5. Cap or tax? Exploring the potential for a carbon tax or emissions trading in China

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INTRODUCTION

China is often blamed for slowing down or even obstructing progress in global climate negotiations, as was shown in the Conference of the Parties (COP) 15 in Copenhagen in December 2009 (Lütken 2010). Most developing and emerging economies find it hard to accept an absolute target for their greenhouse gas (GHG) emissions, viewing it as a potential restriction of their economic development (Cooper 2008). However this observation does not imply that China is not taking any action with regard to climate change mitigation. On the contrary, China has initiated many ambitious policies, such as technology mandates and small-plant shut-down policies in the power sector; vehicle emissions standards; a 1000-firm energy saving programme in the 11th Five-Year Plan and now a 10000-firm energy saving programme for the 12th Five-Year Plan; feed-in-tariffs and renewable quotas to support renewable energy technologies. Most of the recent policies are command-and-control policies. However, domestically, the instrument choice debate to curb GHG emissions is very lively. As in other countries or regions, the debate largely comes down to the choice between two market-based policy instruments: a carbon tax or an emissions trading scheme.

In this chapter we first analyse the recent and ongoing cap or tax debate in China. We set out theoretical discussions on the instrument choice question. Then, we describe China's current domestic climate policies and measures adopted by China's government for GHG emissions reductions. We assess the arguments for both instrument groups based on China's particular situation and provide a number of design recommendations, before drawing the main conclusions for the Chinese case.

CAP OR TAX

Although environmental policy science traditionally proposes command-and-control, market-based instruments and voluntary approaches as the three main instrument groups (Arimura et al. 2008), the core of climate mitigation policy can be narrowed down to a choice between two market-based instruments: a carbon tax and a cap-and-trade system (Hepburn 2006). Both instruments put a price on carbon. A tax does this by fixing the price, leaving the resulting emitted quantity undetermined. Emissions trading does exactly the opposite: the quantity is fixed by the policymaker and the price is left to be determined by the market. Apart from these differences, the two instruments have a number of similarities. They both (1) internalize environmental externalities; (2) can raise government revenues¹ which can be recycled into the economy by reducing other distortionary taxes (Parry 2001); (3) face the risk of 'dilution' because of exemptions and preferential treatment for certain sectors, obtained by lobbying (Edenhofer et al. 2010); (4) require thorough examination of the costs and benefits to determine the appropriate tax rate or the number of allowances (Hepburn 2006); and (5) require specific regulation for implementation, compliance, penalties for non-compliance and a monitoring and enforcement scheme.

The question arises as to which instrument is 'the best' for substantially reducing GHG emissions, taking into account all the relevant decision-making criteria, such as effectiveness, efficiency, competitiveness impact, distributional impact and equity, and political feasibility. In theory, in a deterministic world with no uncertainty, price and quantity instruments can both achieve a certain target level of emissions in an equally efficient way² (Edenhofer et al. 2010; Newell and Pizer 2003; Hepburn 2006). However, in reality, uncertainty is omnipresent, calling for a more comprehensive approach. Weitzman (1974) showed that, if uncertainty is introduced, one of the instruments may become preferable to the other depending on the relative slope of the marginal benefit and marginal cost curves. He showed that a tax is more efficient than a cap-and-trade system if the marginal benefit curve of the environmental good in question is flatter than the marginal cost curve.³ Emissions trading is more efficient if the marginal cost curve is flatter than the marginal benefit curve. Applied to climate change, when the benefits of mitigation are not expected to increase quickly, but the costs of further mitigation (after the low-hanging fruit has been picked) are expected to rise rapidly, a price instrument would be the most suitable instrument (Hepburn 2006). Newell and Pizer (2003) and Hepburn (2006) agree that, given the characteristics of the climate change problem, a tax is preferable to a cap-and-trade scheme. Yet, many

authors continue to conclude that the theory does not provide a decisive answer to this question (Fan et al. 2011). A lot depends on the perspective or the particular criteria that one uses for this evaluation. In the rest of this section, we will look at this choice issue from other perspectives.

The first perspective, and one which is less frequently debated than the effectiveness and efficiency criteria, is the institutional and design side of the policy instrument. In order for a tax to be efficient, the tax base must be related to the emission itself or at least to the economic factor causing the emission (Edenhofer et al. 2010). Taxes on final consumption are less efficient than input taxes, since the necessary reallocation towards more carbon-friendly alternatives cannot be fully achieved in the case of output taxation. The best tax base is always the emission itself (Oates 1995). As well as the question of the tax base itself, the level of the tax is also crucial. This is clearly a downside of a price instrument: the risk of not achieving the mitigation target by choosing a tax rate that is too low or too restrictive entails suboptimal efficiency (Hepburn 2006). The obvious advantage of permit trading is the fact that achieving the mitigation target (effectiveness) is guaranteed (Edenhofer et al. 2010). However Weitzman (1974) warns that determining the number of tradable allowances and the timing for the issuing of the licenses is as challenging as determining the level of any tax. Conversely, the uncertainty with regard to the timing of the issuing of the licenses can be passed on to the private sector, which is supposedly able to deal with it more efficiently (Edenhofer et al. 2010).

