Exploring and Explaining the Relationship Between Pollution Permit Adoption and Economic Advancement

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In this paper, I discussed the regression between nations adopting the pollution permit, in particular the cap and trade program and their economic development due to the fact that climate change becomes one of the momentous issues that environmentalists all over the world are facing. Every country, including developed, developing and not developed countries have the desire for climate change impact mitigation and adaptation, and most nations have agreed to a particular goal in the Kyoto Protocol and the Paris Agreement. There are other significant tools for limiting carbon emissions in a nation. Nevertheless, the cap and trade program show considerable advantages to other tools, not only in terms of lowering carbon emissions but also in providing benefits to the economy. However, cap and trade programs still show several disadvantages, leading to nations prefer the alternatives. Data was collected as secondary research to visualise the overall trend between the advancement of the economy and the rate of adoption. The purpose of this paper is to give an unbiased, analysed evaluation of the technology and quantify the rate of adoption of the program at the present, to offer a solution to improve the issue of climate change and by at the same time promote the method of controlling greenhouse gas emission that is most beneficial to nations.

Keywords: Sustainable design, Cap and trade, Pollution permit, Carbon tax, Green tax

Introduction

In these previous years, significant efforts have been seen globally on combating environmental issues in general and air pollution in particular, and Greenhouse gases are responsible for the tremendous negative changes that is causing the issue, such as photochemical smog, acid rain, death of forests, reduced atmospheric visibility and numerous other consequences relating to health issues and deconstruction of infrastructures. Therefore, According to the Paris Agreement, a landmark international accord that was adopted by 195 nations, nearly every nation on Earth in 2015 to address climate change and its negative impacts, "global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C" (Mellisa Denchak, 2021/2018, Limit global temperature rise by reducing greenhouse gas emissions) In order to pursue the goal, greenhouse gas emissions must reach their highest point before 2025 with at least 43% falling by 2030. Hence, it is important to think about how to devise policy and regulations to tackle this challenge.

To approach the issue, both behavioural and regulatory factors have to be considered to make changes. Behavioural factors are factors originally influenced by human behaviour. They might be the consequence of personality, living situation, leading to limited knowledge and concern about the impact on the environment create a lower demand for eco-friendly solutions, services and products. Nevertheless, on a governmental perspective other than shifting and acknowledging people to lower the demand of using high emissions, there exist 2 principal economic instruments which include "green" tax and pollution permits that could be apply as a solution to the issue. Green tax, Eco tax, or environmental tax is a mandatory payment on activities which are considered to be harmful to the environment, especially on emissions of greenhouse gas, resulting in pollution overall (Bosquet, 2000)[1]. On the other hand, Pollution permits are regulated allowances that allow producers to generate pollution. If pollution over the permitted allowance is created, a fine will occur. If firms find they produce less pollution than allotted, they can sell the excess permits to another firm for money.

Both techniques satisfy economists favour as currently most prefer controlling pollution by taxes or marketable permits rather than by more direct means (command and control); this view is rooted in the belief that firms are in the best position to make choices over time about how to reduce their own emissions in a way that minimizes discounted abatement costs or, equivalently, maximizes discounted profits (Makoto Hasegawa, Stephen W. Salant, 2015, introduction)[2].

The result as well as the techniques, and on balance, the drawbacks and benefits brought by the 2 instruments cannot prove if one is preferable to the other. However, in the matter of reality, due to the familiarity factor of the policy tool, the vast majority of nations have favoured carbon tax over "cap

and trade". But the amount of pollution permits is expected to increase in the near future. The United States, one of the most advanced, and biggest economies in the world, is also the exception of favouring pollution permits over other tools of controlling emissions. The results so far from their use in various U.S. programs have been positive and permission permits have a significant role. The instruments have proven to be not only environmentally effective, but also cost-effective, since those companies that bank the excess allowances (or amount of the cap) can reduce their costs remarkably.

