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Achieving Comparable Effort through Carbon Price Agreements

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The United Nations Framework Convention on Climate Change (UNFCCC)'s 2007 Bali Plan of Action calls for the next agreement to ensure the "comparability of efforts" across developed countries while "taking into account differences in their national circumstances." Trends in national emissions and economic growth vary widely between countries, as do year-to-year fluctuations around those trends. This means that achieving similar reductions relative to historical base years can require very different levels of efforts in different countries. These differences have greatly hampered climate cooperation because it means that commitments that are similar in effort *look* inequitable. Further, divergent underlying trends make it difficult to know the effort that any particular commitment will require. The failure of the G-8 to set a base year for its agreed 80 percent reduction of emissions by 2050 illustrates the contention in formulating even collective targets.

The presumption that binding commitments can take only the form of a percentage reduction relative to historical levels has dimmed the long term prospects for stabilizing the climate, not least because it alienates rapidly industrializing countries such as China and India. Parties could negotiate emissions levels rather than reductions relative to base years, but even then they are not assured of comparable efforts because many things that affect the burden of achieving the target can happen between the year of negotiation and the commitment period. The recent financial crisis and global economic downturn are clear reminders of the volatility in the underlying economic environment in which parties make these emissions commitments. Additional uncertainties include unanticipated economic growth, technology breakthroughs, prices for renewable energy and natural gas (a lower-emitting alternative to coal), and political instability. To properly protect the climate, the international regime should endure through any number of economic and political fluctuations.

A Price Collar for Major Economies

Here we offer a way forward. Parties could break the stalemate around hard targets and ensure the comparability of efforts by supplementing commitments on emissions with commitments for price signals on carbon. Under our proposal, all major parties would need to show at least a minimum level of effort regardless of whether they achieve their emissions target, and they would be allowed to exceed their target if they were unable to achieve it in spite of undertaking a high level of effort.

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Specifically, in addition to a cumulative emissions target for the 2013–2020 period, major economies would agree to a "price collar" on emissions in their domestic economy comprised of:

1. a starting floor price on a ton of carbon dioxide (CO_2)–equivalent emissions for 2013
2. a starting price ceiling on a ton of CO_2-equivalent emissions for 2013
3. a schedule for real increases in the price floor and ceiling, such as 4 percent per year.

The floor and ceiling prices need not be uniform across countries as long as all Parties were comfortable with any differences. To comply with their commitments, Parties must demonstrate two things. First, they must show that they have imposed a price on CO_2-equivalent emissions at least at the agreed floor price to an agreed extent, for example over most or all of the commitment period across all or most of their domestic economy. Second, Parties must show that their cumulative emissions are no higher than their announced target OR that their domestic price on emissions has reached or exceeded the ceiling price to an agreed extent.

This price-based framework has several advantages. It allows Parties to negotiate explicit bounds on the level of effort that they undertake, ensuring that all Parties' efforts are serious and that no country's commitment is unfeasible. It also makes the comparability of effort fully transparent, and Parties can choose price limits that would have no effect if the level of effort required to achieve their emissions target is what they had expected.

The price floor ensures that no Party's commitment is unduly lax, such as the targets for the countries of the former Soviet Union under the Kyoto Protocol. To the extent that Parties adopt similar price signals, the approach helps lower the overall cost of achieving a particular level of climate protection. Competitive concerns would provide some incentive to converge over the long run.

The upper bound on required effort allows Parties to comply with their commitments even if their targets turn out to be unduly stringent. On one hand, this could lower the expected environmental performance of the agreement once targets are fixed, but on the other hand, it could allow Parties to take more ambitious targets than they otherwise would have. It also helps keep Parties within the agreement when they may have otherwise simply dropped out.

