

Chapter 12

BBNN: Sustainability

In this chapter I introduce environmental restrictions to the same framework. As in the case of political constraints, the challenge of reconciling different and conceivably inconsistent objectives is discussed: where I go over integral solutions to the problems of both the Latin Triangle and the Kyoto Triangle.

12.1 Environmental Sustainability

It is time now to turn our attention to the use of the resources – or the the environmental aspects of the BBNN. As we have been doing all along, we are going to oversimplify the problem, not with the intention of insulting, but to develop a workable framework that will allow us to construct a view of the world.

The section starts by developing the environmental restriction schedule – what is called ER. Then it discusses again the indeterminacy of equilibria. We discuss the problems of each. In this case there is no political cycles as the ones that arise in the Latin Triangle. The reason is that the environment moves much slower than social events. This is in some dimensions making the tensions between the environment and everything else more dangerous. If the environment were deteriorating fast, we probably would have taken corrective actions already. So, in some aspects, the fact that the indeterminacy does not create cycles implies that the economics and the politics is what dominates the choices.

In the end we discuss solutions. We discuss mainly three solutions – one that is based entirely in choosing the appropriate equilibrium; one that is based on technological improvements; and one that is based on population.

12.1.1 Environment Schedule

Understanding and summarizing the impact on the environment is an extraordinarily difficult task. However, we are going to oversimplify the problem by assigning most of the environmental issues to excessive demand – either too much individual consumption, or too much population. In fact, this is not terribly incorrect. Most researchers indeed look at the problem of excessive consumption of natural resources (renewables or not), excessive production and pollution, congestion, and many others, as the outcome of a excessive boom in consumption and population.¹

¹If you are interested you need to see (and take) John Sterman's class on sustainability (or at least take his first class) and you will realize how large the negative impact of population has been on emissions, and consumption.

We assume that there exists a level of aggregate demand at which the impact on the environment is zero. In other words, this is the level of demand at which the environment is sustainable. One interesting aspect of what we are doing is to assume that the sustainability issue does not depend on exchange rates, nor wages – which is a reasonable assumption. This implies that the ER schedule is vertical, as depicted in Figure 12.1. To the right of the ER the environment suffers, and the more to the right, the more it suffers; while to the left of the ER the environment is protected and consumption is sustainable.

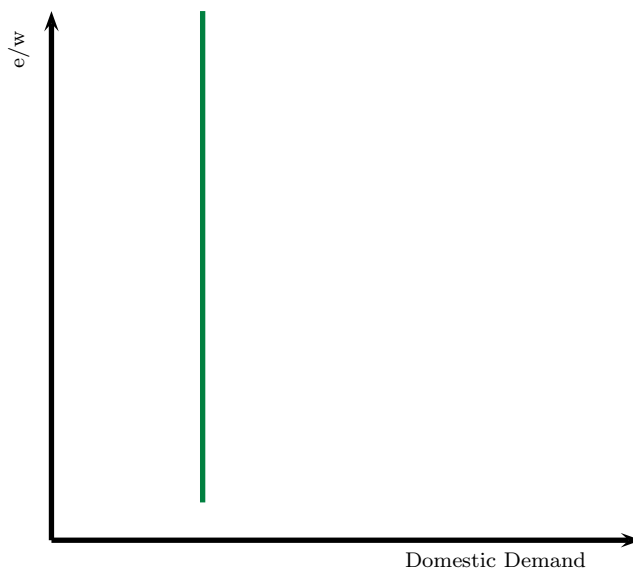


Figure 12.1: ER Schedule

How the different views of the problem of the environment are reflected – or can be summarized – within this framework?