Given the importance of pollution permits, this paper aims to extend our understanding of the factors associated with their adoption. There is an expectation regarding how the advancement of the economy is expected to show an effect, as any changes known involving new techniques and requiring advanced monitoring systems require finance resources for setting up, compliance, and reporting.

In this research paper, there will be a thorough examination of some economic factors that are associated with the adoption of cap and trade programs, at the country level. By using advanced economy indicators (GDP per capita) and figuring out the overall trend between the rate of adoption of the program and the advancement of the economy. In particular, by using a simple linear probability model created using technology to visualise the regression between the GDP of a nation and whether or not it has adopted pollution permit. Aiming to provide to what extent has pollution permits has been applied and what are the beneficial and drawbacks factors of pollution permits that leads to the current level of application, to give an unbiased conclusion of whether or not nations should scale its use.

What is a Pollution Permit?

In this paper, pollution permits will be focused on cap and trade scheme. Cap and trade are a market-based environmental policy to serve the purpose of limiting emissions of carbon dioxide and promotes environmentally friendly alternative. Initially, government must calculate a "cap" on the maximum emission based on the environmental goal. Afterwards, the government will divide these permits, often called "allowances", to be granted to each firm, techniques of allocating could be different among countries, most popular are auction allowances, give them away for free to covered facilities, or some combination of the two. To stop emissions "leakage". It is usual to distribute at least some allowances for free. Auctions bring in money that can be put toward environmental projects or other things. The green tax plays a role similar to a license to emit greenhouse gases and the total amount is limit by the "cap". Because allowances are tradeable, bankable, and scarce, they become a price signal for the cost of emitting when companies buy and sell allowances. Emitters have the freedom to choose how they want to use their allowances. For instance, emitters are urged to create compliance procedures to satisfy the requirements for emission reduction. Typically, a compliance program involves the adoption of pollution controls and energy efficiency improvements. Additionally, an emitter can "bank" their allocation by deciding to keep it for later use. In order to offer market integrity a secure, transparent registry can trace transactions, prevent theft, and stop allowances from being counted twice. Additionally, the majority of governments choose impartial specialists to examine transaction data and look out for fraud. For instance, in the US the Commodity Futures Trading Commission (CFTC) provides further market monitoring for some secondary carbon markets (the trading of allowances between individuals and/or businesses). Currently, EU ETS is currently the world's largest system. It operates in all 28 EU countries plus Iceland, Liechtenstein and Norway, limiting emissions from more than 11,000 heavy users of energy including power stations and industrial plants, and airlines operating between the ETS member countries[3].

Why do Countries Adopt Permission Permits?

Global temperatures are rising and the climate is changing as a result of the buildup of greenhouse gases (GHGs) from human activities, such as carbon dioxide (CO2) (IPCC, 2013). Nations from all around the world committed to a goal of reducing the rise in global average temperatures in an effort to reduce the effects of climate change, therefore all nations are seeking to find a solution. The cap and trade have shown several advantages compared to other techniques of cutting Carbon Emissions.

1. ***Show immediate result***
   Firstly, compared to carbon tax, which has no limitations in the allowances of emissions of carbon, Cap and trade systems, on the other hand, can show immediate results. By setting the cap, governments can ensure carbon reduction quantities to a certain level. Most firms will be following the allocated amount of emissions strictly to avoid additional cost, which will be leading to higher cash outflow. As a consequence, the authority of the government in controll will be more active and the accuracy of the estimation will also be higher. Although they may incur an increase in administrative cost.

2. ***Allowing businesses to have control over their usage of Carbon production permits***
   Secondly, cap and trade programs influence consumption and production patterns by attaching the carbon price to energy-intensive goods. The program is also highly efficient in influencing production and consumption patterns within the economy. Especially, when the price of carbon is inconsistent due to the fact that it is price elasticity on demand. Coping with fluctuation could cause numerous drawbacks, minimizing the emissions of carbon will be one

new priority for some particular companies due to this reason. Therefore, by forcing business to control their carbon production by using pollution permits will encourage them to reduce significantly their carbon production activities to avoid the risk due to the cost inconsistency characteristics of the activities.

