private homes;
- 3) Accelerated experiments with carbon capture to find accurate cost-benefit calculation for all forms of geo-engineering.

Here comes the solar power revolution that will allow a massive reduction in fossil fuels. Let us see what it entails in terms of management tasks for global coordination, assisted by for instance the COP21 Secretariat and the IPCC.

Table 1. Number of Ouarzazate plants for 40 per cent reduction of CO2 in some giant countries (Note: Average of 250 - 300 days of sunshine used for all entries except Australia, Indonesia, and Mexico, where 300 - 350 was used).

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
United States	26 - 28 ⁱ	2100	3200
China	none ⁱⁱ	0	3300
EU28	41 - 42	2300	2300
India	none ⁱⁱ	0	600
Japan	26	460	700
Brazil	43	180	170
Indonesia	29	120	170
Australia	26 – 28	130	190
Russia	none ⁱⁱⁱ	0	940
World	N/A	N/A	16000

Note:i)The United States has pulled out of the deal; ii) No absolute target; iii) Pledge is above current level, no reduction; iv) Upper limit dependent on receiving financial support; v) EU joint pledge of 40 % compared to 1990.

It will of course be argued against such a 40 per cent speedy reuction in CO2s that it leads to economic recession. So may it be! But it would reduce future much higher costs. After all, economies adapt and will recover due to all new investments needed in a decarbonised world. Ramesh (2015) emphasizes that India needs much economic assistance for decarbonisation – a giant task for global coordination to assist poor nations!

Let us look at the American scene in Table 2.

Table 2. Number of Ouarzazate plants necessary for 40 per cent reduction in CO2 (Note: Average of 250 - 300 days of sunshine per year was used for Canada, 300 – 350 for the others).

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Canada	30	230	300
Mexico	25	120	200
Argentina	none ⁱⁱ	0	80
Peru	none ⁱⁱ	0	15
Uruguay	none ⁱⁱ	0	3
Chile	35	25	30

Some Latin American countries have lots of hydro power, but it may dwindle rapidly due to abrupt climate change. Solar power would be excellent energy for Mexico and Brazil for example.

Table 3 has the data for the African scene with a few key countries, poor or medium income. As they are not in general energy consuming on a grand scale, like Asia, decarbonisation should be feasible with Super Fund support.

Table 3. Number of Ouarzazate plants necessary in 2030 for 40 per cent reduction in CO2 (Note: Average of 300 - 350 days of sunshine per year was used).

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Algeria	7 - 22 ^{iv}	8	50
Egypt	none ⁱⁱ	0	80
Senegal	5 - 21	0,3	3
Ivory Coast	28-36 ^{iv}	2	3
Ghana	15 – 45 ^{iv}	1	3
Angola	35 – 50 ^{iv}	6	7
Kenya	30 ^{iv}	3	4
Botswana	17 ^{iv}	1	2
Zambia	25 – 47 ^{iv}	0,7	1
South Africa	none ⁱⁱ	0	190

Note: Note:i)The United States has pulled out of the deal; ii) No absolute target; iii) Pledge is above current level, no reduction; iv) Upper limit dependent on receiving financial support; v) EU joint pledge of 40 % compared to 1990.

Table 4 shows the number of huge solar parks necessary for a few Asian countries.

Table 4. Number of Ouarzazate plants necessary for 40 per cent reduction in CO₂s. (Note: Average of 250 - 300 days of sunshine was used for Kazakhstan, 300 - 350 days of sunshine per year for the others).

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Saudi Arabia	none ⁱⁱ	0	150
Iran	4 – 12 ^{iv}	22	220
Kazakhstan	none ⁱⁱ	0	100
Turkey	21	60	120
Thailand	20 - 25 ^{iv}	50	110
Malaysia	none ⁱⁱ	0	80
Pakistan	none ⁱⁱ	0	60
Bangladesh	3,45	2	18

Given the economic advances in Asia, most countries need a lot of solar power parks for decarbonisation. The COP21 management would be able to help.

Finally, we come to the European scene.

Table 5. Number of Ouarzazate plants necessary for 40 per cent reduction in CO₂s (Note: Average of 250 - 300 days of sunshine per year was used)

Nation	Co2 reduction pledge / % of 2005 emissions	Number of gigantic solar plants needed (Ouarzazate)	Gigantic plants needed for 40 % reduction
Germany	49 ^v	550	450
France	37 ^v	210	220
Italy	35 ^v	230	270
Sweden	42 ^v	30	30

Note:Note:i)The United States has pulled out of the deal; ii) No absolute target; iii) Pledge is above current level, no reduction; iv) Upper limit dependent on receiving financial support; v) EU joint pledge of 40 % compared to 1990.

The turn to renewables in Europe occur at the same time as atomic power stations are going to be closed, at least in some countries. This makes solar power plants even more relevant, a coal power must be abolished, rather sooner than later.

CONCLUSION

Time has come for halting and reducing CO₂ emissions by real implementation and not utopian dreams of a sustainable economy (Sachs, 2015). There is nothing to wait for any longer (Stern, 2015), as the COP23 must set up the promised Super Fund. No time for politicking in the UN any longer (Conca, 2015; Vogler, 2016).

There is no one single policy approach that "WE" must take. Each government has to present its plans and specific situation to a Cop21 managing board, in collaboration with markets and financial institutions. It must be underlined that the ultimate responsibility rests with the state and their governments (Stern, 2007, 2016). It is either Hawking irreversibility or strong global coordination as response to the new abrupt climate change abut theory. - no more time for delays (Conoa, 2015; Vogler. 2016). And holistically utopian ideas (Sachs, 2015) about sustainable development must be put aside for concentration on decarbonisation. Economic coordination requires the Super Funs (Ramesh, 2015)-

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- i The United States has pulled out of the deal
 - ii No absolute target
 - iii Pledge is above current level, no reduction
 - iv Upper limit dependent on receiving financial support
 - v EU joint pledge of 40 % compared to 1990

Micro-Small and Medium Enterprises Development of Mango Puree Processing Through Business Partnership: Case Study at CV. Promindo Utama in Cirebon Regency, West Java, Indonesia

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Abstract

Micro-Small and Medium Enterprises (SMEs) lay a vital role in the development and economic growth in Indonesia. CV. Promindo Utama is the largest producer of mango puree in Cirebon Regency. SMEs needed a good partnership with other parties to develop and strengthen its existences. This study aims to measure performances, analyze patterns and mechanisms of a partnership between CV. Promindo Utama with farmers and marketing partners and analyze its development efforts. The methods used in this qualitative research were performance measurement, partnership pattern and mechanisms analysis and descriptive analysis. The results indicated that overall performance of CV. Promindo Utama was profitable and the partnership pattern used with two partners was a common trading pattern. The development effort can be done by developing agribusiness business network and optimizing the business partnership that has been formed.

Keywords: SMEs, Business partnership, Performance, Development effort, Mango Puree



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Introduction

Indonesia is dominated by micro, small and medium-scale business actors. Therefore, Micro-Small and Medium Enterprises (SMEs) becomes one of the economic support in Indonesia. Cirebon Regency is the third largest mango producer in West Java after Indramayu and Majalengka Regency. In the last five years between 2012-2016 with total production 213.191,6 ton (BPS West Java Province, 2017). Thus, mango becomes one of potential in Cirebon.

One of the efforts to develop the potential and improve the competitiveness of mango in Cirebon with other mango-producer areas is creating added value that can improve the existence of mango as an icon of Cirebon Regency. The creation of this added value can be done by processing mango into a puree. CV. Promindo Utama is the largest producer of mango puree in Cirebon.

According to Hafsah (2004), the problems faced by SMEs can be categorized into two types: 1) internal factors, consists of lack of capital, lack of human resources, and has a weakness in marketing network, 2) external factors, consists of the business climate that not fully conducive, lack of business facilities and infrastructure, and lack of market access.

The problems that often occur in SMEs which used main raw material from the agricultural sector is the availability. Mango is a seasonal commodity, which is only available in certain months. Therefore, it requires certainty and guarantees in the procurement of guaranteed raw materials in terms of quantity, quality, and continuity by business partnering. Besides that, the scope of SMEs is relatively small and that caused the business network becomes weak so that access to the market was limited.

SMEs needed a good partnership with other parties to develop and strengthen its existences. Especially in agribusiness that consists of subsystems that interconnected with each other, from the input subsystem to supporting institution subsystem. There is needed a cooperation between every subsystem so that each subsystem able to work properly and support each other.

According to Hafsah (2004), one of the efforts that can be done to overcome the problems faced by SMEs is by the business partnership. Partnerships between small businesses and large businesses will help each other and there will be mutually beneficial relationships. The partnership is also can expand market share and make business management more efficient. So that SMEs have the power in competing with other business actors, both from within and outside the country.

This research aims to measure performances, analyze patterns and mechanisms of business partnership that exists in CV. Promindo Utama with farmers and marketing partners in doing its business and analyze its development efforts. The business partnership that undertook by CV. Promindo Utama can be one of the efforts to continue to grow and strengthen its position as a mango puree processor.

Method

This research was conducted in CV. Promindo Utama, Cirebon Regency, West Java, Indonesia. The object that will be reviewed in this research is the development of SMEs through business partnership on SMEs processing of puree mango. The design of this study is qualitative with case study method while the data and information come from primary and secondary sources. Data collected are based on observations, discussions, and in-depth interviews with respondents. The respondents are owner CV. Promindo Utama, mango farmer as a partner that supplies its raw material, puree mango processor/industry as a market partner, and government.

The design of data analysis in this study are performance measurement, partnership pattern and mechanisms analysis and descriptive analysis. Gerba and Viswanadham (2016) stated that SMEs performance can be measured by financial and non-financial performance measurement, includes profitability, total assets, return on investment (ROI), sales volume, employment size, capital employed, market share, customer satisfaction, productivity, turnover, delivery time, and other. Musfialdi (2013) measure the performance of SMEs with three aspects, such as profitability, productivity, and market. In this research SMEs performance measure profitability, productivity, and market.

1. Profitability

1) Total Costs

According to Sukirno (2011), total cost can be known by using the formula:

$$TC = TFC + TVC$$

Where :

TC = Total Costs (Rp)

TFC = Total Fixed Costs (Rp)

TVC = Total Variable Costs (Rp)

2) Total Revenue

According to Sukirno (2011) total revenue can be known by using the formula :

$$TR = P \times Q$$

Where :

R = Revenue (Rp)

Q = Quantity (kg)

P = Price (Rp/kg)

3) Profit

Profit can be count by subtracting total revenue with total cost (Sukirno, 2011). Profit can be known by using the formula :

$$\pi = TR - TC$$

Keterangan :

π = Profit (Rp)

TR = Total Revenue (Rp)

TC = Total Cost (Rp)

4) Productivity

According to Sarjono (2001) formula that used for productivity is :

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

Where :

Output = Total of outputs produced (liter)

Input = Total of inputs used (HOK)

Result and Discussion

CV. Promindo Utama started its business in 1996 led by Sholeh BH Kurdi. CV. Promindo Utama's first products were nata de coco and gula asam drink. In 2003 CV. Promindo Utama started to produce mango puree in cooperation with Balai Besar Penelitian dan Pengembangan

Pasca Panen Pertanian Bogor. At the end of 2005, CV. Promindo Utama also produced puree from various kinds of fruits, such as soursop, guava, strawberry, lemon, and pineapple.

1. Performance of CV. Promindo Utama

1) Profitability

Profitability in CV. Promindo Utama was measured by calculating the profit received by CV. Promindo Utama, business capital, and business assets.

a. Profit

The profit which was being analyzed in this research came from the advantages obtained in producing mango puree. The component of the total costs consists of fixed costs and variable costs. Details of operational costs of mango puree processing in 2017 are listed in Table 1.

Table 1. Operational Costs, Revenue, Profit, and R/C of Mango Puree Processing in 2017

No.	Items	Amounts/year (Rp)
1.	Fixed Costs	34.864.583,33
2.	Variable Costs	470.297.854
3.	Total Costs	505.162.437,5
4.	Revenue	618.750.000
5.	Profit	113.587.562,5
6.	R/C	1,22

Based on the results in Table 1. the profit which is gained by CV. Promindo Utama from mango puree processing in 2017 was Rp 113.587.562,5 with R/C ratio of 1,22. The value of R/C was greater than 1 so the ratio has the meaning that this mango puree business was reasonable to do.

b. Capital and Business Assets

The initial capital used by CV. Promindo Utama to produced mango puree was Rp 10.000.000. This capital came from the personal capital that collected from the profit of selling nata de coco. CV. Promindo Utama didn't borrow any money from the bank because the owner has a principle that he will never borrow money from the bank. Assets that measured in this research are fixed assets. Fixed Assets are assets that are not generally intended for resale, but are intended to be used for the activities of a company (Shahab, 1991).

Total fixed assets consist of mango puree production process equipment, land, and building. The amount of total fixed assets of CV. Promindo Utama in 2017 was Rp 1,593,150,000. Seeing the development of assets owned by CV. Promindo Utama for mango puree processing, from the initial capital that only Rp 10,000,000, has increased for 15 years. As stated by Karana, et al (2014) in order to sustain the business and develop its business, SMEs will require substantial capital for assets development and capital increase.