Well, hardcore *I-Do-Not-Care-About-Global-Crap* tea party fans will draw the ER line to the extreme right. They might put the ER so much to the right that all possible equilibria are within the “sustainable environment” region. On the other hand, the *The-World-Is-Going-To-End-Tree-Huggers* will draw the ER all the way to the left – implying that there is no possible equilibrium consistent with the environment. I believe reality is between these two extremes and I will draw the ER relative to the other equilibria mostly reflecting my own views. In fact, even if we agree that the world is truly in the middle of these two extremes, how big the damage has been is also a source of disagreement.

Actually, the evidence is so mixed on the speed at which the world is deteriorating that we cannot settle this dispute by looking at real wages, or the current account, or riots in the streets. Like what we have done for the other variables. In fact, the day the environment “riots”, we are already too late to find a solution, and the damage is possibly irreversible.

So, in this notes I will draw ER where I think it makes sense, and I hope to have a discussion in class to try to summarize all possible views – or at least, I to try to dismiss your incorrect views. I believe that the level of consumption implied by equilibrium in the current account and in the labor markets is already too high to be consistent with a sustainable environment. In other words, my view – and again this is personal and with little evidence behind it – is that the IMF equilibrium is already to the right of the ER for most

countries.

Having said all this, I am sure we will agree on one thing for sure: if everything remains the same - same population, same technology, no shocks, then an increase in the demand increases the negative impact in the environment. This direction of the deterioration is unambiguous; and therefore, independently of where the ER is, moving the economy to the right is worse for the environment, and moving to the left is better.

12.1.2 Kyoto's Triangle

In Figure 12.2 I have depicted the ER together with the BB-NN-SP framework we have developed so far. I have depicted it in such a way that there are only four equilibria.²

The way I have depicted the ER adds one more equilibrium to the ones we have discussed so far. Consistent with my views, I have depicted the ER – crossing through the European equilibrium – implying that the IMF and the populist equilibria are at the right of the ER. This means that the IMF equilibrium is one in which the level of consumption is too high from the environmental point of view – and the populist one is even higher.

Throughout all our discussion of the ER the distance between the ER and where the economy is placed is a measure of the “detriment” exerted to the environment. So, how far to the right the economy is plays an important role in our discussion. This is why the placement of the ER is not trivial at all.

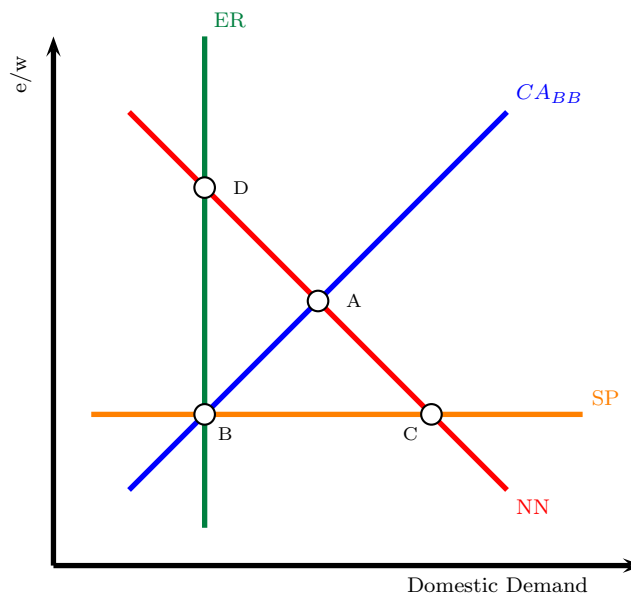


Figure 12.2: BBNN Sustainability

What are the characteristics of each equilibrium? In Table 12.1 we summarize the characteristics. In words, at the IMF equilibrium (A), the economy is in internal and external balance, but it exhibits social

²If I would have moved it slightly to the left or right, we would have five equilibria, but to be honest, these four are the interesting ones. When you have the five equilibria two of them are equivalent in terms of their characteristics – i.e. in terms of their disequilibria

tensions and the demand implies some deterioration of the environment – which I denote simply as polluting. In other words, this is the purely economic equilibrium or financial equilibrium in which the economy is in equilibrium, but socially, politically and environmentally it is not. So, even though there is full employment and there is no current account deficits the economy is not sustainable.