In addition, Parties can implement their commitments as they see fit domestically, including through a tax or cap-and-trade system that provides transparent price signals. The domestic mechanics of the price collar could work in a number of ways within a cap-and-trade system. For example, a central bank of carbon could intervene by buying or selling permits to keep the price within bounds. This is similar to the open market operations of the U.S. Federal Reserve in short-term money markets. Alternatively the government could place a reserve price on allowances that it auctions and offer additional permits at a price no lower than the agreed ceiling value. Parties could control any revenues generated by their domestic climate policy and use them to offset other tax burdens if they saw fit. The effects of these domestic programs would be measurable, reportable, and verifiable much earlier in the commitment period than emissions levels, thus giving an early indication of treaty compliance.

The flexibility of a price-based commitment is well-suited to developing countries like China that are uncomfortable with hard emissions caps but may be open to imposing a carbon tax, for example. One option would be to allow such countries to begin by adopting a price floor alone, without an explicit emissions target and then later transition to commitments more like those of industrialized countries.

Establishing comparable national price targets across countries means that international trading of permits would be unnecessary, adding to the system's robustness by avoiding a fragile international regime based on a common allowance market. McKibbin and Wilcoxen (2002) and McKibbin, Morris, and Wilcoxen (2009) explain the advantages of coordinated national institutions over global institutions for creating a robust policy regime.

Some environmentalists are uncomfortable with a price collar approach, domestically or internationally. Some believe that any limit on the price of allowances undermines the environmental integrity of the commitment. However, this belief gives moral status to the cap, an essentially political decision. Even if climate science can inform policymakers about the relationships between greenhouse gas concentrations and climate impacts, science alone cannot balance the tradeoffs across the benefits and costs of particular short-run targets for individual countries. Further, if Parties can only adopt hard targets as commitments, then they may choose looser caps or none at all rather than risk excessive stringency or noncompliance. Moreover, an explicit upper bound on prices can prevent a disorderly collapse of domestic programs, perhaps the worst possible outcome for the environment.

Others argue against putting an upper limit on carbon prices on the grounds that very high carbon prices could spur technologies that will eventually provide low cost abatement, thus obviating the apparent cost savings of a limit on carbon prices. Clearly, a limit that is lower than the expected carbon price can discourage investment in abating technologies relative to the case without the limit. However, by establishing a price floor as well as a price ceiling—at appropriate levels—a price collar both prevents the collapse of the program and limits the downside risk for investors in low-carbon technologies. Both factors bolster investment confidence. Further, we question the notion that volatile near-term prices for carbon will induce sufficient technological development to lower prices in the long run by an amount sufficient to provide positive net present value. Rather, the economic literature has long supported the cost-minimizing case for gradual and predictable price increases for emissions.

Several implementation details would be required for our proposal to work. First, the UNFCCC would have to develop guidelines on demonstrating compliance with the agreed price range. This would include methods of verifying price signals and the extent to which they were in effect. The treaty must also ensure that excess emissions are reasonably proportional to the degree to which the price ceiling binds, measured for example by the duration over which the price ceiling applies, the share of total allowances that the government sells at the ceiling price, or the share of emissions taxed at at least that rate. For example, high excess emissions would need to be accompanied by a long duration of prices at the ceiling and/or a relatively large share of allowances transacted at the ceiling price.

Second, regulatory (non-price) climate policies, such as low-carbon fuel standards, would require special rules to determine their price equivalent. The UNFCCC could develop methodologies to calculate a shadow price on emissions analogous to the way the World Trade Organization converts trade protection policies into tariff equivalents. Parties could count towards their price signals any existing fossil energy taxes, but such credit would have to be net of any subsidies to fossil energy or other greenhouse-gas emitting activities.

In our approach, the price floor ensures that no party can use terrestrial sinks or government-financed offsets alone to meet its commitments. However, the agreement should specify how parties will account for land-based carbon stock changes when targets are set. Another important element of the agreement is the level of technology transfer and financial assistance to developing countries. Given the complexity of developed country commitments, our view is that these issues are best handled separately from the target-setting negotiations.

An Illustrative Price Collar for the United States

To illustrate how a price collar could work, we constructed several representative climate policy scenarios using the G-Cubed intertemporal general equilibrium model, a widely used model of the global economy. First, we established a "reference scenario" that reflects our best estimate of the likely evolution of each region's economy based on the relationship between economic growth and emissions growth in model's regions over the last decade. The reference scenario also included the effects of climate policies already announced or implemented by governments other than that of the United States.