2) Productivity

Productivity is the end result that obtained by SMEs related to its business activities to meet what the consumers really wanted and needed (Musfialdi, 2013). The indicators for productivity in this research are labor productivity and product quality.

a. Labor Productivity of CV. Promindo Utama

Measurement of labor productivity can be used to know the level of effectiveness and work efficiency of labor in producing the product. Labor productivity can be calculated by using the formula below :

$$\text{Labor Productivity} = \frac{22.500 \text{ Liter}}{585 \text{ HOK}} = 38,46 \text{ Liter/HOK}$$

From that calculation in 2017, the value of labor productivity was 38,46 liter/HOK. The value indicated that every use of labor input equal to 1 HOK (Hari Orang Kerja) will produce output equal to 38,46 liters of mango puree.

b. Quality

The quality of mango puree which was produced by CV. Promindo Utama was measured using mango puree specification. The specification of mango puree that produced by CV. Promindo Utama will be compared with aseptic totapuri mango puree that produced by ABC Fruits in India. The comparison between the two specifications of mango puree is shown in Table 2.

Table 2. A Comparison of Mango Puree Specification between CV. Promindo Utama and ABC Fruits

Parameter	Mango Puree from CV. Promindo Utama	Mango Puree from ABC Fruits ¹⁾
Variety	Arumanis and Gedong	Totapuri
Total Soluble Solids	13-16 ⁰ brix	Minimum 14 ⁰ brix
Flavor and Aroma	Gedong mango: typical flavored like mango gedong Arumanis mango: typical flavored like arumanis mango	Typical desert quality totapuri mango
Color	Gedong mango: egg yolk color Arumanis mango: yellow color	Bright golden yellow
Shelf Life	9 months at 2 ⁰ C	24 months at 10 ⁰ C 18 months at 25 ⁰ C

Source : ¹⁾<http://abcfruits.net/wp-content/uploads/2013/12/Aseptic-Totapuri-Puree-Specification.pdf>. (2018)

From the customer's side, the quality of mango puree that produced by CV. Promindo Utama has been satisfactory for its customers. CV. Promindo Utama was able to formulate the specifications of mango puree in such a way so that customers can follow the specified specs.

3) Market

a. Sales Volume

The demand for mango puree was always changing in every year. It happened because there was no written contract so that sometimes there was a sudden demand from the customer. Sales volume of mango puree from 2013-2017 is shown in Figure 1.

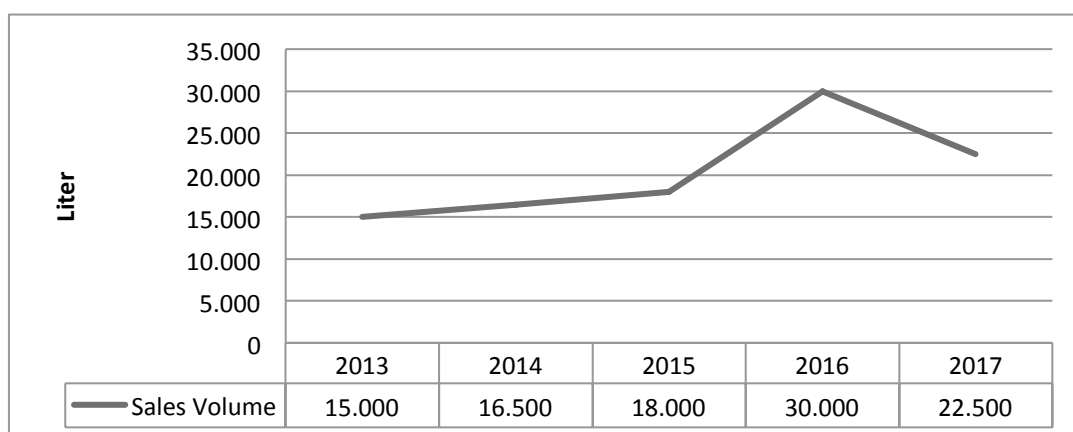


Figure 1. Sales of Mango Puree in 2013-2017 (Liter)

The sales of mango puree in CV. Promindo Utama from 2013-2017 was so fluctuating. The fluctuation of mango puree sales volume in CV. Promindo Utama can be influenced by several things, including the market conditions of its partners (customers). If the condition of the customers market is not very good, it will affect the demand for mango puree, the customers will reduce the demand for mango puree so that the sales volume decreases. In addition, increased demand for other products makes the production of mango puree was decreased due to limited storage capacity.

b. Achievement of Market Position

Mango puree that produced by CV. Promindo Utama can compete with domestic puree or with import puree in terms of price and quality. In terms of price, imported mango puree tends to be more expensive because there is an entrance fee, in addition to the purchase of imported puree there is a minimum purchase requirement, that is 15.000-20.000 liters, so for small-scale purchases, it will not be served. Another advantage of CV. Promindo Utama is able to achieve all market segmentation, such as, SMEs that processing mangoes and HORECA (Hotel, Restaurant, Café) that the quantity of purchasing is still not too large and customers mango processing factories with large purchases that produce juice of other processed mangoes.

For domestic competitors, the competitors of puree mango producer are not much, there are more for processing factories of guava, soursop, and pineapple purees such as in Tangerang and Depok areas. The number of competitors that produce mango puree is still small and the use of technology is still simple if compared with the CV. Promindo Utama. For example, mango podang urang puree that produced by Kelompok Wanita Tani (KWT) Budidaya Tiron Makmur in Kediri, East Java, besides there is a different type of mango used, the use of technology for the production process is still simple. The production process of puree mango podang urang was using a blender (Mutmainnah, et al., 2017), while CV. Promindo Utama already using semi-modern technology like pulper machine. CV. Promindo Utama already has its own customers. Beside that CV Promindo Utama has penetrated overseas markets. CV. Promindo Utama once exported puree to Japan in 2006.

2. The Partnership between CV. Promindo Utama and Mango Farmers

Initially the partnership between CV. Promindo Utama with mango farmers was using written agreement (formal contract). Written agreements were only valid for five years. But now the

rules that applied in the partnership is using an informal contract with the principle of trust between the two parties.

CV. Promindo Utama enforces contracts at the beginning because they worried that mango farmers will sell mangoes to other places. As revealed by Sulistyowati et al (2016) the dilemma of cooperation occurs when there is an offer from another promising party with a higher price and makes the farmers faced with many choices. The change of agreement was due to the fact that after five years the trust between the two parties was already established.

CV. Promindo Utama holds a meeting with mango farmers before the mango puree processing to discuss the partnership agreement between the two parties, such as the price, the required mango specification, the packing method, the payment mechanism and the quantity of mango that requested by CV. Promindo Utama to mango farmers as its partner. The pattern of partnership that runs between CV. Promomindo Utama with mango farmers was a form of general trading partnership. The partnership scheme that exists between CV. Promindo Utama with mango farmers is presented in Figure 2.

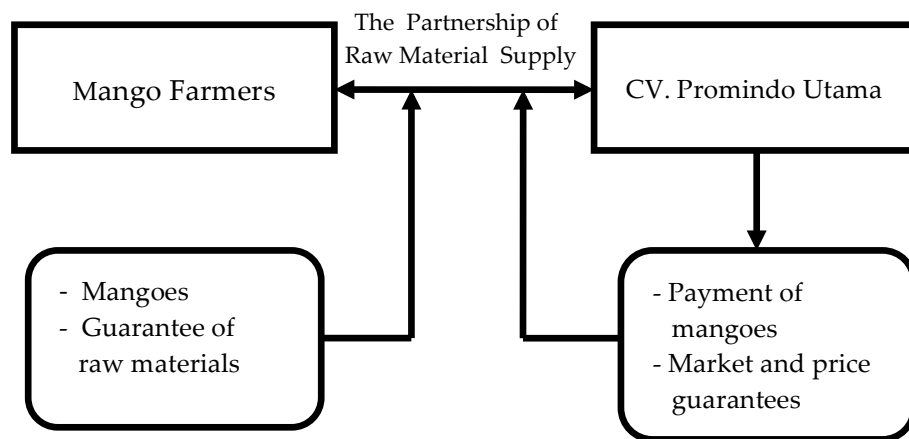


Figure 2. The Partnership Scheme between CV. Promindo Utama with Mango Farmers

In the general trading partnership, the business relationship between CV. Promindo Utama with mango farmers was a relationship in the marketing of mango farmers' production. The farmer's group as a partner was tasked to supply the main raw material needs and provide a raw material guarantee for CV. Promindo Utama, both in terms of quality, quantity, and continuity. While the CV. Promindo Utama in charge of processing and selling that mango puree to its marketing partners, namely customers. CV. Promindo Utama provides market guarantees and price guarantees for partner farmers.

3. The Partnership between CV. Promindo Utama and Its Customers

In running its business, CV. Promindo Utama establishes partnerships with nine partners to sell mango puree. The initial phase of establishing a partnership between CV. Promindo Utama with marketing partners or customers is the customers who want to buy mango puree and establish a partnership with CV. Promindo Utama sends an e-mail to the CV. Promindo Utama about their needs of mango puree. After that the CV. Promindo Utama will reply e-mail from customers include price, initial payment terms about 20%-50% and repayment are done after one month.

Agreement between the CV. Promindo Utama with the customers will be different if customers have done repeat order. The customers make purchasing order which contains the required amount of puree then paid according to the agreement when purchasing order. There is a customer who paid off at the time of one month from delivery of mango puree, at the time of 45 days from delivery, and there are also customers who pay one week after delivery. For purchasing order in the CV. Promindo Utama customer should be doing purchasing order in 3-4 days for the process.

In terms of mechanisms, agreements, rights and obligations of both parties, the partnership pattern between CV. Promindo Utama and customer is a form of general trading partnership. Partnership scheme between CV. Promindo Utama and customer are outlined in Figure 3.

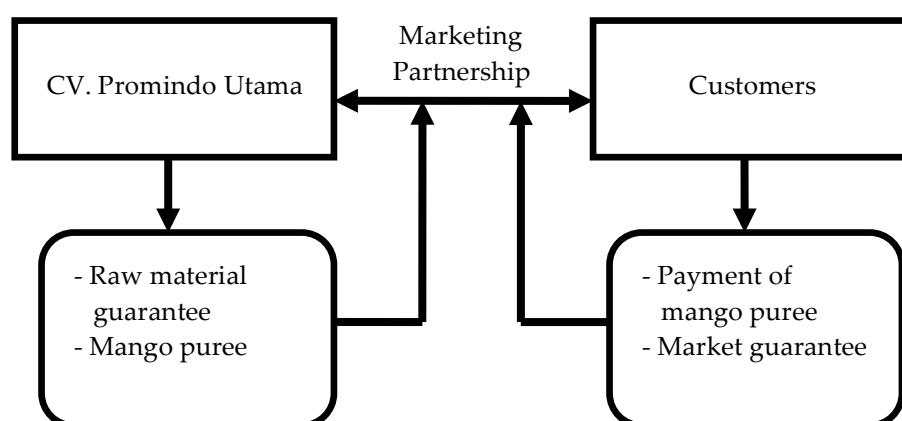


Figure 3. The Partnership Scheme between CV. Promindo Utama with Customers

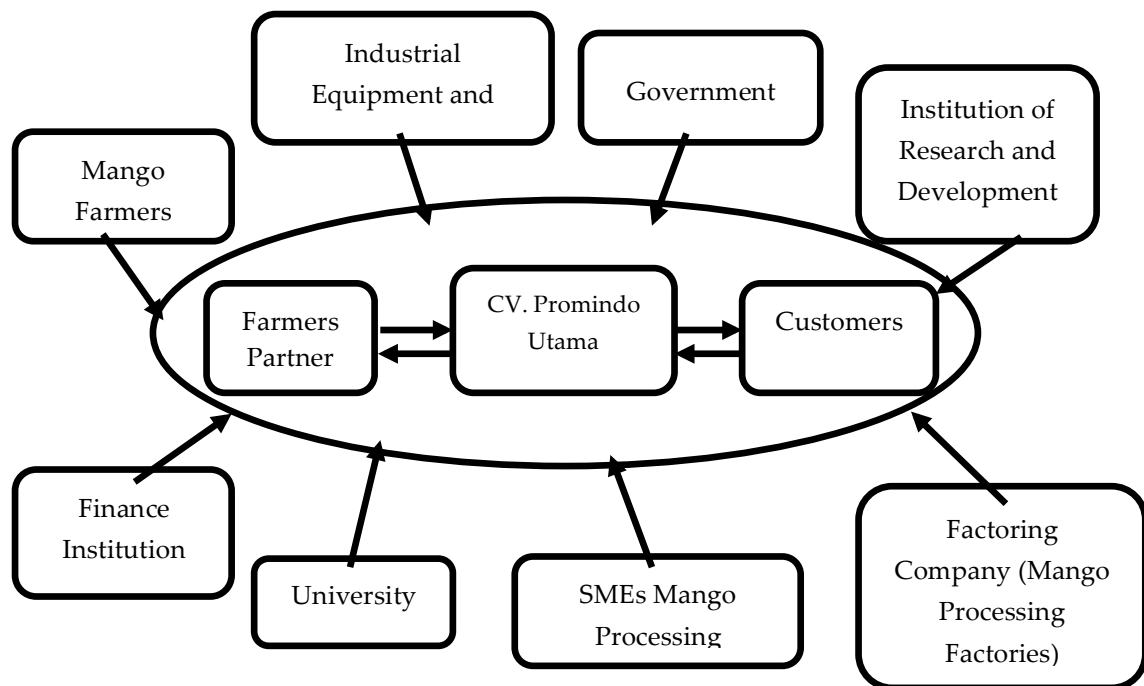
The general trading partnership was a partnership between a partner group and a partner company, which the partner company sold the product from partner group or a partner group supplying the necessary needs of the partner company (Zakaria, 2014). In the general trading partnership, the business relationship between CV. Promindo Utama with the customers was only cooperation of marketing. CV. Promindo Utama was in charge of supplying the raw material needs and providing a raw material guarantee that was mango puree for the customers. Customers as a marketing partner in charge of processing and selling puree mango into other products such as juice or mango puree drinks. Agreements that formed between the two parties initially used formal agreements or written agreements but the agreement between the two parties turned into an informal agreement, an unwritten agreement using the principles of kinship, trust, and mutual understanding. As revealed by Sulistyowati et al (2013), consideration of the formation of informal agreement on partnership relationship is an aspect of norm and trust between both parties.