3. ***Provides innovation incentives***
   Thirdly, Provides innovation incentives for the private sector. As firms have the pressure of lower carbon emissions, there will exist a new demand for solutions or alternative production processes. The private sector is encouraged by carbon markets to seek out choices that would result in the lowest abatement costs, which in turn drives technological advancements and investments. The increase in efficiency of the country's manufacturing stage of production, along with renew and advancement generates income that can be used to compensate consumers or to finance related initiatives like projects to advance low-carbon technology R&D and technology demonstration. Therefore, pollution permits will not only cut greenhouse gasses to be produce directly but encourage new technology to be invented to further improve the solution choices available for dealing with greenhouse gases.

In summary, not only does this policy promote a choice for firms and offer an effective way of bringing down the greenhouse gases emission, but it also promotes great long run incentives as well.

However, there are also disadvantages associated with cap and trade program, leading to limitations when nations adopt the policy. As known, firms will be charging an extra amount aside from original production cost if carbon is produced, to ensure the maintenance of the net profit margin the price of products might increase. Therefore, maintaining domestic industrial competitiveness is a central issue that needs to be considered when introducing a cap-and-trade scheme to sustain the competitiveness in international market. However, concerns about competition can be turned into commercial possibilities. Investing in R&D for low-carbon technological innovation, as well as their commercialization and deployment, for instance, can help early adopters in energy-intensive sectors increase their competitiveness. Technology and innovation itself cannot be the appropriate resolution to reduce carbon emissions down to the agreed level; however, those are key elements to a successful technique of controlling, especially to show institutional capacity. These tools need to be developed with strong foundations, including the delegated authority that is well responsible for registry, monitoring, reporting and compliance systems and backed by appropriate legislation. The reputation of the Cap and Trade system has a substantial effect on the confidence of investors which have direct effect on private sector. For the purpose of avoiding unnecessary risks to the economy, the government must design an explicitly well-functioning and consistent cap and trade market, and secure of the credibility, predictability, simplicity and transparency of the scheme. Businesses will need to commit both resources and time to adapt how they operate after the plan is introduced. Some organizations will have to make significant up-front investments in order to construct new infrastructure or upgrade existing infrastructure. Economic tools, such as tax breaks, loan guarantees, and subsidies for research and development, are required to support the situation and reduce investment risks for the private sector. Although, the technology and innovation investment might require huge financial resources.

In fact, most of these issue regarding the program can be avoid by further research and information into the real-life application of the program. As this program does not follow a well-established procedure and process like tax, it often causes uncertainty. Therefore, further study into the matter to possibly provide a backbone instruction for adopting the program to be applied by nations can increase the rate of adoption.

Methods

The hypothesis is brief out with reliable sources of explanation. Different opinions were viewed. Secondary data were collected to construct a linear model graph. The graph was then analysed to give applicable conclusions toward past, present and future adoption of the tool.

Conceptual Linkage

Recently, more developed countries with advanced economies have been given more responsibility for sustaining the environment after the global registration of the United Nations. In the past, advanced economies have played a tremendous part in causing global warming and emissions of carbon dioxide. Major developing countries, for example China and India, are adding to the stock. Advanced economies, including the United States, Canada, Japan and much of western Europe, account for just 12 percent of the global population today but are responsible for 50 percent of all the planet-warming greenhouse gases released from fossil fuels and industry over the past 170 years (Nadja Popovich, Brad Plumer,2021, para. 02)[4]. Given that carbon emissions are a key contributor to global warming, developed nations should drastically reduce their emissions in order to protect the environment. Because the emissions from wealthy countries are of a lifestyle type, while those from developing countries are of a survival nature, they cannot be considered equal. At the 1992 United Nations Conference on Environment and Development held at Rio de Janeiro, the principle of Common but Differentiated Responsibilities (CBDR) was formalized. Principle 7 of the Rio Declaration was enshrined as the concept of

CBDR. It was stated in the declaration that, "In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge their responsibility that they bear in the international pursuit of sustainable development in view of the pressures that their societies place on the global environment and of technologies and financial resources they command." (Vanya Verma, 2020, introduction)[5]. Developing countries or least developed countries only have little to almost no responsibility for global warming are also having to experience severe risk from rising average temperature. Moreover, some nations are not able to afford repairing the consequences of developed nations' actions. These advanced economies are bearing the pressure to cut down emission, preserving the environment as set right for their historical. Therefore, cap and trade stands to be a highly efficient solution for advanced economies and have a higher chance of being adopted by these economies, as cutting down carbon dioxide is prioritised more in developed countries compared to developing countries.