In equilibrium B, or the European equilibrium, the country has equilibrium in the external accounts, it has a relatively high standard of living – given the wage in dollars – and the demand is low enough that the impact in the environment is null. The only problem the country has is the relatively large level of unemployment. So, even though the economy is sustainable from the social and environmental point of view, labor markets are in significant disarray. This is sustainable for a while, but the social safety net required to keep the unemployed content is a large burden for the whole economy.

In the populists equilibrium (C) the political and social equilibrium is satisfied. Salaries are high and employment is at the natural rate. So, in this regard people are very happy! However, the country is running a current account deficit – which requires the country borrowing from foreigners or equivalently running down their savings. In addition, the demand is so high that the environmental impact is the worse from all the possible equilibriums. This is clearly an unsustainable situation. In general, however, the escape valve is the external accounts. So, in most cases is the shutting down of foreign lending what forces the economy to adjust – not the environmental impact.

Finally, equilibrium D is very similar to the European equilibrium. The aggregate demand is low enough that the environmental impact is null. However, instead of making the workers suffer from unemployment, in this equilibrium wages are much lower than in equilibrium. This is a country that because their wages are depressed, the country is running a current account surplus. I tend to call this equilibrium the Kyoto equilibrium, or the Japanese equilibrium. Importantly, saying that the wages in Japan are depressed does not mean that wages in Japan are lower than their counterpart in Cambodia. Wages in Japan are depressed relative to the wages in the IMF equilibrium. In other words, wages are lower than those that would be required to achieve current account equilibrium. Because the wages are small, then the economy runs a current account surplus. This is also an unsustainable situation. First, there is tension in the political system, and more importantly, not all countries in the world can run surpluses – by definition some have to perform the opposite transaction.

	Equilibrium	Labor Market	Current Account	Social Peace	Environment
A	IMF	✓	✓	Conflict	Pollution
B	Europe	Unemployment	✓	✓	✓
C	Populism	✓	Deficit	✓	High Pollution
D	Kyoto	✓	Surplus	Conflict	✓

Table 12.1: Characteristics of the Possible Equilibria in the BB-NN-SP-ER

It should be clear that all equilibriums are unsustainable. However, it should also be clear that countries circle around the Latin Triangle as opposed to experiencing environmental driven policy cycles. We have already discussed how to solve the Latin Triangle, the natural question is then to ask how to solve the Kyoto's Triangle.

12.1.3 Solving Kyoto's Triangle

What moves the ER curve? The shocks that move the ER are very limited. Clearly productivity improvements that consume less resources (and allows to produce the same) are moving the ER to the right. We discuss this in detail in the next section, so here I just state their possibility. The reason is because changes in productivity not only move the ER but also the BB, and hence they need to be studied together.

12.1.3.1 Shift in Consumption Preferences

Except for technological improvements, it seems that moving the ER to the right is a difficult task. There are however, other shocks that can achieve this. The way to think through this is to try to understand how can we improve the standards of living without consuming more. If such arrangement exists, then consumers would be willing to engage in those.

For example, an important tool to reduce the environmental impact of consumption is to move away from private labels and cheap products, to branded goods. This is indeed an idea that was presented to me by an MBA student in the middle of a class — yes, one of you actually had a good idea. We know this is a rare event so I will keep confidential the name of the culprit. And NO, it was not this year that I got the comment. It was ages ago! You guys have actually not produced a single good comment so far and we are close to page 200 on the notes. So, do not even try I have given up.

Let us return to the shift from fakes and no labels to branded products. It is well known that people like brands. To my daughter (the little one), buying a jean in Costco does not have the same appeal that buying it in Abercrombie. In fact, I can't see the difference, hence all my jeans are from Costco or Walmart, but her jeans (or her ONLY two jeans) are from Abercrombie, and Hollister. Branded products generate satisfaction for some consumers. They are more expensive, but people are willing to purchase them, because of the additional status they provide.