4. Development Efforts of CV. Promindo Utama

The development of CV. Promindo Utama through business partnerships can be done by optimizing the agribusiness network in the form of fruit processing cluster. The cluster is formed on the scope of a specific geographical region that consists of producers, suppliers, buyers, and the other actors to develop and strengthen collaboration among all parties involved with mutually beneficial relations (Tambunan, 2005).

Through a cluster, SMEs can get many advantages and SMEs can solve the problems that related to business scale, production process, marketing, procurement of inputs, risks associated with demand fluctuations, and weakness in market information. The advantages can only be obtained if the cluster has well-developed both internal and external networks (Tambunan, 2005). The internal network consists of CV. Promindo Utama, mango farmers as a partner of procurement the raw materials and customers as a marketing partner while the external network consists of other business actors and various supporting institutions such as government institutions, financial institutions, industrial equipment and machinery, universities, and the other actors.

The development efforts of the internal and external network in the cluster can be done by developing agribusiness network and optimize the business partnership that has been formed. According to Saptana and Indrianingsih (2006) the development of business partnership in order to build agribusiness network can be done by (1) Strengthening of horticulture agribusiness group in a production center; (2) Bridging and unifying inter-group perceptions, interests and efforts with business partners; and (3) Intensive guidance and counseling for agribusiness development on partnerships. In a business partnership, in order to provide benefits for each party that involved, between the parties should be mutually built, not just a sale and purchase transactions. Illustration of CV development effort CV. Promindo Utama through business partnership is shown in Figure 4.



Source: Tambunan (2005)

Figure 4. The Scheme of Development Effort for CV. Promindo Utama through a Business Partnership

In West Java, a fruit processing cluster has been established for all people who processed fruit into various processed foods called Masterbu (Masyarakat Klaster Pengolah Buah). The government has been fostering for five years to make Mastebu from 2008-2013. This masterbu

consists of Cirebon, Indramayu, Majalengka and Kuningan Regency (Ciayumajakuning). Masterbu members consist of farmers as main raw material suppliers, input supplier, SMEs processing, as well as shops that sold these fruit products.

CV. Promindo Utama can be developed if the associated with it can play its role properly. Farmers partner through farmer groups played a role in fulfilling the needs of raw materials for CV. Promindo Utama. The partnership between the two parties was generally good, but occasionally the mango farmers break the agreement on mango specifications. Processing industry and SMEs mango processing have a role as a market for CV. Promindo Utama. Relations between the two parties were generally good, as both parties got the benefit from the partnership and will continue the partnership, but there were some obstacles, such as the payment were sometimes not timely repaid and the sudden demand from the customers.

The government has a very important role for all members of Masterbu to provide a program that can be a solution to the problem that faced by SMEs. Sulistyowati et al (2018) stated that the government has tried to provide a program to solve the problem but in reality, it has not been effective yet. The government was expected to provide continuous coaching to members of Masterbu. The guidance can be under the guidance of administration and marketing because it is one of the weaknesses of SMEs. Besides that, the government was expected to provide appropriate assistance for SMEs, including CV. Promindo Utama. One of the obstacles that experienced by the CV. Promindo Utama was limited of capacities, such as processing room and processing machine. The government will cooperate with the tool and machine industry for giving this machine equipment because they were more familiar with the specification of equipment and machinery. Together, both parties provide the equipment that required by SMEs, especially CV. Promindo Utama.

Universities, research, and development institutions have an equally important role with other stakeholders in developing CV. Promindo Utama. Universities and research and development institutions work together to provide new findings in the field of science and innovation that can improve CV. Promindo Utama development.

Financial institutions play a role in providing loans for the members of Masterbu including CV. Promindo Utama with requirements that can be fulfilled by SMEs especially for interest and collateral. One of the obstacles that faced by SMEs was to get a loan from a bank and there were even SMEs who are unwilling to borrow to the bank due to interest and collateral. As stated by Duan et al (2009) that SMEs do not have enough assets to be collateralized.

Bridging and uniting perceptions and concerns among the members with business partners is an important thing that must be done by CV. Promindo Utama with Masterbu members. These routine meetings can be a means for members to express the problems that they had and together find their way out with the principle of kinship. By conducting regular meetings with all members of the Masterbu, it is expected that all members will be able to understand their concerns so that nothing will hamper the partnership between the two parties.

Conclusion

The performance of CV. Promindo Utama was profitable in terms of profitability, productivity, and market. The pattern of partnership done by CV. Promindo Utama with its partner both mango farmers and customers was a general trading pattern. The agreement between the two

parties was informal agreement (unwritten) with the principles of kinship, trust, and mutual understanding. The development effort of CV. Promindo Utama can be done by developing agribusiness network and optimize business partnerships that have been formed.

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Impact of Money Supply on Some Macroeconomic Variables on The Nigerian Economy

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Abstract

The link between aggregate money supply, inflation and economic growth has raised a lot of scholarly debate in the field of economics and finance. The study sets to investigate the impact of money supply on macroeconomic variables in Nigeria from 1985 to 2016. The specific objectives of the paper were to ascertain the impact of narrow money supply, broad money supply, inflation rate, and exchange rate on real gross domestic product on one hand, and narrow money supply, broad money supply and exchange rate on consumer price index in Nigeria. The ex post facto research design and descriptive statistics were used to observe the variables in retrospect. To achieve the objectives of the study, two models were built to mimic the trend. To avoid spurious results, the Augmented Dickey Fuller test was used to solidify the data, which integrated at first difference I(1). The ordinary least square technique was employed to determine the magnitude and direction of the variables in the models. It emerged that narrow money supply has a positive and significant impact on inflation and real gross domestic product; conversely, broad money supply does not have any significant impact on inflation and real gross domestic product. Empirical evidence further showed that exchange rate has an insignificant impact on inflation and real gross domestic product. Inflation rate on the other hand, has an inverse and statistically insignificant impact on real gross domestic product in Nigeria. Ceteris Paribus, the results suggest that economic growth and inflation is a function of money supply (narrow money supply) and exchange rate in Nigeria. The paper recommends that efforts should be put in place to better the exchange rate between the naira and other currencies. This will help avoid the imported inflationary pressure on goods and services in the country.

Key word: Money supply, inflation, real gross domestic product, narrow money supply, exchange rate.



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Introduction

The nexus between aggregate money supply, inflation and economic growth has raised a lot of scholarly debate in the field of economics and finance. Money supply is a very sensitive variable - the size and velocity of money supply determines the pace of any economic activity. Apart from being a powerful instrument of monetary policy, its expansion or contraction dictates the growth in investment and output of any economy. It is therefore the usual slogan of the Monetarist school of thought that money matters. They argued that changes in the amount of money in circulation is a major determinant other economic indices. In other words, the changes in the size of money supply have a number of implications on the macroeconomics variables like inflation and economic growth.

Ceteris Paribus, inflation has a linear relationship with money supply and a negative relation with growth in real income or output (Nyong, 2001). In support of this argument, Ogun & Adenikinju (1995) found that the period of oil boom in Nigeria was characterized by rapid monetary growth which coincided with the periods when the country experienced double-digit inflation. The growth in money supply and its economic implications is therefore an issue to be thoroughly investigated. This subject has bordered the minds of Nigerian policy makers for decades. Despite the lacks of consensus among different schools of thought on its effectiveness as an instrument of monetary policy, the Central Bank of Nigeria (CBN) relies on it as its major barometer for shaping economic activities. The design and shift of the monetary measures taken by the central bank in recent times have been either expansionary or contractionary. Expansionary policy tools have been used to increase money supply with the intent of increasing output. Contractionary policy tools have been used on the other hand to decrease money supply in the economy in order to discourage consumption thereby curtailing inflation.

Obviously, Nigeria is a third world country that is predominately dependent on crude oil for economic survival. Nigeria's economic aspirations have remained that of changing the structure of production and consumption patterns, diversifying the economic base and reducing dependence on oil, with the aim of putting the economy on the part of sustainable, all-inclusive and non-inflationary growth. The implication of this is that while rapid growth in output, as measured by the real gross domestic product is important, the revolution of the various sectors of the economy is even more critical. This is consistent with the growth targets of most developing countries.

Irrespective of this glowing objective, over the years, the economy of Nigeria has been beleaguered with several challenges. There has been rise in general price levels leading to major economic distortions in the late 1970s, consequent to the civil war, salary increment, and excess government spending (Olorunfemi & Adeleke, 2013). The gradual, but increasing, inflation rate became serious during the 1980s with the adoption of the structural adjustment program aimed inculcating liberal policies in all spheres of the national economy, plus several military interventions in governance - the various military leaders who came into power pursued expansionary policies in economic management. Inflationary pressures during the SAP era of 1986-1990 was due largely to sundry factors, especially the depreciation of the Naira on the foreign exchange market, which increased the Naira prices of imported goods including raw materials and capital goods as well as an unprecedented growth in money supply during the period (Onoh, 1990). The outcome was a huge balance of payment deficit.

In spite of many, and frequently changing policies, Nigeria has not been able to harness her economic potentials for rapid economic growth and development (Ogbole, 2010). Today,

monetary and fiscal policies are both commonly accorded prominent roles in the pursuit of macroeconomic stabilization in developing countries, but the relative importance of these policies has been a serious debate between the Keynesians and the monetarists. The monetarists believe that monetary policy exert greater impact on economic activity while the Keynesian believe that fiscal policy rather than the monetary policy exert greater influence on economic activity. Despite their demonstrated efficacy in other economies as policies that exert influence on economic activities, both policies have not been adequately used in Nigeria (Ajisafe & Folorunsho, 2002).

This notwithstanding, the Central Bank of Nigeria (CBN) has continued to play the traditional role of regulating the stock of money in such a way as to promote the social welfare of Nigerians (Cochrane, 1998). Over the past two or more decades, the primary objective of many developed and developing countries (including Nigeria) have been the maintenance of price stability that supports sustainable economic growth and employment growth. As in most countries worldwide, the Central Bank of Nigeria (CBN) relies on a money demand function in the design and implementation of its monetary policy. The money demand function is used both as a means of identifying medium term growth targets for money supply and as a way of manipulating not only the interest rate and reserve money for the purpose of controlling the total liquidity in the economy but also for managing prices of commodities in the economy (Owoye & Onafowora, 2004).

Unquestionably, one of the macroeconomic goals which the government strives to achieve is the maintenance of stable domestic price level. To achieve this, monetary policy is used to regulate the value, supply and cost of money in an economy, in consonance with the expected level of economic activity (Baghedo & Ebibai, 2014). This goal is pursued in order to avoid the cost of inflation or deflation and the uncertainty that follows when there is price instability (Salam, Salam, & Feridun, 2006). Thus, this macroeconomic goal is aimed at ensuring price stability basically to avoid excess increase and excess decrease in prices of commodities. (Imoughele, 2014), this invariably leads to the attainment of internal and external balance, and the promotion of long run economic growth. This study therefore seeks to ascertain the impact of money supply on inflation and economic growth in Nigeria.

Objectives of the Paper

The broad objective of this paper is to scrutinize the impact of money supply on inflation and economic growth in Nigeria. The specific objectives of this paper are;

- (1) To investigate the impact of narrow money supply on inflation and real gross domestic product in Nigeria.
- (2) To determine the impact of broad money supply on inflation and real gross domestic product in Nigeria.
- (3) To determine the impact of exchange rate on inflation and real gross domestic product in Nigeria.
- (4) To ascertain the impact of inflation on real gross domestic product in Nigeria.