In order to remain an advanced economy, sustainability must be prioritised. The "sustainability" concept was first introduced in 1972 at the Stockholm United Nations conference emphasizing the links among economic development, social development, and environmental protection (Drexhage & Murphy, 2010). There were developments leading to changes in minor details over the last 40 years. However, these three factors continue to be the foundation of sustainability today, with each factor emphasizing a distinct component. Particularly, the social dimension is more related to community investment, working conditions, human rights and fair trade, public policy, diversity, safety, and anti-corruption. The economic dimension connects with accountability, corporate governance, stakeholder value, economic performance, and financial performance. And lastly, the environmental dimension focuses on energy, water, greenhouse gases, emission and waste. Between the three dimensions, countries are most commonly seen prioritising its economical dimension as economic dimensions are the foundation of the development of any nation. But, according to TBL, in order to achieve an actual long-term sustainable pattern, the investment for three sectors are required to be fairly comparable to meet in the centre of the counterpart three circles. Moreover, the case is even more applicable for developed countries, as one dimension is moderately satisfied, shifting financial investment partially to environmental sustainability is significantly crucial. In further explanation, according to Maslow's theory, human need is developed on eight different levels (1) physiological needs; (2) safety needs; (3) love and belonging; (4) esteem; (5) cognitive needs; (6) aesthetic needs; (7) self-actualization; and (8) self-transcendence. In the highest level of human- needs are transcendence, which include human consciousness, behaving and relating, as ends rather than means, to oneself, to significant others, to human beings in general, to other species, to nature, and to the cosmos. It is obvious that self-transcendence and environmental sustainability are intertwined. It is reasonable to suppose that consumers will be prepared to be environmentally sustainable after they have attained a state of self-transcendence. Needs lower down in the hierarchy must be satisfied before individuals can attend to higher needs. Therefore, it is reasonable to understand how important the environmental factor is to advance the economy, when the other factors have been fulfilled, in turn, self-transcendence will be desired, and the concern for the environment will then increase. As a result, cap and trade will be adopted more by advanced economies to improve the quality of life.

Lastly, the most noticeable reason is inadequate financial resources in comparison to industrialized countries. Developing nations grappling with the effects of climate change are directly impacted by this predicament. The agricultural outputs of developing nations provide as an example of how a lack of financing, human capital, and technological resources has affected such nations' ability to practice sustainable agriculture. The financial position of a developed economy suggests to them various options dealing with the environment.

Advanced Economy Indicator

The term "advanced economies" is written, using day-to-day language, to describe nations with high economic growth and security, a substantial accumulation of industrial capital, modern technologies, and institutions that are firmly embedded within the global economy. There is no straightforward formula that can help label an economy as advanced or not. They are usually defined as having a high level of per capita income, a very significant degree of industrialization, a varied export base, and a financial sector that's integrated into the global financial system.

GDP per capita is one key element in considering if an economy is advanced or not. GDP stands for Gross domestic product and per capita is divided by its population. It is an economic metric that breaks down a country's economic output per person. By using GDP per capita, economists can determine how prosperous countries are based on their economic growth. Countries with a higher GDP per capita tend to be those that are industrial, developed countries. If a nation's GDP per capita is increasing but its population is remaining stable, this could indicate that technical advancements are increasing output while maintaining population levels. Small populations and high GDP per capita are signs that a nation has developed a self-sufficient economy based on an abundance of unique resources.