Think about the environmental impact of this transaction. The jeans from Hollister have roughly the same amount of cotton than the ones from Costco; they required roughly the same amount of energy to be manufactured; but they are five times more costly; and people are happier paying more for them and wearing them! So, for the same income or the same expenditure on jeans the consumer that buys branded products purchases less jeans for the same amount of money. Which implies that such consumer actually spends the same amount of money in way less cotton!

The value added in the branded product is in the design, in the idea, and its reputation; and from the environmental point of view designs and ideas have very little negative impact. They consume less energy, less cotton, less resources, and surprisingly, they generate more utility to the consumer than the Costco jeans.

Of course an immediate question is what do we do with the poor? What if a person cannot afford a branded jean? I have no problem with making affordable jeans available to the world, but it is important to remember that such action has an environmental cost. If the tradeoff is understood we can have a conversation. I actually think that because we have no idea how to solve the problem of poverty what we tend to do is to provide excess goods and services as if the problem of poverty is all on the lack of consumption and income. I think we need to think harder. This attitude – although good – will certainly have a very negative impact on the environment. I come back to this point later when I discuss development macroeconomics.

Figure 12.3 shows the impact of changes in consumption patterns. In principle, consumers are consuming the exact same amount of money – they are just spending it differently. So, because the environmental impact of the same aggregate demand is smaller, then the shift in consumption is equivalent to displacing the ER to the right.

In the end, if the movement is big enough, equilibrium A becomes consistent with environmental restrictions. The assumption is that the shift in consumption from one type of good to the other is painless from the aggregate demand point of view. This is not the case when taxes need to be included, or when markets need to be created, with the objective of internalizing an externality. This is discussed in subsection 12.1.3.2

Finally, it is important to remember that this movement is not correcting the Latin Triangle problem, and actions that lead to solve those issues might end up exacerbating the environmental constraints. We

come to these issues below in subsection 12.1.3.3.

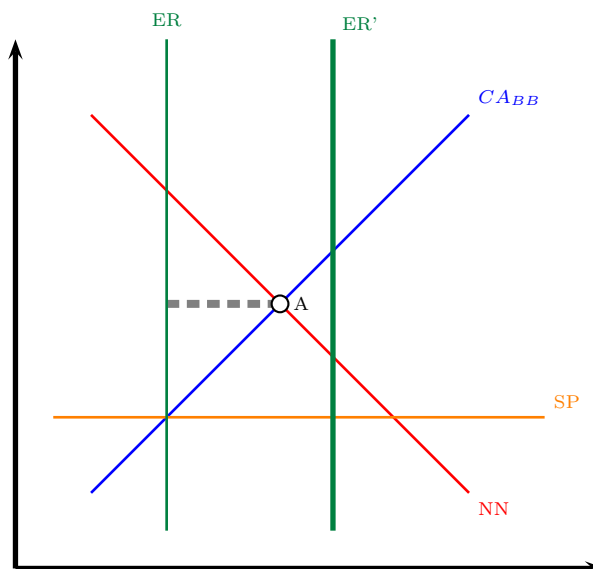


Figure 12.3: BBNN Sustainability and Consumption Shifts

12.1.3.2 Taxes to Shift Consumption and Production Preferences

Unfortunately, there are not a lot of examples in which consumers voluntarily would shift their consumption in favor of those items that are more environmentally friendly. In fact, the previous example is one in which my daughter has the right preferences but i'm too cheap to do the shift. The government can certainly help.

For example, another important example of how shifts in the demand can improve the environment is the consumption of proteins. A consumer can eat a big, delicious, juicy steak, or chew on two pounds of horrible flavorless beans. Certainly consuming proteins from beans has a much smaller impact on the environment. In this particular case cows are the second biggest producer of methane – a bad greenhouse gas. However, it is not clear that eating beans is much better than a steak. And in this particular case, it is harder to change the preferences of consumers.