Empirical Literature Review

Several studies have been carried out to ascertain the impact of money supply on economic growth and inflation in developing and developed countries with varying results and conclusions. For instance, Mamo (2012) in a cross country study employed fixed effect panel model and Panel Granger causality to test the effect and causal relationship between inflation

and economic growth. The study used strongly balanced panel data which contained 13 SSA countries covering 1969-2009. The estimation results showed that inflation was negatively and significantly related to economic growth. It means that inflation has an adverse effect on economic growth. The Panel Granger causality test showed that inflation Granger causes economic growth for all countries in the sample, while economic growth Granger causes inflation for two countries. Similarly, Chaturvedi, Kumar, & Dholakia (2009) equally used a simultaneous equation model for a panel of 140 countries over the 1970-2005 periods to show that there exists a bilateral causal relationship between the growth and inflation as predicted by recent theories. Most importantly, the results indicated that inflation is harmful to growth whereas the effect from growth to inflation is beneficial. Doroshenko (2001) also considered the relationship between money supply and inflation. The findings confirmed a long-run relationship between money growth and inflation.

A recurring debate in the country specific literature on the effectiveness of monetary policy to stabilize the Nigerian economy in terms of price stability and subsequently stimulating economic growth and stability of money demand function that need not to be ignored in a study of this nature about Nigeria is the "TATTOO DEBATE" put forward by Tomori (1972) which found income, interest rate and real income to be the major determinants of demand for money in Nigeria. Owing to perceived shortcomings of Tomori's work, Ajayi (1974), Teriba (1974), Ojo (1974) and Odama (1974) questioned that postulation and came up with their own positions. Consequently the debate centred around the significance of income in money demand function for Nigeria, the stability of the function, and the choice of appropriate definition of money in Nigeria.

On the issue of income, in line with Tomori (1972) assertion, Teriba (1974) and almost all the other scholars agreed that income is the most significant determinant of money demand in Nigeria. On interest rate, Teriba (1974) contrasted Tomori (1972) view by arguing that long term interest rate is significant (unstable demand for money) but short term rates are insignificant (stable demand for money function). Those who however, argued that the rate of interest is not significant have two reasons for their argument (Mai-Lafia, 1995). Firstly, the interest rates have remained relatively stable in developing countries so that there is too little variation to allow conventional estimators to capture the effect of interest rates in the demand for money function. Secondly, that owing to the underdeveloped nature of the financial structure of less developed countries, the substitution between money and real assets may be quantitatively more important than that between money and financial assets. Owoye & Onafowora (2007) found income elasticity of 2.067 for Nigeria and interest elasticity of 0.306. On the appropriate definition of money demand in Nigeria, Tomori concludes that M_1 performs better than M_2 . In contrast, Ajayi (1974) asserts that M_2 performs better than M_1 . In an attempt to mediate between Tomori (1972) & Ajayi (1974), Gwosh (1981) contends that both M_1 and M_2 can be used as the definition of money in Nigeria. As lively as the debate was, the issue still remains inconclusive. Several studies have been conducted around the globe on the subject matter.

Following this debate, Nwaobi (2002) made efforts to examine the stability of the Nigeria's money demand function and found it to be stable. Nwaobi (2002) then suggests that monetary policy could be effective and that income is an appropriate determinant in the estimation of money demand in Nigeria. Anoruo (2002) explores the stability of M_2 money demand function in Nigeria during the Structural Adjustment Programme (SAP) period. He observed that M_2 money demand function in Nigeria is stable for the study period. Again, like Nwaobi (2002), he asserts – using M_2 money demand function, that it is a viable monetary policy tool that could be used to stimulate economic activity in Nigeria.

Recently, Gatawa, Akinola, Muftau, & Olarinde (2017) empirically examined the impact of money supply, inflation, and interest rate on economic growth in Nigeria using time series data from 1973-2013. VAR model and Granger Causality test within error correction framework were used. The results of the VEC model provided evidence in support of a positive impact of broad money supply while inflation and interest rate exhibits a negative impact on growth most especially in the long run. The short run parsimonious results revealed that with the exception of inflation, broad money supply and interest rate were negatively related to economic growth. For the test of causality, it was revealed that none of the explanatory variables granger causes economic growth, implying that money supply, inflation and interest rate have not influenced growth.

Chinuba, Akhor, & Akwaden (2015) used time series data to study the impact of money supply on economic growth covering 1981-2008 with simple OLS on the Nigeria economy, the results showed that money supply exerted a considerable positive impact on economic growth. An investigation into the long-run and short-run impact of money supply on economic growth of Nigeria for the period 1986-2006 was carried out by Omotor, (2010) using VAR Model, the results provide evidence in support of the long run positive impact of money supply on growth in income but has no impact in the short-run.

Similarly, Aziakpono (2003) presented and tested a model on money supply and economic growth to determine either or both anticipated and unanticipated money affects real output and growth in Nigeria. The evidence revealed that while anticipated money supply affects real output and growth in Nigeria, the unanticipated money supply did not. Omoke & Ugwuanyi (2010) tested the relationship between money, inflation and output by employing co-integration and Granger-causality test analysis. The findings revealed no existence of a co-integrating vector in the series used. Money supply was seen to Granger cause both output and inflation. The result suggest that monetary stability can contribute towards price stability in Nigerian economy since the variation in price level is mainly caused by money supply and also conclude that inflation in Nigeria is to a large extent a monetary phenomenon. M_2 appeared to have a strong causal effect on the real output as well as prices.

Abbas & Husian (2006) examines the casual relationship between money and income and money and prices in Pakistan. The co-integration analysis indicates, in general, the long run relationship among money, income and prices. The error correction and Granger causality framework suggest a one-way causation from income to money in the long run implying that probably real factors rather than money supply have played a major role in increasing Pakistan's national income, regarding the causal relationship between money and prices, the causality frame work provides the evidence of bi-variate causality indicating that monetary expansion increases and is also increased by inflation in Pakistan. However, money supply seems to be the leader in this case.

Akujuobi (2010) studied monetary policy and Nigeria's economic development using multiple regression analysis, namely; gross domestic product (dependent variable) and independent variables: Cash Reserve Ratio (CRR), Liquidity Ratio (LQR), interest rate, Minimum Rediscount Rate (MRR) and the treasury bill rate and found out that apart from cash reserve ratio, others impacted much on the economic development of the nation.

Similarly, Chimobi & Uche (2010) examined the relationship between money, inflation and output in Nigeria. The study adopted co-integration and granger causality test analysis. The co-integrating result of the study showed that the variables used in the model exhibited no long

run relationship among each other. Nevertheless, money supply was seen to granger cause both output and inflation. The result of the study suggested that monetary stability can contribute towards price stability in the Nigerian economy since the variation in price level is mainly caused by money supply and concluded that inflation in Nigeria is to an extent a monetary phenomenon.

Usman & Adejare (2014) empirically examined the effect of money supply, foreign exchange on Nigeria economy with secondary data covering the period of 1988 to 2010. Multiple regressions were employed to analyze the variables; gross domestic product (GDP), Narrow Money, Broad money, exchange rate and interest rate. The results found that all the variables have significant effects on the economic growth with the adjusted R² showing that about 97.3% variation in the GDP from 1988 to 2010 is due to NARM.

Similarly, Aminu & Amono, (2012) conducted an empirical investigation into the effect of inflation on the growth and development of Nigeria economy. The work employed Cobb Douglas Production function with ordinary least square method and concluded that inflation possess a positive impact on economic growth. Osuala, Osuala, & Onyeike (2013) carried out an empirical study on the impact of inflation on economic growth over a period of thirty-one years. The VAR results revealed a statistically significant positive impact of inflation on economic growth in Nigeria while the causality test showed that there is no causality in between the two variables. In the same vein, Taiwo (2011) investigated the impact of inflation and investment on economic growth in Nigeria with the use of ordinary least square (OLS) method and annual secondary data from 1981 to 2006, the investigation based on inflation-GDP revealed that inflation has negative and insignificant impact on economic growth, meaning that as inflation increases economic growth falls.

Ifionu & Akinpelumi (2015) examined the effect and implication of selected macroeconomic variables on money supply (M₂), using derived secondary data gotten from the Central Bank Statistical Bulletin (2013). Coupled with the application of econometric technique such as; O.L.S., causality test and Co-integration of time series data to estimate the long and short run relationship and causality of employed variables. The results revealed that all variables were stationary at various lags and there exists a long run relationship between variables employed and it was discovered that apart from inflation had an inverse significance with money supply (M₂) and exchange Rate (EXR), all other variables such as gross domestic Product (GDP) were found to have a positive impact on money supply.

Malik (2006) studied the effects of monetary policy actions on inflation using Near-VAR approach. His results showed that effect of monetary policy transmits into inflation with a lag of half year and then take another year to reach the peak. This study suggested the identification of variables that are most important in explaining inflation in Pakistan by considering monetary policy actions, supply side factors and foreign inflation.

Kenneth, Yuni, & Ihugba (2016) investigated the relationship between inflation and economic growth in Nigeria using a two stage least square estimation to examine the simultaneous models of the study. The study showed that inflation is beneficial to growth though not significantly while growth is significantly beneficial to inflation; given the positive relationship between inflation and growth and the negative relationship between growth and inflation. The results further showed that money supply and trade openness are significant determinants of real GDP for all three estimation techniques under consideration. While, real GDP, money supply and interest rate are significant determinants of inflation.

Furthermore, Femi (2014) the study examined the effect of economic variables such as inflation, income; interest rates, price level and exchange rate have on demand for money, by applying regression analysis with an Error Correction Model (ECM) on various economic variables, covering a period of thirty-three years (1970-2003). The study revealed that inflation was not affected by trend but by Nigerian government policies and that inflation does not exert any significant influence on demand for money.

Olorunfemi & Adeleke (2013) studied the impact of money supply and inflation rate in Nigeria using secondary data that ranged between 1970-2008. The study used Vector Auto Regressive (VAR) model. The results revealed that money supply and exchange rate were stationary at the level while oil revenue and interest rate were stationary at the first difference. Results from the causality test indicate that there exists a unidirectional causality between money supply and inflation rate as well as interest rate and inflation rate. The causality test runs from money supply to inflation, from the interest rate to inflation and from interest rate to money supply.

Adeyeye & Fakiyesi (1980) estimated and tested the hypothesis that the main factor responsible for instability of prices and inflationary tendencies in Nigeria was government expenditure. Working with annual time series data spanning 1960–1977, they tested the hypothesis that the rate of inflation in Nigeria is linearly related to the rate of growth of money stock, government expenditure, especially deficit, and growth of government revenue, especially monetization of foreign exchange from oil export. The result established some significant positive relationships between inflation rate and growth in bank credit, growth of money supply and growth in government expenditure, while the relationship with growth of government revenue was uncertain.

Using quarterly data, Osakwe (1983) attempted to verify the amount of government expenditure that affected money supply in the ten-year period 1970–1980. Significant statistical evidence obtained from the analysis showed strong relationships between increases in net current expenditure and growth in money supply, on the one hand, and growth in money supply and inflation, on the other hand. Further increases in money wage rate and money supply (with a lag in effect) were identified as the two most important factors that influenced the movement of prices during the period.

Baghelo & Ebibai (2014) empirically examined the impact of monetary policy on selected macroeconomics variables such as gross domestic product, inflation, and balance of payment in Nigeria from (1980-2011) using ordinary least square (OLS) regression analysis. The error correction method is used to ascertain if there is a static long run equilibrium relationship among the explanatory variables and subsequently derive an adequate dynamic model of the short run relationship. The study showed that the provision of investment friendly environment in the Nigerian economy will increase the growth rate of GDP.

Nwaobi (2002) used data from 1960 through 1995 and the Johansen co-integration framework found that money demand, real GDP, inflation and interest rate are co integrated in Nigeria. He also found stable money demand in the period under study. Fatukasi (2004) investigated the determinants of inflation in Nigeria between 1981 and 2003. The study made use of non-linear multiple regression models. He posited that the causes of inflation in Nigeria are multi-dimensional and dynamic, requiring full knowledge at any point in time to be able to proffer solutions to the inflationary trends in the country. Also, Omoke (2010) tested the causal long-term relationship between budget deficit, money growth and inflation in Nigeria. Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) test were carried out to test the stationarity of the

variables used. The result of the study pointed to a close long-term relationship between inflation and money supply.

In another country specific study, Olusanya (2009) analyzed the main sources of fluctuations in inflation in Nigeria. Using the framework of error correction mechanism (ECM) it was found that the lagged CPI, expected inflation, petroleum prices and real exchange rate significantly propagate the dynamics of inflationary process in Nigeria. Bakare (2011) conducted a study on the determinants of money supply growth and its implications on inflation in Nigeria. The study employed quasi-experimental research design approach. The results showed that credit expansion to the private sector determines money supply growth and inflation in Nigeria. He therefore concluded that changes in money supply are concomitant to inflation in Nigeria.

Anyanwu & Kalu (2015) examined the correlation that exists between money supply and economic growth using time series data for 18 years (1994-2012) on money supply, CLBA and output. The findings showed that change in money supply (M2) has significant effect on variables such as CBLA and output in Nigerian economy within the period under review. It also showed that there is a significant strong multiple correlation among Real GDP, money supply and commercial banks' loans and advances ($R= 95.1\%$). The coefficient of Determination (R^2) reveals that 90.5% of variations in RGDP were explained by the selected explanatory variables.