The first U.S. policy scenario that we present is a target path for U.S. emissions that approximates the Obama administration's proposed targets for 2020 and 2050 of 14 percent and 83 percent reductions, respectively, from 2005 emissions levels. Details appear in Table 4 of McKibbin, Morris, Wilcoxen, and Cai (2009). The scenario assumes a cap-and-trade program with a linear path of emissions caps from 2012–2020, and then another linear path from 2020–2050. It requires the United States to hit each year's emission target exactly, with no flexibility about when the emissions reductions would occur. Also the scenario includes no offsets or other cost containment provisions. Although these assumptions differ from how the program would likely work in practice, the scenario is useful because it produces a price path that can illustrate how the price collar could work.

In our second scenario, we supplement the targets with a price floor and ceiling that are $10 and $35 respectively per ton of CO_2 emissions in 2012, both rising at 4 percent annually. Figure 1 shows the allowance prices that emerge in the two scenarios. The dashed path labeled "Without Collar" is the price of a ton of CO_2 that would emerge if the economy is required to achieve the emissions targets in each year, without allowing banking, borrowing, or offsets. The shaded region shows the range between the price floor and price ceiling defined above. The solid line labeled "With Collar" shows the price that would prevail with the collar in place. It and the "Without Collar" curve coincide in the range between the price floor and the price ceiling.

The price floor triggers briefly at the start, during which time the government would remove some permits from the market. Over the subsequent decade, the permit price stays within the price collar. By 2023, the strong demand for permits causes the market price to hit the ceiling and the government offers additional permits at the ceiling price as described above (this is similar to the McKibbin and Wilcoxen (2002) Hybrid proposal). By 2042, the price ceiling has become high enough that it rises above the market price of allowances. At that point, demand for additional permits drops to zero, and emissions no longer exceed the annual cap.

Figure 2 shows annual U.S. CO_2 emissions for the two scenarios. Under both policies, emissions fall in every year. With the price collar in place, emissions fall somewhat more slowly when the ceiling is binding. The additional permits are shown by the shaded area.

Figure 3 shows the effects of both scenarios on cumulative U.S. emissions through 2050. Both reduce emissions substantially relative to the reference scenario and are generally very similar. In this example, introducing the price collar increases projected cumulative emissions by about 4 percent, or 6 billion metric tons, relative to the cap-and-trade scenario without the price collar. By imposing an upper bound on compliance costs, the collar increases the net present value of personal consumption (a measure of welfare) by $80 billion relative to the scenario without the collar.

The cap-and-trade legislation currently under consideration by the U.S. Congress includes an important additional provision known as “banking” that allows firms to save unused allowances. Banking provides an incentive for firms to abate some of their emissions earlier than absolutely necessary in order to have more allowances in future years when caps are tighter. To examine the relationship between banking and a price collar, we constructed a third policy scenario in which firms were required to achieve the same cumulative emissions as the first simulation (without the price collar) but were allowed to bank emissions when it was profitable to do so.

Figure 4 compares the estimated price trajectory of carbon allowances under the banking scenario (the dashed curve labeled “With Banking”) to that for the price-collar case (the solid curve labeled “With Collar”). Each scenario includes only one of the two mechanisms: no price collar is imposed in the banking case, and banking is not allowed in the price-collar case. From 2012–2023, the price-collar case trajectory lies below that of the banking case, indicating that the original emissions targets are relatively loose during the first decade. If permitted to do so, firms would want to do more abatement in order to bank allowances. The reduced number of allowances available for contemporaneous use would drive up the equilibrium price to the level shown by the “With Banking” curve.

From 2023 on, however, the two curves are essentially identical. Both rise at the interest rate until 2042, and after that, they follow the original price trajectory. The reason the curves are similar is that our price collar is designed to be very similar to the cost-minimizing path (see McKibbin, Morris, Wilcoxen, and Cai 2009 for discussion of the relationship between the banking and cost-minimizing paths). Had the initial price ceiling been higher, say $36 per ton, the two curves would have crossed; the collar trajectory would have risen above the banking path.