Export diversification is the second most important factor. There are contrasting opinions regarding if it is not only the level of exports that leads to growth, but what also matters is the degree of diversification of such exports or of the export base. These views' proponents have emphasized the importance of diversification as a key factor in growth. Romer (1990)[6], for

instance, recognized diversity as a production factor, while Acemoglu and Zilibotti (1997) assert that diversification may boost income by increasing the likelihood of dispersing investment risks across a larger portfolio.

Integration into the global financial system gives investors and economists data to distinguish the advancement level of the economy. Trading to and out of the country of goods and services by firms is called international trade. Consumer goods, raw materials, food, and machinery all are bought and sold in the international marketplace. Trade in the international market allows nations to get access to goods and services that are not available domestically, allowing citizens to approach a higher-level lifestyle, as well as expanding the country's market. As a result of international trade, the market is more competitive. This ultimately results in more competitive pricing and brings a cheaper product home to the consumer.

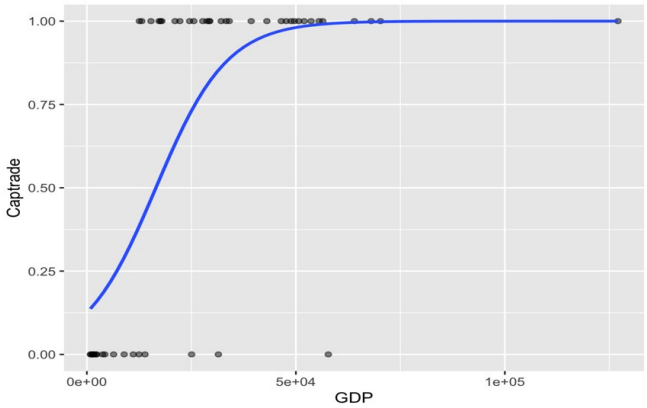
Data Analysis

The main outcome variable of interest in this paper is whether a country adopts a cap and Trade program. I manually constructed a measure of whether a country adopts this program. Specifically, I constructed a binary variable, where adoption = 1, and no adoption = 0. However, given that I have only a subsample of countries, this sample is not a perfect representation of the entire world, and this study is limited by data availability. The research process was rather straightforward, the information is publicly published on the European Commission website (International carbon market). In total, 50 countries' numerical data were used in this paper.

The main independent variables that I examine in this study are: GDP and net export, etc. Due to the availability of the data, for GDP per capita, I constructed the measure using data from "GDP by Country - World meter," (GDP by Country)[7] For net export, I constructed the measure using data from *World Bank Open Data*

In my sample, I collected details on the cap and trade programs for the following countries: Argentina, Australia, Austria, Bahamas, Belgium, Benin, Brazil, Bulgaria, Cambodia, Canada, China, Costa Rica, Croatia, Czechia, Denmark, Ecuador, Egypt, Estonia, Ethiopia, Finland, France, Germany, Greece, Guinea, Hungary, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Mali, Malta, Mexico, Netherland, New Zealand, Nigeria, Oman, Poland, Portugal, Romania, Slovenia, South Korea, Spain, Sweden, Timor-Leste, UK, US, Vietnam, Zambia. Among the countries in my sample, 32 adopted, and 18 have not adopted. This is an adoption rate of 64%, however, this percentage does not accurately represent or generalize the percentage of countries that have adopted the program in the world as the countries that were picked was biased to an extent to ensure enough data would be collected to see the correlation between the rate of adoption and the advancement of the nation.

I conducted a regression analysis with cap and trade as the dependent variable and GDP + net export as the independent variable. The outcome variable is binary. The conventional way to analyse this kind of outcome variable would be to use logistic regression. However, for the ease of implementation, I simply use linear probability models. I estimate models in the form of CapTrade = b1GDP + 2NetExport + c.