Inam (2014) studied the role of money supply on economic growth in Nigeria between 1985-2012 using augmented Cobb-Douglas production function and relying on co-integration/Error - Correction methodology. The results showed that money supply have a linear and statistically significant impact on economic growth. Babatunde & Shuaibu (2011) examined the existence of a significant long run relationship between money supply, capital stock, inflation and economic growth between 1975 and 2008 using error correction mechanism. The empirical estimates revealed a positive and significant relationship between money supply and capital stock while a negative relationship was found between inflation and growth.

Abdulazeez (2016) using time-series data covering 1990 to 2010, investigated the impact of monetary policy on economic growth in Nigeria. With the aid of multiple regressions analysis technique on money supply, interest rate, and financial deepening on gross domestic product, the study found that all the variables have marginal impact on the economic growth of Nigeria.

Methodology

Research Design

The Ex-Post Facto research design was adopted to examine the impact of money supply on some macroeconomic variables in Nigeria. This design was adopted to enable the researcher to use time series data to explain the impact of narrow and broad money supply, inflation rate, and exchange rate on real gross domestic product on one hand, and narrow and broad money supply and exchange rate on consumer price index in Nigeria in retrospect.

In addition to this design, the author used descriptive statistics and empirical analytical methods like Augmented Dickey-Fuller (ADF) test to solidify the data, Johansen co-integration test to determine the long run relationship in the variables, and multiple regressions to determine the impact of the variables on the explanatory variables in the study.

Nature and Source of Data

The nature of the data used in this paper is called time series data. The time series data gave us the needed information about the numerical values of the individual variables of the study from period to period for the estimation of the models.

The data for the paper was obtained from secondary sources, the Central of Nigeria Statistical Bulletin of 2016 and journals. Specifically, the researcher obtained data for real gross domestic product, inflation rate, narrow and broad money supply, and exchange rates from 1985 – 2016.

Model Specification

The study imitated finance literature and adopted the Multiple Regression using the Ordinary Least Squares like Usman & Adejare (2014), Baghelo & Ebibai (2014), Ifionu & Akinpelumi (2015) to examine the impact of narrow and broad money supply, inflation rate, and exchange rate on real gross domestic product on one hand, and narrow and broad money supply and exchange rate on consumer price index in Nigeria in retrospect in the other hand. The Ordinary Least Squares (OLS) technique is used because it is the most unbiased estimator, consistency, minimum variance and efficiency.

Consequently, the study assumed that real gross domestic product is a function of narrow and broad money supply, inflation rate, and exchange rate, and that consumer price index is a function of narrow and broad money supply and exchange rate in Nigeria. Thus, the mathematical and econometric model follows the augmented technique used by McCallum (1991) and Kohn (1999).

The functional models are stated as follows;

$$RGDP = f(M1, M2, INFR, EXR) \quad 1$$

$$INFR = f(M1, M2, INFR, EXR) \quad 2$$

This is expressed econometrically as follows;

$$RGDPGR = \beta_0 + \beta_1 M1 + \beta_2 M2 + \beta_3 INFR + \beta_4 EXR + u \quad 3$$

$$INFR = \beta_0 + \beta_1 M1 + \beta_2 M2 + \beta_3 EXR + u \quad 4$$

Where;

RGDP = Growth rate of real Gross Domestic Product

INFR = Inflation rate

M₁ = Narrow money supply

M₂ = Broad money supply

EXR = Exchange Rate

u = Stochastic term

β_1 to β_4 = Parameter estimates

A priori Expectations

$\beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 > 0.$

The implication of this is that all the coefficients of the explanatory variables are expected to have a linear impact on the dependent variables.

Operational Description of the Variables

1. **Narrow Money Supply (M₁)** - Currency outside bank plus demand deposits of commercial banks.
2. **Broad Money Supply (M₂)** - M₁ plus quasi money. Quasi-money is defined as the sum of savings and time deposits with commercial banks.
3. **Inflation** – general increase in prices of goods and services over a period of time in Nigeria.
4. **Gross Domestic Product** - the total market value of all final goods and services produced in Nigeria annually.
5. **Exchange Rate** - the value of the naira against other currencies.

Results and Discussions

Descriptive Statistics

The following report the mean, median, and standard deviation of the variables of the study

Table 4.1: Descriptive Statistics for RGDP, M₁, M₂, INFR, and EXR

	RGDP	M ₁	M ₂	INFR	EXR
Mean	4.943667	24.73533	25.89433	20.49333	76.61592
Median	5.100000	20.22000	22.62000	12.10000	94.07500
Maximum	11.36000	62.24000	57.78000	76.80000	158.6200
Minimum	-0.690000	-5.230000	1.320000	0.200000	0.999600
Std. Dev.	3.060835	18.51544	15.34671	20.00498	62.04927
Skewness	0.196472	0.406838	0.426843	1.502732	0.010971
Kurtosis	2.624988	2.251950	2.275053	4.026276	1.220870
Jarque-Bera	0.368799	1.527061	1.567908	12.60757	3.957230
Probability	0.831604	0.466018	0.456597	0.001829	0.138261

Source: Author's Computation using E-view 9.1

Note: RGDP = real gross domestic product, M₁ = narrow money supply, M₂ = broad money supply, INFR = inflation rate, EXR = exchange rate

From the descriptive statistics results, the mean real gross domestic product growth rate over the period of the study is 4.94, while M₁ (narrow money), M₂ (broad money), INFR (inflation rate) and EXR (exchange rate) are: 24.73, 25.89, 20.49, and 76.61592 respectively. The standard deviation of real gross domestic product growth rate, M₁, M₂, inflation rate and exchange rate reveals that the values in the data set are close to the mean. Thus reflects a small amount of variation of the data of the variables. All the variables positively skewed as indicated by the positive skewness coefficients.

Augmented Dickey Fuller (ADF) Unit Root Test

The ADF unit root test in this study was employed to solidify the numeric values of the variables. This helped us ensure that the regression outputs were not spurious. The results of the unit root test at level and first difference are presented in table 4.2.

Table 4.2: Unit Root Test for RGDP, M₁, M₂, INFR, and EXR

Variable	Level	1 st Difference	Order of integration
RGDP	1.3774	1.9889	I(1)
M ₁	-1.5581	-2.9116	I(1)
M ₂	-1.0345	-2.2293	I(1)
INFR	-0.2942	-2.6030	I(1)
EXR	-1.9395	-2.8639	I(1)
Critical Value @ 5%	-1.9583	-1.9592	

Source: Author's Computation using E-views

Table 4.2 show the summary of the unit root test of the variables used for the study. The results shows that all the variables used in the model are all integrated at first difference, symbolized by I(1), all at 5 percent significance level.

OLS Results for Models I & II

The Ordinary Least Square (OLS) is used in this study to estimate and determine the impact of the explanatory variables on the dependent variables of the study. The results are presented in tables 4.3 and 4.4 respectively.

Table 4.3: Regression Outputs for Model I

Dependent Variable: RGDP

Method: Least Squares

Sample: 1985 2016

Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.378644	1.485134	3.621656	0.0013
M ₁	0.158868	0.074099	2.143991	0.0419
M ₂	-0.162466	0.082949	-1.958629	0.0614
EXR	0.023757	0.099586	2.385576	0.1637
INFR	-0.059128	0.033224	-1.779659	0.0873
R-squared	0.509574	Mean dependent var		4.943667
Adjusted R-squared	0.491106	S.D. dependent var		3.060835
S.E. of regression	0.836677	Akaike info criterion		5.074155
Sum squared resid	201.1684	Schwarz criterion		5.307688
Log likelihood	-71.11233	Hannan-Quinn criter.		5.148864
F-statistic	5.191085	Durbin-Watson stat		1.648027
Prob(F-statistic)	0.009167			

Source: Author's Computation using E-view

The results showed that narrow money supply (M₁) possess a positive and significant impact on RGDP. Broad money supply (M₂) possesses a negative and insignificant impact on RGDP growth rate. Exchange rate has a linear and insignificant impact on RGDP growth rate; while for inflation rate (INFR), the results predict a nonlinear and insignificant impact on RGDP growth rate in Nigeria.

Further results show that the coefficient of determination (R^2) explained approximately 51% of the variation/changes in the dependent variable (RGDP growth rate). The test of the aggregate significance of the model also unveils that the model is statistically significant because the F-statistics (5.191085) is greater than the F-prob(0.009167) which is statistically zero. The Durbin Watson statistic of 1.648027 is greater than the R^2 output of 0.509574. This shows the absence of first order autocorrelation. The Akaike info criterion of 5.07 indicates that the model is correctly specified. The standard error of regression reveals that in about two-third of the time the independent variables explained the dependent variable by exactly 84 percent.

Table 4.4: Regression Outputs for Model II

Dependent Variable: INFR
Method: Least Squares
Sample: 1985 2016
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.988841	0.399780	12.47895	0.0000
M ₁	0.158364	0.056476	2.804075	0.0187
M ₂	0.106232	0.109901	0.966615	0.1024
EXR	0.650081	0.140658	4.061743	0.9520
R-squared	0.689006	Mean dependent var	6.380007	
Adjusted R-squared	0.681310	S.D. dependent var	0.336225	
S.E. of regression	0.045966	Akaike info criterion	-3.020716	
Sum squared resid	0.021129	Schwarz criterion	-2.624995	
Log likelihood	35.18644	Hannam-Quinn criter.	8.508300	
F-statistic	2.103845	Durbin-Watson stat	1.648007	
Prob(F-statistic)	0.009167			

Source: Author's Computation using E-view

The results showed that narrow money supply (M_1) has a linear and significant impact on inflation rate (INFR). This means that every 1 percent increase in narrow money supply led to about 0.16 percent increase in the rate of inflation. Similarly, broad money supply (M_2) also has a positive and statistically insignificant impact on inflation rate. Also, exchange rate has a linear and statistically insignificant impact on inflation in Nigeria.

The results further revealed that 68 percent of the variation/change in the dependent variable, inflation rate was explained by the explanatory variables in the model. The results also predict that the overall model is statistically significant because the F-statistic is greater than the F-prob (i.e. 2.103845 > 0.009167). Finally, the Durbin-Watson statistic value of 1.648007 is greater than the R^2 value of 0.689006; this suggests the absence of first order autocorrelation.

Summary of Findings, Conclusion, and Recommendations

Summary of Findings

This paper examined the impact of money supply on economic growth and inflation in the Nigerian economy from 1985 to 2016. Consequently, the study uncovered the following;

1. Narrow money supply (M_1) has a positive significant impact on inflation and real gross domestic product in Nigeria.

2. Broad money supply (M₂) does not have any significant impact on inflation and real gross domestic product in Nigeria.
3. Exchange rate has a significant impact on inflation and real gross domestic product in Nigeria.
4. Inflation rate does not have any linear significant impact on real gross domestic product in Nigeria.

Conclusion

The paper evaluated the impact of money supply on varied macroeconomic variables in the Nigerian economy from 1985 to 2016. To achieve the objectives of the study, the ex post facto research design and descriptive statistics was used to observe the variables in retrospect. The Augmented Dickey Fuller test was used to solidify the data and the ordinary least square technique was employed to determine the magnitude and direction of the variables in the models. The empirical results showed that narrow money supply and exchange rate has a significant impact on economic growth and inflation whereas, this is not the case for broad money supply and the rate of inflation on economic growth in Nigeria. Ceteris Paribus, the results suggest that economic growth and inflation is a function of money supply (narrow money supply) and exchange rate in Nigeria.

Recommendations

The following recommendations were made;

1. Accelerate efforts should be put in place to better the exchange rate between the naira and other currencies. This will help avoid the imported inflationary pressure on goods and services in the country.
2. Concerted effort should be made to ensure that efforts aimed at ensuring price stability do not stifle aggregate demand and hence economic growth.
3. Measure should be put in place to improve domestic production. This will reduce demand pull inflation and enhance economic growth.

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An Evidence Analysis Of The Exchange Rate Disconnect Puzzle In Indonesia

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Abstract

A dilemma in international macroeconomics that have been being empirical debating is Meese-Rogoff exchange rate disconnect as the persistent research finding of disengaging between exchange rate and macroeconomic fundamentals. This study analyses the evidence of the exchange rate disconnect puzzle of Indonesian Rupiah *vis-à-vis* the United States dollar. By using ARDL, the result showed that in the short-run, Dornbusch-Frankel sticky price model explains better the refusing of the puzzle evidence which provided macroeconomic fundamental that affect exchange rate movement. Nevertheless, in the long-run, Frenkel-Bilson flexible price model provide a little support in the refusing of the puzzle evidence.

Keywords: exchange rate, macroeconomic fundamentals, ARDL, sticky price, flexible price.



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1. Introduction

International finance interdependence that has been occurring creates an excellent variation effect towards the correlation of whole macroeconomic variables in several empirical studies, even it contrary to the theoretical concept. This instability correlation provides conundrums that have been debating, one of which is the relationship between the exchange rate and the macroeconomic fundamentals. Theoretically, the exchange rates volatility, in the long run, is determined by several macroeconomic fundamentals such as money supply, real income, real interest rate, inflation, trade balances and another significant variable (Lagana & Sgro, 2007; Tawadros, 2016). Another result that is supporting the relationship between exchange rates and fundamentals which provided by Davreux and Engel (2002), Guo and Savickas (2005), and Abhyankar et al. (2005). They showed the result which centered on the theoretical developments and explanations, the econometrics technique including data improvement, and the economic value of assessing the performance of these fundamental models.