By design, the banking scenario achieves the same cumulative emissions target as the original scenario, or 6 billion metric tons less than the price-collar case. As shown in Figure 5, the additional abatement occurs entirely during the first decade, when emissions are lower in the banking case than the price-collar case (the shaded region in the figure). In subsequent years, allowance prices and annual emissions are equal in the two simulations.

A policy combining banking with a price collar will have the best features of both. As long as no macroeconomic surprises occur, banking allows firms to manage their abatement efficiently and thereby minimize the overall cost of achieving the desired emissions reductions. As long as the price collar is set—as it was above—so that the expected market price and the ceiling would be consistently very close, there would be little or no incentive for firms to purchase additional allowances from the government. However, if unexpected events make abatement more difficult than expected, the price ceiling would come into effect, providing protection against sharp spikes in allowance prices. Moreover, our illustrative results above suggest that the consequent increase in cumulative emissions would be very modest.

Conclusion

Allowing for a price collar within a policy focused on long-run cumulative emissions targets is an effective and politically viable way to move international negotiations on climate policy forward. The economic uncertainty surrounding target commitments is enormous and combining a clear cumulative emissions target with a price collar optimally balances the environmental objective with the need to ensure that commitments remain feasible. Using plausible assumptions, the example in this paper illustrates how a price collar does this.

Focusing exclusively on reductions from historical emissions as the only meaningful form of commitment has greatly hampered negotiations on climate commitments, especially for developing countries where the uncertainty about the future and the cost is greatest. In contrast, the price collar can ease major developing countries into the system by allowing them to adopt only a price floor in the early years. It also offers a transparent and verifiable assurance of the comparability of effort across countries. Further, parties can design price collars so that they have no effect if predictions about the level of effort required to achieve a target are correct.

Incorporating price-based commitments into the treaty along with an emissions goal also demonstrates compliance during, as well as after, the commitment period.