A solution, a very good solution indeed, is to tax meat. When consumers do not want to shift their preferences the environmentally damaging goods can be taxed. In fact, the best example is taxing gasoline. Studies have shown that to repair the environmental damage of one gallon of gasoline requires about 10 to 12 dollars. So, doesn't it make sense to put this as the tax? And not only change consumption patterns but also collect the resources required to repair the damage?

Sometimes the taxes can be substituted by a market – a market that internalizes the externalities of pollution and in the pricing system the “correct” tax is levied.³

What is the impact of a tax or a creation of a market in the BBNN? Figure 12.4 depicts the typical

³See HBS UV2543-PDF-ENG, HBS 9-209-064 and HBS 9-708-026.

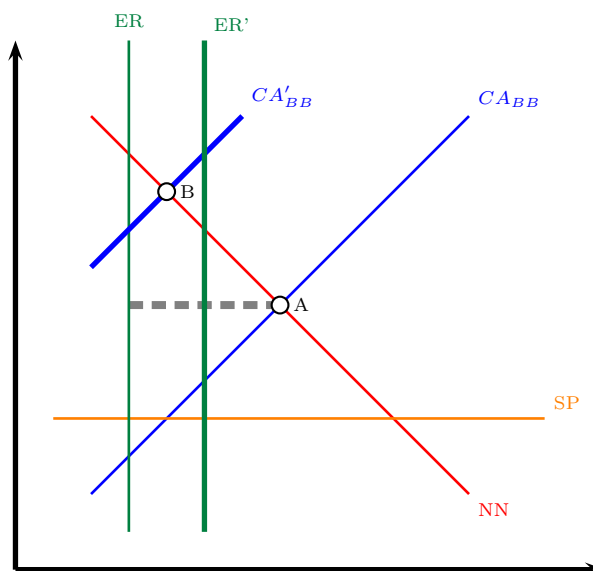


Figure 12.4: BBNN Sustainability and Tax Changes

impact. This is a complex shock in the sense that moves two schedules, the BB and the ER.

The taxes shift consumption or production away from the polluting activity and toward the non polluting ones. This produces a reduction in the demand, and because we are taxing some forms of production they produce a decline in competitiveness.

[to be completed]

12.1.3.3 Productivity Improvements

As we discussed earlier, there are technological improvements that would increase production without increasing the use of resources. In fact, this is perhaps the alternative that receives most of the attention in the public discussion. However, technological improvements have two implications – yes, they improve the ER and therefore a country could sustain a larger demand with a smaller impact on the environment – but also the technological improvement increases productivity and displaces the BB to the right. Which schedule shifts the most? the BB or the ER? This is indeed a crucial question.

In Figure 12.5 I have depicted three possibilities. In panel (a), I have depicted a technological improvement that has a large impact on production, but a small one on the environment. Let me discuss this case in detail. The original equilibrium is denoted by the schedules BB, NN, SP, and ER. As can be seen, the IMF equilibrium in this case is one in which there is a negative impact in the environment. The negative impact is highlighted by the horizontal gray dashed line. When the technological improvement takes place, the BB moves to the BB', while the ER moves to ER'. In this new set of schedules, the IMF equilibrium implies a much higher standard of living (good), a higher demand (good in principle), social peace (good, because the economy is below the SP line), but the environmental impact, measured by the length of the dashed line, has increased.