Exchange rates determination which provided problems on international macroeconomics, is still not completely solved. Oppositely, the empirical evidence which builds by Meese & Rogoff (1983) who studied the exchange rate determination with five independent variables, therefore, concluded that have no significant effect of the fundamental macroeconomics towards exchange rate of the dollar against Mark, Yen, and Pound. Furthermore, Cushman (2000) confirm that the discovery of this conundrum becomes a debating in international macroeconomic in some currency cases which so-called the exchange rate disconnect puzzle.

Recently an empirical study of Engel and West (2005) used the United States exchange rate against the other six members of the 'Group of Seven' (G7) are Canada, French, Germany, Italy, Japan, and the United Kingdom explained well-known the puzzle. In particular, which using quarterly data from 1974:1 until 2001:3 they found a little providing support of the fundamental variables such as relative money supply, output, inflation, and the interest rate on predicting changes of the United States floating exchange rates. Specifically, in multivariate specifications of the long run equilibrium relationship almost have no valid evidence of the monetary model and co-integration in only five out of the 24 equations in the bivariate setting of how exchange rates determined.

The purpose of this study is to investigate the evidence of Meese-Rogoff exchange rate disconnect puzzle the case of Indonesian Rupiah *vis-à-vis* the United States dollar using quarterly data from 1990.Q2-2017.Q1. The focal point of this study is to examine the primary determinants of the nominal exchange rate and macroeconomic fundamentals relationship in the form of flexible price monetary model of Frenkel (1976) and Bilson (1978) which compared to the sticky price monetary model of Dornbusch (1976) and Frankel (1978). In peculiar, this study tries to investigate the ability of macroeconomic variables to predict exchange rates movement in the short run and long run.

Following parts divide this study. In the second part would be presented the theoretical framework and previous study of flexible and sticky prices. The third would explain the methodological concept and econometric modelling. Moreover, the forth would be analysed the result of causality test and discussed the evidence of Indonesian exchange rate disconnect puzzle, while the last part would be concluding and policy recommendation.

2. Literature Review

In the early 1970s separated from World War II, most countries pegged their currency on the fixed exchange rates that cannot be divided by the Bretton Woods System. The system specifically created to avoid the speculation of the foreign exchange rates market. Afterwards, in 1973 system failed to maintain the mechanism of foreign exchange rates volatility after United States dollar devaluated inside the period. Lagana & Sgro (2007) mentioned that the breaking down of the Bretton Woods System encouraged testing the exchange rate models using

determination and their theoretical variable causality. The first empirical testing was directed to examine the validity of exchange rates which characterised by “flexible and sticky price” models.

2.1. The Flexible-Price Monetary Approach: A Theoretical Framework

The monetary model exchange rate determination with flexible price assumes that purchasing power parity condition holds when prices are perfectly flexible (Frenkel, 1976; Bilson, 1978). The condition of holding the purchasing power parity is following the equation:

$$s_t = p_t - p_t^f, \quad (1)$$

Where, s is the log of the spot exchange rate, described as the differential of home p_t and foreign p_t^f price levels, respectively. Based on the quantity theory of money, both of prices are determined by the equilibrium in the home and foreign country, respectively given in the following equation:

$$p_t = m_t - \varphi y_t + \lambda i_t, \quad (2)$$

$$p_t^f = m_t^f - \varphi y_t^f + \lambda i_t^f, \quad (3)$$

Where m , y , and i represent the stock of money, real income, and interest rate respectively, and f denotes the corresponding foreign country variable. Frenkel (1976) and Bilson (1978) assume that for this condition, the elasticity with respect to income, φ , and semi elasticity with respect to the interest rate, λ , are equal between the countries engaged. Substituting the equation (2) and (3) to the equation (1) yields the representation of the flexible price monetary model given in the following equation:

$$s_t = (m_t - m_t^f) - \varphi(y_t - y_t^f) + \lambda(i_t - i_t^f). \quad (4)$$

Notably, in equation (4) states that a rise in home interest rate relative to the foreign interest rate leads to depreciation to the home currency. Thus, this condition holds the uncovered interest rate parity that the expected depreciation of home currency equal to the interest rate differential. Then the market will be aware to the expected inflation rates as holds in the condition of purchasing power parity implicitly given in the equation (1) which expected depreciation of home currency equal to the expected inflation rates differential (Frenkel, 1976). Henceforth, the differential interest rate equal to the expected inflation rates differential, which given in the following equation:

$$\Delta s^e = i_t - i_t^f = \pi_t - \pi_t^f \quad (5)$$

Substituting the equation (5) to the equation (4) yields the alternative representation of the flexible monetary price which following equation:

$$s_t = (m_t - m_t^f) - \varphi(y_t - y_t^f) + \lambda(\pi_t - \pi_t^f). \quad (6)$$

Equation (6) states that the exchange rates, as the alternative price of money is determined by the differential of the stock of money, real income, and inflation rates. Notably, an increase in the home inflation rate relative to the foreign inflation rate will increase to a depreciation of the home currency.

To provide more useful a flexible price condition of monetary exchange rate determination of the equation (6) can be rewritten as an econometrically model:

$$s_t = \alpha + \beta(m_t - m_t^f) + \varphi(y_t - y_t^f) + \lambda(\pi_t - \pi_t^f) + \varepsilon_t \quad (7)$$

Where $\beta=1$, $\varphi=-1$, and $\lambda=1$. The equation (7) of the flexible price of the monetary model as earlier provided by Frenkel (1976) and Bilson (1978) has been widely estimated and become furthest model that will be examined in this study.

2.2. The Sticky-Price Monetary Approach: A Theoretical Framework

The monetary approach of the exchange rate determination model in sticky price states that only in the long run, purchasing power parity will hold, otherwise is unrealistic (Dornbusch, 1976; Frankel, 1978). The long-run condition of the purchasing power parity holding is following the equation:

$$\bar{s}_t = p_t - p_t^f, \quad (8)$$

Where \bar{s}_t indicate the log of the spot exchange rate in the long-run equilibrium. Thus, following the Fankel-Bilson equation (6) that provide a characterization of the long-run equilibrium:

$$\bar{s}_t = (m_t - m_t^f) - \varphi(y_t - y_t^f) + \lambda(\pi_t - \pi_t^f). \quad (9)$$

In the short-run, the spot exchange rate can deviate from its equilibrium value; the market expects the spot rate to regress toward equilibrium at a rate proportional to the gap which following equation:

$$\Delta s_t^e = -\theta(s_t - \bar{s}_t) + (\pi_t - \pi_t^f). \quad (10)$$

The equation (10) states that exchange rate expectations thrive the correspond to a simple regressive expectations model is modified to include secular rates of inflation. Substituting the uncovered interest parity in equation (5) into the equation (10) yields the representation for the gap of current and its equilibrium level of spot rate which following the equation:

$$s_t - \bar{s}_t = -\frac{1}{\theta}[(i_t - \pi_t) - \varphi(i_t^f - \pi_t^f)]. \quad (11)$$

The equation (10) above states that the current exchange rate differs from its long-run rate in proportion to the real interest rate differential. Substituting the equation (9) into the equation (11) to acquire the exchange rate determination model with sticky price monetary condition, which following equation:

$$s_t = (m_t - m_t^f) - \varphi(y_t - y_t^f) + \left(\lambda + \frac{1}{\theta}\right)(\pi_t - \pi_t^f) - \frac{1}{\theta}(i_t - i_t^f). \quad (12)$$

To provide more useful a sticky price condition of monetary exchange rate determination of the equation (11) can be rewritten as an econometrically model:

$$s_t = \alpha + \beta(m_t - m_t^f) + \varphi(y_t - y_t^f) + \eta(\pi_t - \pi_t^f) + \gamma(i_t - i_t^f) + \varepsilon_t \quad (13)$$

Where $\beta=1$, $\varphi=-1$, $\eta=\left(\lambda + \frac{1}{\theta}\right)$, $\gamma=-\frac{1}{\theta}$, $\eta > \gamma$ in absolute terms. Based on equation (12) the sticky the price monetary model of Dornbusch (1976) and Frankel (1978) assume that the coefficient on the interest rate differential is not less than zero and the expected inflation differential, η , is equal to zero.

2.3. Monetary Approach of the Exchange Rate Determination: The Empirical Framework

The monetary approach in a different version that was employed by Frenkel and Koske (2004) investigated the wellness of this approach to explain the determination of the euro nominal exchange rate *vis-à-vis* six currencies. The maximum and eigenvalue tests showed that for the euro against currencies of Canada, Switzerland, Japan, Norway, and the UK, both of the tests indicate actively support of the fundamental variables to the engaged exchange rates at 1 percent

significance level. Other alongside the results showed that for the exchange rate *vis-à-vis* US dollar provide cointegrating relationship at 20 percent significance level.

Engel and West (2005) examined six exchange rates of industrialised countries used cointegration to test the long-run relationship between the exchange rate and some fundamental variables such as relative money supplies, relative output, interest rate differential and inflation rate differential. Mainly they employed the standard Johansen and Juselius (1990) approach for the testing of the exchange rate determination and conducted become multivariate equation and the bivariate equation of the exchange rates for every country which engaged each other and every fundamental macroeconomic variable separately. They conclude that result explains the evidence of the puzzle that almost all of the fundamental variables except inflation rates provide a small explanation to the floating exchange rates.

Similar dataset to the Engel and West (2005), by using autoregressive distributed lag (ARDL) approach to the cointegration, Oskooee (2014) showed there was no evidence of the exchange rates disconnect puzzle in Finland, Italy, Portugal, France and Switzerland. The model provided a result that the exchange rates and fundamental monetary variables moved together in the long-run. Their employing of Granger causality test also confirmed the ARDL test that monetary fundamentals granger causes the exchange rates. Thus, they concluded the supporting of the monetary model that they employed.

3. Research Method

This study uses quarterly data from 1990 quarter two until 2017 quarter one. Data downloaded from the official site International Monetary Fund (IMF) and The Organisation for Economic Co-operation and Development (OECD). The dependent variable is the spot exchange rate of Indonesian Rupiahs per U.S. dollar (s_t). Another four independent variables are differential of broad money using M3 of Indonesia and USA as a proxy of money supply differential ($m_t - m_t^f$), GDP growth differential between Indonesia and USA as proxy of relative income differential ($y_t - y_t^f$), consumer price index as a proxy of price differential ($\pi_t - \pi_t^f$), and interest rate differential ($i_t - i_t^f$).

The analysis begins from estimating equation (7) of the flexible price model and equation (13) of sticky price model using Autoregressive Distributed Lag (ARDL), particularly bound testing approach to cointegration which developed by Pesaran et al. (2001). The ARDL also used by some empirically tests the validity of the monetary theories to exchange rate determination. ARDL used to analyse the existence of cointegration relationship between the exchange rates and the monetary fundamentals variable to discover the presence of the puzzle.

The requiring estimation before running the ARDL test is the Augmented Dickey-Fuller (ADF) Unit Root Test unit root to establish the stationarity of the variables. The cointegration testing of the relationship between the exchange rate and the fundamentals of Fenkel-Bilson flexible price monetary as the first model, we rewrite equation (7) in a constrained error-correction format which following bound test as outlined by the $ARDL(n_1, n_2, n_3, n_4)$ which following equation:

$$\begin{aligned} \Delta s_t = & \alpha + \sum_{k=1}^{n_1} \phi_k \Delta s_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta (m_t - m_t^f)_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta (y_t - y_t^f)_{t-k} \\ & + \sum_{k=0}^{n_4} \lambda_k \Delta (\pi_t - \pi_t^f)_{t-k} + \delta_1 s_{t-1} + \delta_2 (m_t - m_t^f)_{t-1} + \delta_3 (y_t - y_t^f)_{t-1} \\ & + \delta_4 (\pi_t - \pi_t^f)_{t-1} + \varepsilon_t \end{aligned} \quad (14)$$

The second is the cointegration relationship between the exchange rate and the fundamentals of Dornbusch-Frankel sticky price monetary model by rewriting the equation (13) in a constrained error-correction format which following bound test as outlined by the $ARDL(n_1, n_2, n_3, n_4, n_5)$ which following equation:

$$\begin{aligned} \Delta s_t = & \alpha + \sum_{k=1}^{n_1} \phi_k \Delta s_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta(m_t - m_t^f)_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta(y_t - y_t^f)_{t-k} \\ & + \sum_{k=0}^{n_4} \eta_k \Delta(\pi_t - \pi_t^f)_{t-k} + \sum_{k=0}^{n_5} \gamma_k \Delta(i_t - i_t^f)_{t-k} + \delta_1 s_{t-1} + \delta_2 (m_t - m_t^f)_{t-1} \\ & + \delta_3 (y_t - y_t^f)_{t-1} + \delta_4 (\pi_t - \pi_t^f)_{t-1} + \delta_5 (i_t - i_t^f)_{t-1} + \varepsilon_t \end{aligned} \quad (15)$$

By estimating equation (14) and equation (15), the effects of each variable on the exchange rate in the short-run are inferred by the coefficient estimates attached to each of the first-differenced variables. The long-run effects are gained by the estimates of $\delta_1 - \delta_4$ (for Fenkel-Bilson flexible price monetary model) and $\delta_1 - \delta_5$ (Dornbusch-Frankel sticky price monetary model) which are normalized by δ_1 . Specifically, by using F-test examine the existence of long-run relationship, test the null hypothesis of no level relationship (no cointegration).