Figures

Figure 1. Price per ton of CO_2

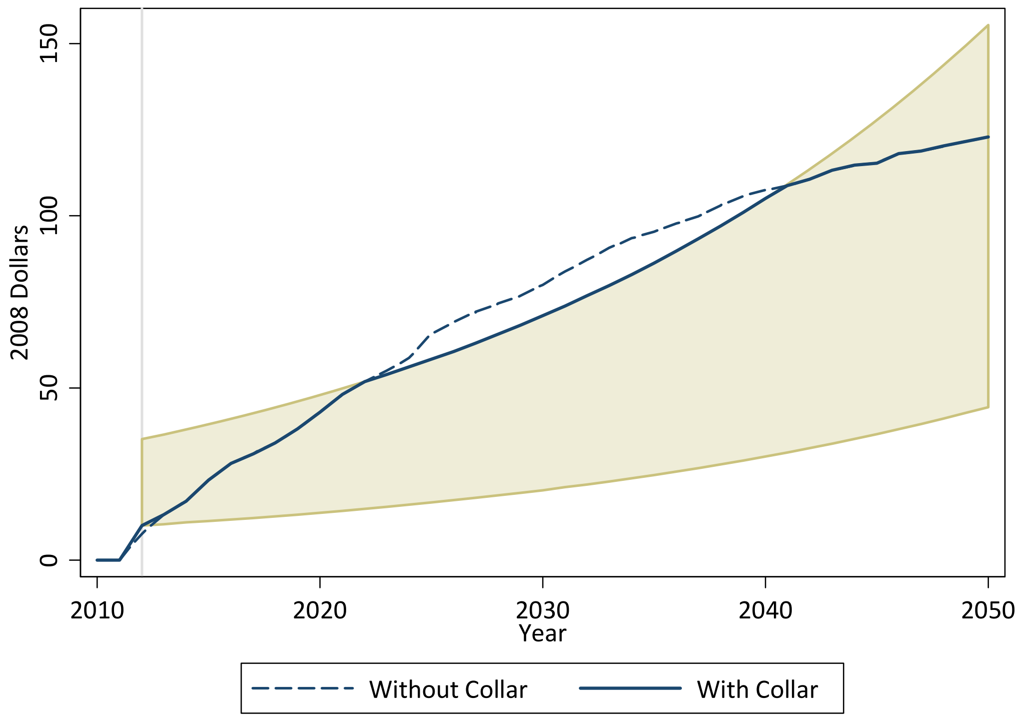


Figure 2. Annual U.S. CO_2 Emissions

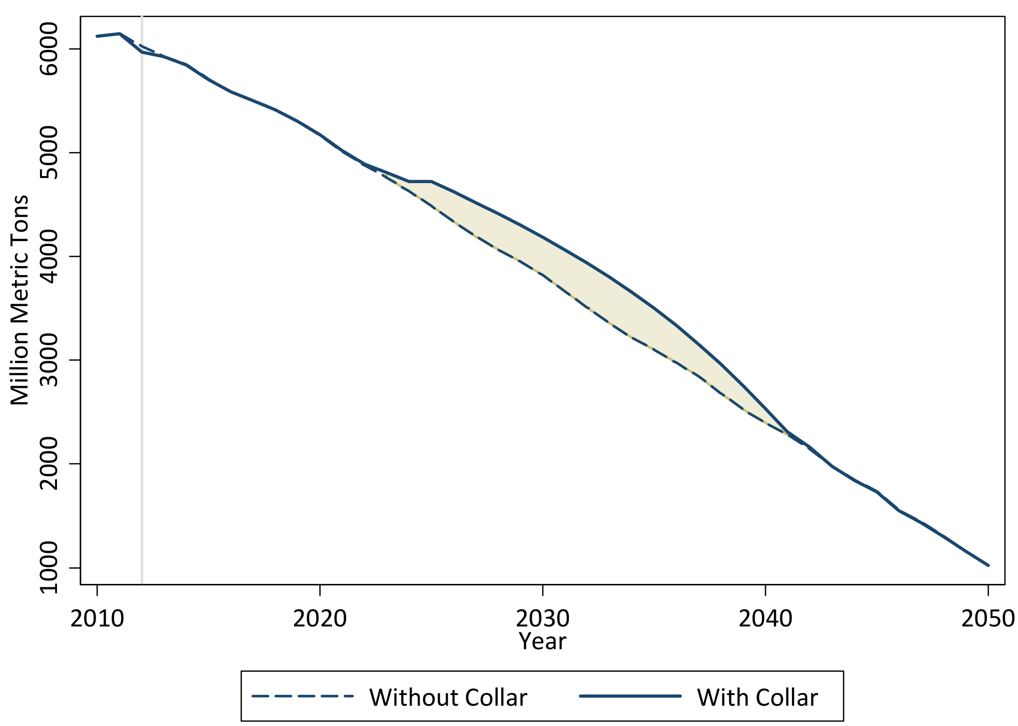