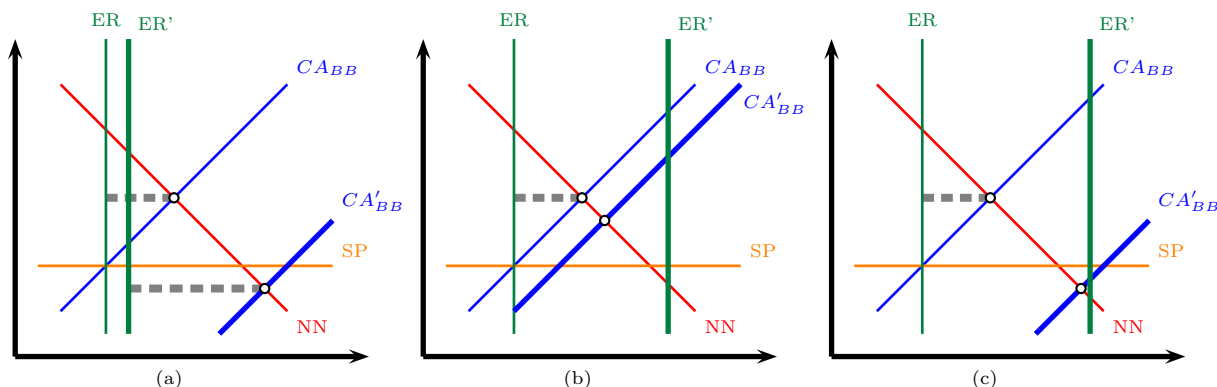


Figure 12.5: BBNN Sustainability and Productivity Improvements

This is a very bad productivity increase from the environmental point of view. Having said that, this is a very good improvement from the standard of living and political points of view. In fact, imagine you are the president of China, with social tensions arising, and your ministry of development proposes a policy that has the impact just described on your country. Wouldn't you take it? Imagine this is China in 1970? Coming from hunger and the cultural revolution! Would you accept it? Of course you would, and even though this is a bad idea from the long run aspect of the world, it solves real and important unsustainable considerations to the country immediately.

What is worse from this type of productivity increases is that in the short run the environmental impact is reduced. This is particularly true when the economy remains in the initial equilibrium. In other words, it is common that a new investment for the same level of production has a smaller footprint. However, because the new productivity makes the country richer, the economy moves from the initial equilibrium to the long run one. Such increase in demand leads to the negative consequences.⁴

Panel (b) shows a productivity increase that has a massive impact on the ER, but a small one on the BB. As before, the shock moves the schedule to ER' and BB'. Notice that in this case, the improvement on the environment is so big that the IMF equilibrium is to the left of the ER', meaning that there is no gray line – there is no negative environmental outcome of this type of productivity increase.

This country, however, is suffering from the Latin Triangle, and their implied cycles. So, even though the environment is sustainable, the economy and the politics are not. Finally, panel (c) shows the perfect productivity increase, that solves both the Latin triangle and the environmental conflict.

The first example is an environmentally damaging process of growth. This is a process of growth that indeed took place in every country during their industrialization. Those productivity increases and technological improvements increased wages and demand, but deteriorated the environment. Countries at different times went through this process. China and India are doing it right now, and because we are paying attention to the environment now much more than in the 40's we are trying to limit this process of development in some of these nations. Their argument is that Europe did it before and they should be entitled to do it now. Both views, in my opinion are wrong. They are emphasizing short run objectives as opposed to long run sustainable considerations.

For instance, having China keep consuming the same as what they were consuming in the 60's seems unreasonable. I mean, they suffered from hunger and millions died! Do we seriously think that the world

⁴I think John Sterman's fear of some productivity increases in economics is summarized by this example. In fact, he is really concerned about technological improvements that lead to more consumption – which ultimately imply a higher footprint.

would be sustainable and peaceful if developed nations force the chinese into such level of consumption? On the other hand, I think is quite reasonable to ask car to have the power they had in the 60's. I love cars, but I cannot understand the benefit of heavier vehicles, that can drive at 140 miles an hour.

The solution is to understand that productivity increases are required and their mixture is not irrelevant. Their mixture is crucial, and relatively rich countries can afford to be pickier on which improvements to implement, but poor countries are in need of any.