Mainly, Pesaran et al. (2001) provide two sets critical value in the stationary testing which applied irrespective of whether the variables are $I(1)$ or $I(0)$. An upper bound critical value assumes all variables are $I(1)$ and $I(0)$ for the all variables are lower bound critical value. If the calculated F-statistic is above the upper bound, then all variables are jointly significance long-run cointegration indicated, respectively to the lower bound of calculated F-statistic. On the other case, if the calculated F-statistic lies between these two bound, the result is inconclusive, and we can use an alternative test by forming lagged error correction term of the linear combination of lagged level variables in equation (14) of Fenkel-Bilson flexible price monetary model. The model is then re-estimated using the same number of optimum lags derived from the $ARDL(n_1, n_2, n_3, n_4)$ which following equation:

$$\begin{aligned} \Delta s_t = & \alpha + \sum_{k=1}^{n_1} \phi_k \Delta s_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta(m_t - m_t^f)_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta(y_t - y_t^f)_{t-k} \\ & + \sum_{k=0}^{n_4} \lambda_k \Delta(\pi_t - \pi_t^f)_{t-k} + \rho ECM_{t-1} + \varepsilon_t, \end{aligned} \quad (16)$$

Giving the similar treatment for the equation (15) of Dornbusch-Frankel sticky price monetary model, the model is then re-estimated using the same number of optimum lags derived from the $ARDL(n_1, n_2, n_3, n_4, n_5)$ which following equation:

$$\begin{aligned} \Delta s_t = & \alpha + \sum_{k=1}^{n_1} \phi_k \Delta s_{t-k} + \sum_{k=0}^{n_2} \beta_k \Delta(m_t - m_t^f)_{t-k} + \sum_{k=0}^{n_3} \varphi_k \Delta(y_t - y_t^f)_{t-k} \\ & + \sum_{k=0}^{n_4} \eta_k \Delta(\pi_t - \pi_t^f)_{t-k} + \sum_{k=0}^{n_5} \gamma_k \Delta(i_t - i_t^f)_{t-k} + \rho ECM_{t-1} + \varepsilon_t. \end{aligned} \quad (17)$$

In this new specification, one can examine the direction and speed of adjustment in the model following any short-run disequilibrium by examining the sign and significance of the ECM_{t-1} coefficient. The ECM basically links the long-run equilibrium implied by the cointegration relationship with the short-run adjustment process describing the mechanism by which the variables react following any shock from the long-run equilibrium. In the context of equation (16) and (17) above, a negative and significant $\hat{\rho}_i$ indicates adjustment of the exchange rate toward the long-run equilibrium following any short-run disequilibrium. Finally, the higher the absolute value of $\hat{\rho}_i$, the faster the adjustment process or the convergence rate.

4. Result and Discussion

The analysis begins with the ensuring of the variables are either $I(0)$ or $I(1)$ to know that there is no series under that consideration using Augmented Dickey-Fuller unit roots test. The result of the stationary using unit roots test in both models is estimated and presented in the table 1:

Table 1. Unit Roots Test Result

Stationary level	Variables				
	(s_t)	$(m_t - m_t^f)$	$(y_t - y_t^f)$	$(\pi_t - \pi_t^f)$	$(i_t - i_t^f)$
Level	-1.6388	4.0639	-6.7886***	-3.0284**	-2.9301**
First Difference	-7.7313***	-3.7506***	-15.925***	-5.9818***	-5.7179***

An asterisk symbol showed the rejection of the null-hypothesis at ***=(1%), **=(5%), and *=(10%)

The table 1 above reports the result of the unit roots test both in level and first difference. Since in stationary test, the probability of t-statistic should be lower compared to the 1%, 5%, and 10% significance level. The table showed that output differential, inflation differential, and interest rate differential variable being stationer in level. However, in the first difference level, all of the variables are stationary by rejecting the null hypothesis at 1% error term level. In particular, since the test conducted under first differences, can be concluded that there are no unit roots in first differences, and so each of the series must be either $I(0)$ or $I(1)$.

After known the result of the stationary test, the estimation proceeds to the next step which is the cointegration relationship that estimates equation (7) of monetary model and equation (13) of Dornbusch-Frankel sticky price monetary model. These estimated models followed by residual diagnostics such as serial correlation and homoscedasticity result which presented in table 2.

In the testing of the autocorrelation using Breusch-Godfrey Serial Correlation LM test apply two lags with the null hypothesis is no serial correlation. Since the probability of F-statistic 0.1567 for Frenkel-Bilson flexible price model and 0.4464 for Dornbusch-Frankel sticky price model are higher than the significance level, the null hypothesis failed to reject. It implies that residuals of both models are serially uncorrelated. Similarly testing for residual homoscedasticity, the Breusch-Pagan-Godfrey used the null-hypothesis is homoscedasticity. The result shows that the probability of estimated F is 0.0000 for Frenkel-Bilson flexible price model and 0.4464 for Dornbusch-Frankel sticky price model which lower than significance level even 1%. Thus, the residual is heteroskedastic in both of model estimated. The result of the residual test showed in the table of Appendix 1.

To test the presence of cointegration used in examining the null hypothesis states that no levels of relationship. The analysis focuses on the result of F-statistic comparing to the $I(0)$ and $I(1)$ critical value bound using the technique as mentioned in the previous section. The result of F-Bound Test which presented in the following section.

The result showed that F-statistics of both models are higher than $I(1)$ bound critical value in all significance level. It implies that the null hypotheses of both models are rejected. The result can be concluded that there is long-run cointegration between the exchange rates and macroeconomic fundamentals both in the Frenkel-Bilson flexible price model and Dornbusch-Frankel sticky price model. The empirical result of analysing equation (7) of Frenkel-Bilson flexible price monetary model and equation (13) of Dornbusch-Frankel sticky price monetary model states the relationship between exchange rate and each fundamental macroeconomic variable in both models to accompany the cointegration result above.

Figure in appendix 2 shows the parameter instability using CUSUM and CUSUM of square tests for each estimated model. Figure 1(a) shows that parameter of Frenkel-Bilson flexible price model estimator satisfies the stability requirement which CUSUM graph inside 5% significance boundary so is the figure 1(c) which provide a parameter of Dornbusch-Frankel sticky price model estimator. Nevertheless, figure 1(b) shows the failing of CUSUM of square requirement satisfying, which the graph shows the line of CUSUM of the square is outside of 5% significance boundary along after 1998 and before 2002. However, figure 1(d) shows that requirement stability of Dornbusch-Frankel sticky price model using CUSUM of the square test is satisfied. The F-Bound test result summaries in table 2.

Table 2. F-Bound Test Result

Models	F-statistic	Signif. Level	$I(0)$	$I(1)$
Fenkel-Bilson Flexible Price	6.381322	10%	2.37	3.2
		5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Dornbusch-Frankel Sticky Price	8.621824	10%	2.2	3.09
		5%	2.65	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

The presentation of the result of autoregressive distributed lag which assessed the null hypothesis that there is no correlation between spot exchange rate and fundamental macroeconomic variables showed in table 3. In the form of Flexible-Price model, differential money supplies stem correctly signs in lag zero, and opposite sign in the lag 1 with both coefficients are not statistically significant. Looking at the real income differential variable which produced four lags have correctly negative sign except in the lag three with all of the coefficients are statistically significant. This variable correctly confirms Frenkel (1976) and Bilson (1978) who earlier render the flexible price model of monetary exchange rate model and. Since spot exchange rate used in this study is the value of Indonesian Rupiahs per one U.S. dollar. It states that the higher of the spot exchange rates value, the more depreciate Indonesian Rupiahs towards U.S. dollar. Bilson (1978) and Rogoff (1999) portray the coefficient of real income variable both in the home and the foreign country as the income elasticity of demand. Thus, a rise in the real income in Indonesia will increase domestic money demand then decrease the value of spot exchange rates which indicates an appreciation of Indonesian Rupiahs towards U.S. dollar as high as the rate of income elasticity of demand of each lag.

Table 3. ARDL Estimation Result

<i>ARDL Estimates</i>	Frenkel-Bilson Flexible Price Model		Dornbusch-Frankel Sticky Price Model	
	<i>(1, 1, 4, 2)</i>		<i>(1, 1, 4, 0, 3)</i>	
	Coefficient	Standard Error	Coefficient	Standard Error
(C)	0.294714***	0.093430	0.310525**	0.150850
(s_{t-1})	0.976577***	0.009605	0.976609***	0.014772
$(m_t - m_t^f)$	0.012724	0.008026	0.013100*	0.007048
$(m_{t-1} - m_{t-1}^f)$	-0.013080	0.008355	-0.013523*	0.007277
$(y_t - y_t^f)$	-0.025406***	0.005867	-0.026571***	0.004851
$(y_{t-1} - y_{t-1}^f)$	-0.027989**	0.013967	-0.019676***	0.004845
$(y_{t-2} - y_{t-2}^f)$	-0.019069***	0.004919	-0.018688***	0.006183
$(y_{t-3} - y_{t-3}^f)$	0.014776*	0.008006	0.009306	0.006603
$(y_{t-4} - y_{t-4}^f)$	-0.013184***	0.003441	-0.026707***	0.005357
$(\pi_t - \pi_t^f)$	-0.008519	0.006957	-0.007397***	0.001798
$(\pi_{t-1} - \pi_{t-1}^f)$	0.008194	0.009712		
$(\pi_{t-2} - \pi_{t-2}^f)$	-0.005634	0.004475		
$(i_t - i_t^f)$			0.042785***	0.008154
$(i_{t-1} - i_{t-1}^f)$			-0.070540***	0.013357
$(i_{t-2} - i_{t-2}^f)$			0.051343***	0.013050
$(i_{t-3} - i_{t-3}^f)$			-0.023234***	0.008209
F – Statistic	614.5689 [0.000000]		731.8937 [0.000000]	
Adj. R²	0.984968		0.989276	
EC	-0.023423***	0.004059	-0.023391***	0.003165
Long-Run Coefficient Estimate				
$(m_t - m_t^f)$	-0.015177	0.020065	-0.018059	0.023745
$(y_t - y_t^f)$	-3.025669**	1.183554	-3.519905	2.189758
$(\pi_t - \pi_t^f)$	-0.254432**	0.117682	-0.316239	0.224810
$(i_t - i_t^f)$			0.015097	0.132527

Figures reported in the parenthesis () are selected model of ARDL estimation, parenthesis [] is a probability of F-statistic. An asterisk ***, **, and * indicates rejection of the null hypothesis at 1, 5, and 10 percent of significance level respectively.

The estimated of expected inflation rates differential variable which constructed in two lags shows that almost all lags refute the hypothesis of the Frenkel-Bilson flexible price monetary model which given in the equation (6) omitting the lag one. This result of coefficient's trend represents the price elasticity of demand is contrary to the spot exchange rate variable. A rise in expected inflation in Indonesia following the decreasing of demand for money thereupon should depreciate the Indonesian Rupiahs towards U.S. dollar. Nevertheless, this study refuses the model which adopted from Frenkel (1976) and Bilson (1978). Correctly strengthen the trend result, all of the lags yielded in the expected inflation rates differential variables are declining in

the rejection of null hypothesis which involves that the expected inflation rates differential did not alter the exchange rates movement of Indonesian Rupiahs towards U.S. dollar.

In the form of Dornbusch-Frankel sticky price model, lag one of spot exchange rate variable itself statistically significant affect the spot exchange rates movement with a positive sign of the coefficient. Contrasting to the estimation result of the Frenkel-Bilson flexible price model, almost all of variables significantly affect the exchange rate movement with the variability of significance level. Differential money supply has similar trace relative to the previous model though in this model both of variable form statistically significant affect the spot exchange rate movement in 90 percent confidence level. Lag zero of differential money supply variable provides the appropriate sign which involves that rising in the money supply in Indonesia will increase the value of spot exchange rates of Indonesian Rupiahs per U.S. dollar which means more depreciate Indonesian Rupiahs towards U.S. dollar. This result affirmatively confirms Bahmani-Oskooee (2014) which provided a similar sign in of the exchange rates of New Zealand *vis-à-vis* the exchange rates of Canada, French, Germany, Italy, Japan and U.K. Albeit the other lag provides inverse version confirm along with Chou (2017) in his all counterpart sample countries.