Figure 3. Cumulative U.S. Emissions of CO_2

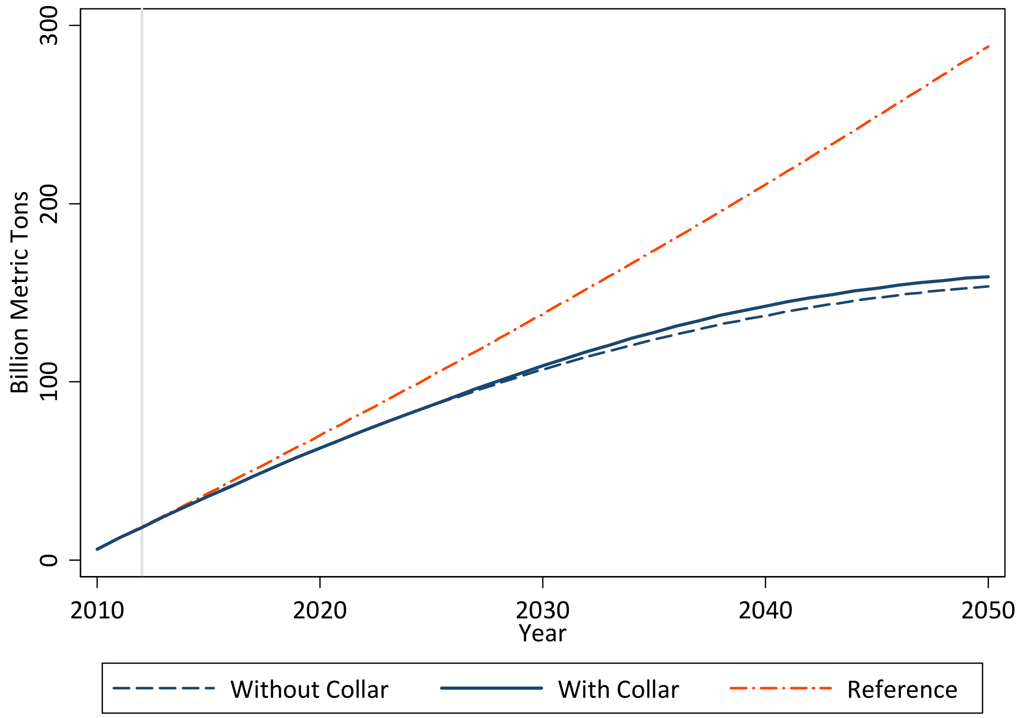


Figure 4. Price per ton CO_2 :
(Banking and No Price Collar) and (No Banking with a Price Collar)