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Residuals:
    Min      1Q  Median      3Q     Max
-0.9692 -0.3211  0.1005  0.3633  0.5504

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 2.977e-01  8.991e-02   3.311  0.00181 **
GDP         1.156e-05  2.383e-06   4.850 1.45e-05 ***
Export      2.352e-10  3.620e-10   0.650  0.51909
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
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Fig. 1 Regression Analysis

The results of the regression analysis are displayed in graph 1. The graph that fits a logistic function to the data, the GDP per capita has shown quite clearly the overall trend between and connection between the advancement of the nation and the rate of adoption of cap and trade programs. It is noticeable how the higher the GDP the Higher the rate of adoption was shown in the graph. There is 1 outlier, Luxembourg with a significantly high GDP per capita. This strongly supports the argument made previously in the paper, explaining how an advanced economy is predicted to have a higher rate of adoption.

In graph 1 I fit a logistic function to the data. The results indicated that GDP per capita is a significant predictor of Y (b = 2.977e-01, t = 4.850, P<.001), and net export is not a significant predictor of Y (b = 3.620e-10, t = 0.650, p = 0.51909). The r-squared value of this regression is 0.3107, this means the predictors have explained 0.3107% of the variance in Y.

Interpretation of Results

My analysis suggests that GDP is a strong and significant predictor of the adoption of Cap and Trade programs. This confirms my prediction, and the reason is that there is a positive relationship between the advancement of the economy and the rate of adoption of cap and trade programs. However, net exports do not predict the outcome variable. One potential explanation for this is that export diversification is more essential as the whole nation's economy does not depend on just a few manufacturing, and agriculture industries. A developing nation could have high net exports as it mainly exports agriculture or any kind of unessential natural resources such as "rice". By stabilizing export revenues, diversification enables governments to insure against unfavourable terms of trade shocks. They can use it to channel favourable terms of trade shocks toward scaling up, growing their businesses, and spreading knowledge. Moreover, the comparison is not accurate due to the currency value. A country's currency exchange value if low will allow the nation to increase its competitiveness. Due to the fact that the companies can produce and sell those goods abroad relatively cheaply.

However, there is uncertainty as GDP per capita cannot fully reflect the trend of adoption. Due to the fact that there are irregular cases such as high GDP due to small populations not the advancement of the economy, or nations that pay higher attention to environmental issues to cultural reasons.

Concluding from the overall trend, as economies become more advanced, you should therefore expect countries to increasingly adopt cap and trade programs. The implication for this is that more advanced economies can extend economic assistance to less advanced economies if they want to further contribute to sustainability goals.

Overall, my analysis suggests that some economic indicators can be a useful way to understand adoption of cap and trade programs.

Discussion

At present, the majority of nations have acknowledged the issue and their responsibility to improve the issue. Some have taken major action by adopting policies and strategies such as but not limited to green tax, and pollution permits especially in nations with more advanced economies due to the reasons listed. Yet some nations with suitable financial situations still prefer other methods over pollution permits because of the combination of disadvantages listed and unfamiliarity with the pollution permit compared to other greenhouse gas reduction strategies. Therefore, further discussion and study into the strategy, particularly regarding its effect on the operation of a business at different scales or comparison of the pollution permit and other methods can increase the rate of adoption and utilize the benefits of the method at a larger scale.

Conclusion

Reduction of greenhouse gases, in particular Carbon Dioxide is imperative to maintaining ecological balance and an economic sustainability. Most nations in the world have signed contracts promising to reduce carbon dioxide emissions. With the rapid growth of economies, more and more carbon dioxide was produced and led to numerous server consequences. However, the number of nations that have adopted this program is increasing yet not high at present despite how the Cap and trade program is proven to be a method of controlling carbon emissions that have numerous advantages. This study takes the question of Exploring and Explaining the Relationship Between Pollution Permit Adoption and Economic Advancement'. In aspect of finding the connection between the advancement of the economy. In this paper, there are explanations regarding why more advanced economies are more likely to adopt the tool. This relationship is expected to apply to most nations. We have also carried out secondary research in order to prove the connections using advanced economic indicators. Therefore, it is expected that more nations will adopt the cap and trade program in the near future as various economies are developing in a rapid pace. The idea could be continued in the path of further investigation into the environmental effect on the economy.

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