12.1.3.4 Population: An easy way out

One very easy solution to the problem of the environment is to decrease population growth, so much that population in the world declines. This is not easy. For some reason people would like to invest in health to live longer. Which means that those bodies will remain for longer, eating much more, and producing more and more methane. However, a significant decrease in population growth does the trick.

In Figure 12.6 we present the outcome of lowering the labor supply in each country. This shock is making the European equilibrium sustainable from the labor point of view. I call this the *easy solution* because a lot of the problems we have today stem from the fact that we are 6.5 billion people as opposed to a couple of millions. So, by reversing the source of the excess demand, we solve the problem.

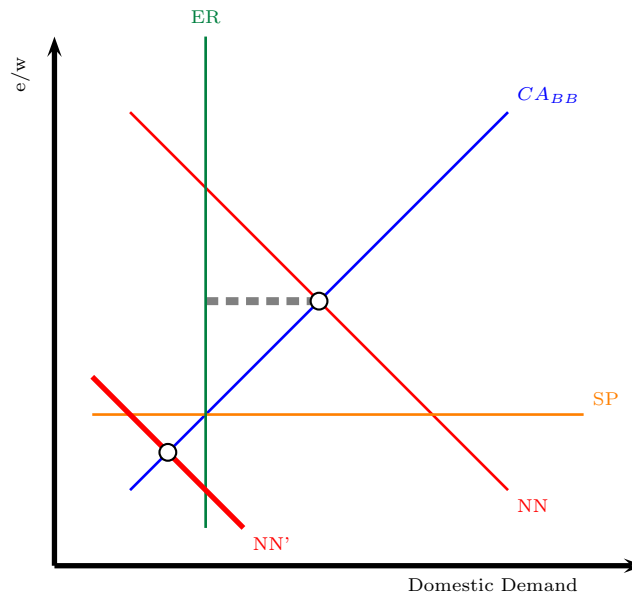


Figure 12.6: BBNN Sustainability and Population

However, this seems to me like an impossible task. For one, I really do not want to live shorter, nor I would like to offer one of my kids in sacrifice. I do, however, can promise some colleagues that I would be glad to volunteer. In practice, even though this is a possibility, this is not going to happen without a catastrophic event – a war, or the environment rioting against us.

12.1.3.5 Learn to Live with Indeterminacy

Finally, before moving to some technicalities at the end of this chapter, I would like to propose what I think is a solution in the short run. Solutions or actions for rich countries. Countries like the US, Europe and Japan can afford to drop their aggregate demand and finance the unemployment – or low employment – through a safety net. This can be achieved by taxing those products that are environmentally damaging, by creating markets that price correctly those externalities, and by taxing consumption directly. This is painful but necessary. I am of the opinion that we need to start acting now. Developed nations can afford to do so, and moving to the european equilibrium, and solving the unemployment problems with the proper safety net seems to be the only medium run solution – until technology catches up.

Developing markets, on the other hand, cannot be expected to replicate this, not to take similar actions. In their case, the problem of lack of provision of basic services, implies that they cannot afford a significant decline in the aggregate demand. So, from the environmental point of view, I believe we have to come to terms that a significant proportion of countries will need to “subsidize” others. In other words, developed nations have to do an effort for their countries, and part of the emerging markets, while developing nations can catch up.

Bibliography

ALLAYANNIS, Y. (2011): "Carbon Credit Markets," *HBS Case UV2543-PDF-ENG*.

PEROLD, A. F., F. REINHARDT, AND M. HYMAN (2009): "The Carbon Market," *HBS Case 9-209-064*.

REINHARDT, F., AND M. HYMAN (2009): "Global Climate Change and BP," *HBS Case 9-708-026*.

MIT OpenCourseWare
<https://ocw.mit.edu>

15.014 Applied Macro- and International Economics II
Spring 2016

For information about citing these materials or our Terms of Use, visit: <https://ocw.mit.edu/terms>.