Entirely coincidental to the previous model, real income differential verifies the result of the study of Rapach and Wohar (2002), Engel and West (2005), and Tawadros (2016). Real income differential variable in almost all of lags statistically significant affect the exchange rates movement of Indonesian Rupiahs *vis-à-vis* U.S. dollar. The sign of the coefficients is proved the expected sign of the model expressly the equation (13). Lag for inflation rate differential changed from two lags become zero lag in the sticky price model by statistically significant affecting the exchange rate movements. However, it is providing inverse coefficient's narrow. As mentioned in the Dornbusch (1976) and Fankel (1978) a raising in the expected inflation conforming by raising in the domestic money demand should cause an appreciation. In this case, an increase in the domestic expected inflation rate alongside following the decreasing of money demand derive an appreciation of Indonesian Rupiahs by decreasing the value of Indonesian Rupiahs per one U.S. dollar. This result confirms Frenkel and Koskee (2004) oppositely for all their counterpart exchange rate countries.

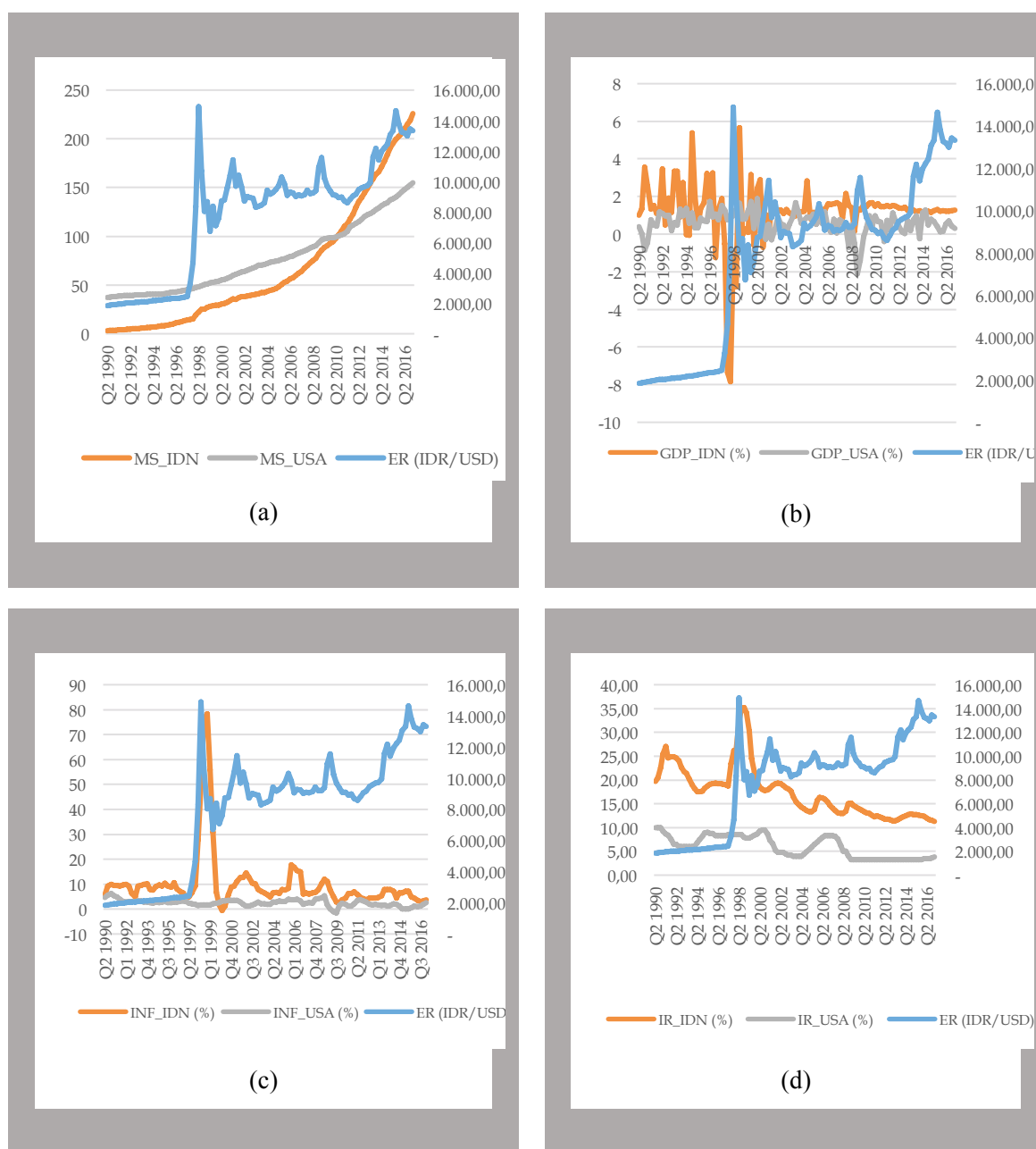
Interest rate differential variable as the central statement of the Dornbusch-Frankel sticky price model confirms the significant effect on the dependent variable in all lags resulted. Nevertheless, the sign of coefficients divided into different narrow. In the lag one and three have corrected sign which confirms Frankel (1978) stated that the increase of the increase of domestic interest rate following by attracting more capital inflow would appreciate the exchange rates movement or decreasing value of Indonesian Rupiahs per U.S. dollar. Other two lags provide opposite sign.

As expected, the error correction term variable which produced by regression of the equation (16) and equation (17) showed in table 3 implies an associated coefficient estimate of -0.023423 for the Frenkel-Bilson flexible price model and -0.023391 for the Dornbusch-Frankel sticky price model. This entail that about 2.34% of every movement into disequilibrium are corrected for within one period of the Frenkel-Bilson flexible price model and Dornbusch-Frankel sticky price model. Moreover, both of model give highly significant effect in error correction variable towards exchange rate movement.

In the long run, no one macroeconomic fundamental variables of Dornbusch-Frankel sticky price model are statistically significant effect the exchange rates movement. Nevertheless, in the Frenkel-Bilson flexible price model only money supply differential variable showed its relationship to the dependent variable. Money supply differential provides a negative sign in both models. The increase in demand for money in home market will decrease the value of home currency per foreign currency means that appreciating of Indonesian Rupiahs. This result confirms the backbone of both models.

Figure 1 showed the movement of the exchange rate and fundamental macroeconomic variables which analysed in this study. Money supply both in Indonesia and USA moved together in the observed period following the increase of the exchange rate of Indonesian Rupiahs per U.S. dollar. A high bounce of exchange rates in 1997 followed by a little bit increasing in the money supply in Indonesia. In 2011 money supply in Indonesia move higher than in USA with a small appreciation of Indonesian Rupiahs towards U.S. dollar. The movements between these variables in the figure confirmed by the result of Dornbusch-Frankel sticky price model in the short-run estimated. Alongside with the figure 1(a), GDP growth in Indonesia moved following the exchange rate appeared clearly in 1997 period. The sharply depreciated to the U.S. dollar, Indonesian Rupiah move together with decreasing of the GDP growth in Indonesia. It confirmed the ARDL estimation result that both models showed a significant correlation between exchange rates and income real which using proxy GDP growth except Dornbusch-Frankel sticky price model in the long-run equation.

Figure 1. Exchange Rates and Fundamental Macroeconomic Variables Movement



(a) exchange rates and money supplies movement; (b) exchange rates and GDP growths movement; (c) exchange rates and inflations movement; and (d) exchange rates and interest rates movement.

Another variable is inflation in Indonesia which moved together with exchange rates, particularly in the Asian financial crisis period. Nevertheless, afterwards in the post-crisis period the inflation rate sharply dropped become negative with a small decreasing of exchange rates towards U.S. dollar. The unique shape in figure 1(d) which showed the opposite movement between interest rate and exchange against U.S. dollar in Indonesia. Before crisis period interest rate decreased nevertheless the Indonesian Rupiahs had a small depreciation. In the post-crisis period, the depreciation of Indonesian Rupiahs towards U.S. dollar following the decreasing of interest rate. This interest rate – exchange rate figure confirms the estimation result of Dornbusch-Frankel sticky price model in the short-run equation.

5. Conclusion

In recent studies, the exchange rate determination analysed the exchange rate disconnect puzzle with some factors determined. This study operates the relatively new in the estimation technique with comparing two models as a backbone of the puzzle contributing. This study provides some conclusion such as the Dornbusch-Frankel sticky price model provide a more significant correlation between exchange rate and macroeconomic fundamental in the short-run rather than in the long-run. Moreover, another model is Frenkel-Bilson flexible price model that provides a little groundwork for the exchange rate and fundamental macroeconomic relationship either in the short-run or the long-run. Although, both models produce the same percentage movement into disequilibrium. Based on the coefficient's sign of the relative income differential which both models either in the short-run or in the long-run provide correctly influence into exchange rate movement. The finding of this study showed that the GDP growth should be used as a primary tool in the full filling the understanding of exchange rate determination.

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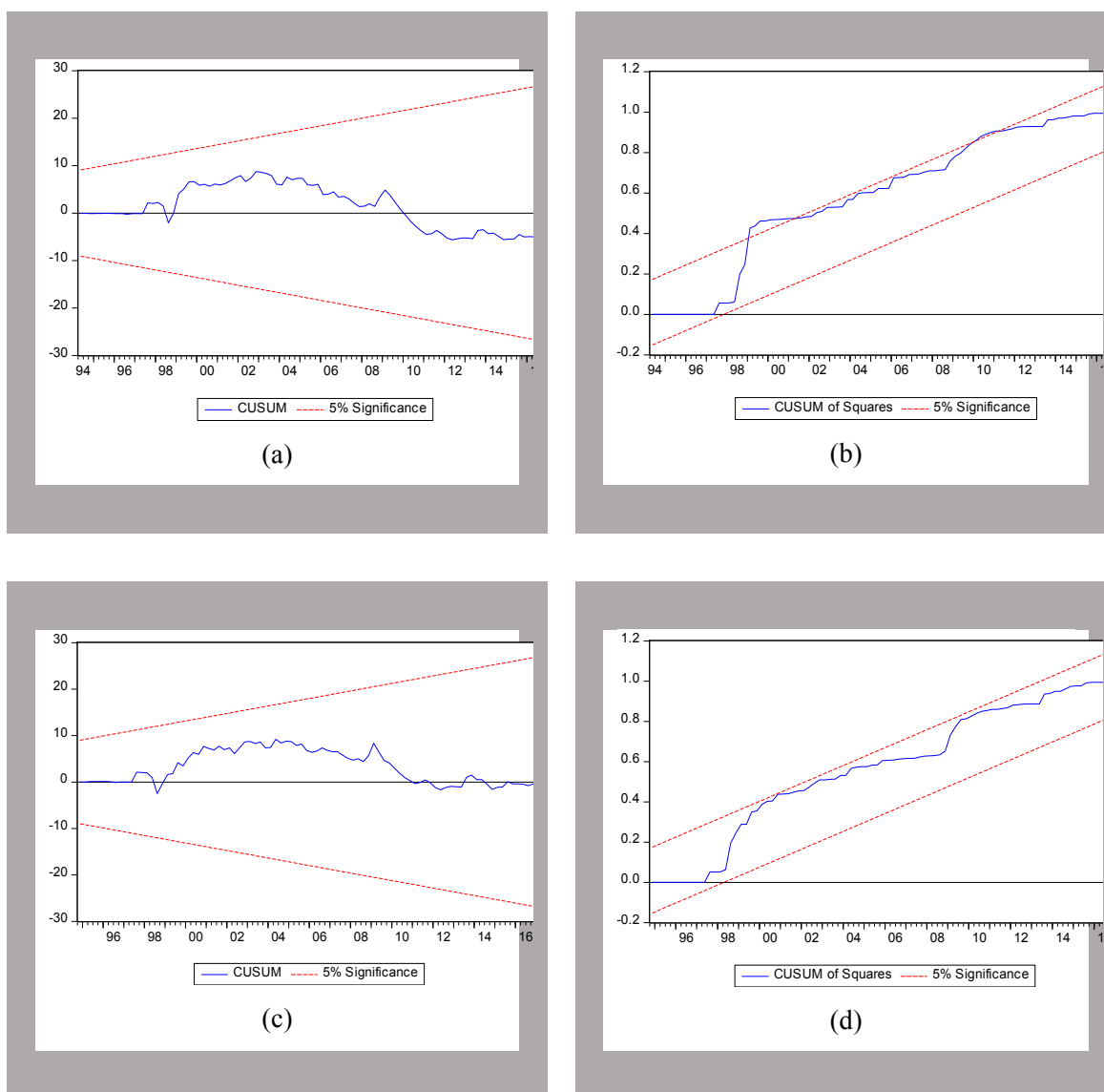
Appendixes

Appendix 1. Residual Diagnostic Test Result

Models	Autocorrelation Test		Homoscedasticity Test	
	F-statistic	Prob. F	F-statistic	Prob. F
Fenkel-Bilson	1.891845	0.1567*	9.857178	0.0000
Flexible Price				
Dornbusch-Frankel	0.813959	0.4464*	2.400401	0.0080
Sticky Price				

An asterisk symbol showed the rejection of the null hypothesis at 1%, 5%, and 10%.

Appendix 2. Recursive Stability Diagnostic



(a) CUSUM test result and (b) CUSUMQ test result of Flexible Price Model; (c) CUSUM test result and (d) CUSUMQ test result of Sticky Price Model.