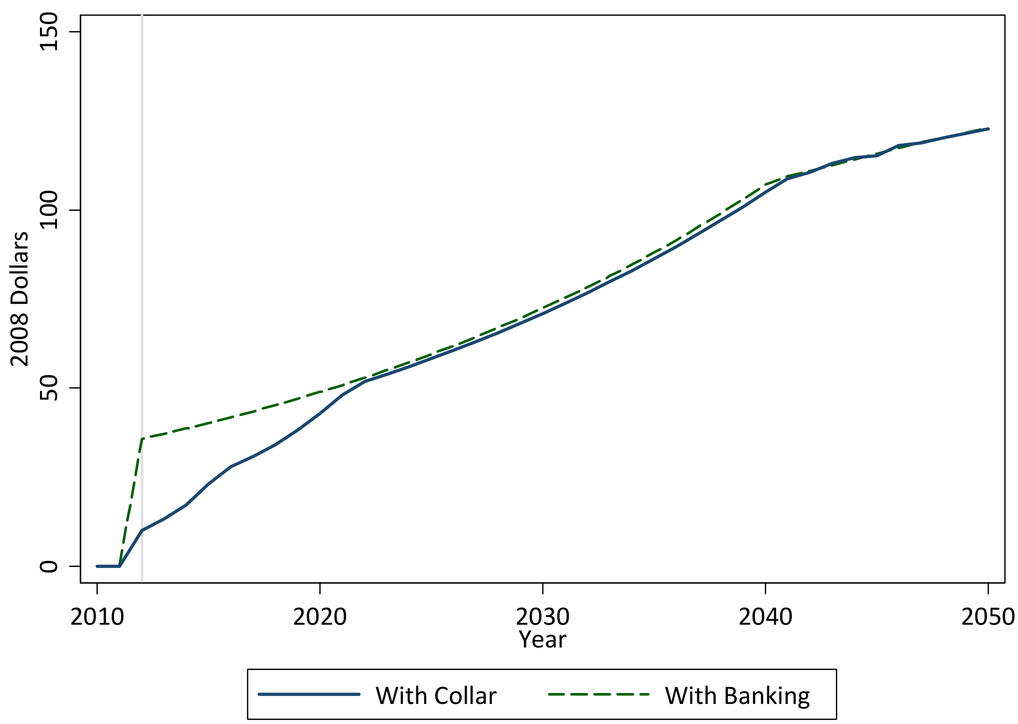
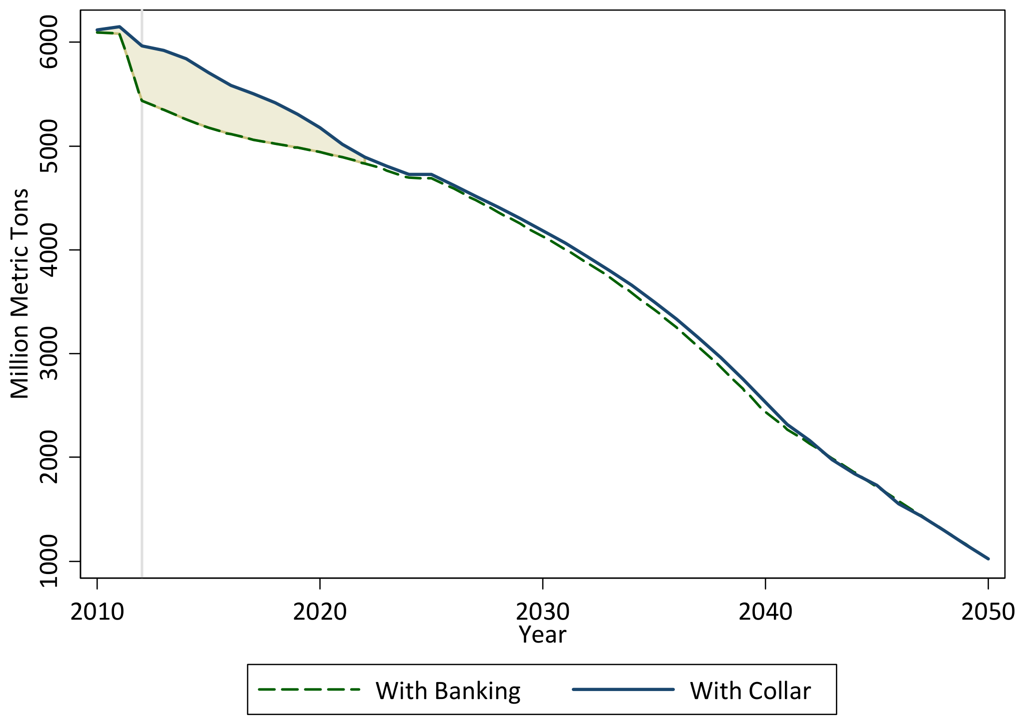


Figure 5. Emissions: (Banking and No Price Collar) and (No Banking with a Price Collar)



REFERENCES

Burtraw, Dallas, Karen Palmer, and Danny Kahn, "A Symmetrical Safety Valve," Discussion Paper RFF DF 09-06, Resources for the Future, February 2009. Downloaded from http://www.rff.org/RFF/Documents/RFF-DP-09-06.pdf

McKibbin, W. Morris, A., Wilcoxen P., and Y. Cai (2009). "Consequences of Alternative U.S. Cap and Trade Policies," The Brookings Institution, in press. http://www.brookings.edu/~/media/Files/rc/reports/2009/07_cap_and_trade/0727_cost_containment.pdf

McKibbin W.J and P.J. Wilcoxen (2002) *Climate Change Policy after Kyoto: A Blueprint for a Realistic Approach*, Brookings Institution, December.

McKibbin, W., Morris, A. and P. Wilcoxen (2009) "Expecting the Unexpected: Macroeconomic Volatility and Climate Policy", in J Aldy and R. Stavins (eds) *Implementing Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World*, Cambridge University Press (forthcoming 2009).

United Nations Framework Convention on Climate Change, Bali Action Plan, Decision 1/CP.13, 13th Conference of the Parties, December 15, 2007. Downloaded from http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3.

White House Office of Management and Budget (2009) *Jumpstarting the Economy and Investing for the Future*, White House Office of Management and Budget, Fiscal Year 2010 document, February 26. page 21. http://www.whitehouse.gov/omb/assets/fy2010_new_era/Jumpstarting_The_Economy.pdf.