According to Avi-Yonah and Uhlmann (2009), taking all arguments into account, a tax is easier to implement and enforce. A trading scheme requires baselines for emissions reduction targets, a mechanism for distributing allowances, use of offsets, effective administration, a mature legal system, effective monitoring and measuring, and a well-functioning sophisticated market (Fan et al. 2011). Consequently, such a scheme requires experience and cannot be set up rapidly, whereas a price instrument can become effective in a very short timeframe (Avi-Yonah and Uhlmann 2009). Implementation costs for emissions trading may also be higher than for a carbon tax (Hepburn 2006).

The second perspective to take into account in discussions on instrument choice is the important issue of political feasibility. Although economists primarily focus on efficiency when analysing instrument choice, political feasibility may be a more important factor in day-to-day politics (Hepburn 2006). Cap-and-trade systems are said to be more feasible than taxes (Edenhofer et al. 2010; Stavins 1998; Avi-Yonah and Uhlmann 2009). In fact, Hepburn (2006) states that obstructive industry lobbying can be predicted to increase according to the following order: (1) subsidies; (2) grandfathered licences; (3) auctioned licences; and (4) taxes. Emissions

trading schemes are especially easier to implement in times of high energy prices and during economic crises (Avi-Yonah and Uhlmann 2009; Edenhofer et al. 2010).⁴ These conclusions are confirmed by the observation that in most policy processes in which the choice between a tax and a cap was explicitly on the table, the cap was ultimately introduced (Stavins 1998).⁵ The policy and political process behind the European Union Emissions Trading Scheme (EU ETS) is, in that sense, particularly telling.⁶

A (carbon or other) tax is problematic with regard to public and political acceptability. Since taxes have been used on such a large scale in virtually every country and predominantly for the purpose of raising revenue, they are unpopular with citizens, consumers and businesses alike. Consequently, emissions trading may be more politically feasible than a tax simply because it is not labelled a tax (Avi-Yonah and Uhlmann 2009). According to Nordhaus (2007), a tax is 'almost a four letter word'. Moreover, besides their general aversion to taxes, people tend to dislike environmental taxes even more than other taxes (Green Fiscal Commission 2009). In this respect, politicians' tendency to grant an (inefficient) free allocation within the framework of tradable permits, which is regarded as a weakness of the instrument, could also simultaneously be seen as its strength. The (inefficient) option of a free permit allocation lightens the burden on the powerful producer groups and offers an attractive compromise to politicians between the advocates of firm climate action and its opponents (Goulder and Parry 2008). Hence, in some cases there may be a trade-off between effectiveness or efficiency and political feasibility criteria for instrument choice. This is illustrated by some experts' fear that, if the market price of the licences becomes too high, politicians may be pressured into relaxing the cap (Avi-Yonah and Uhlmann 2009) which would increase political feasibility, but jeopardize environmental effectiveness. Nordhaus (2007) also points to the difficulty in choosing the emissions baseline to use when setting the absolute cap, whereas a carbon tax is always an extra disincentive for energy use relative to the benchmark of a zero-carbon-tax level.

A third perspective that is relevant for instrument choice is that of public finances. In times of harsh fiscal consolidation, such as in Europe in 2012, support for revenue-raising instruments may be higher, whereas instruments with a cost, such as subsidies, become less feasible. In theory, a tax and a tradable permit system with full auctioning could raise government revenue in a similar way. However according to Hepburn (2006), in practice a price instrument such as a tax may raise more government revenue than emissions trading, even with fully auctioned permits, because auctions will not always raise the optimal amount of revenue.⁷ In a comprehensive revenue-neutral 'environmental tax reform' (ETR), revenues

from environmental taxation are reinvested in the economy by lump-sum payment, reduction of other distortionary taxes or other recycling mechanisms (Ekins 2011). One drawback of the tax from this perspective is the unpredictability and unstable nature of the potential revenue. This uncertainty may hinder an ETR process: trade unions for instance tend to be worried that if the tax base of the environmental good erodes, government will revoke the reduction in the social security contributions.

A fourth relevant perspective is the robustness of both instruments with regard to market failures. According to Edenhofer et al. (2010), the price instrument clearly has the advantage in relation to this criterion. The quantity instrument may entail higher welfare losses in capital, permit or resources markets. Apart from severe failure or collapse, a smaller troublesome feature can be strong volatility in the permit price, which has been one of the undesirable characteristics of the EU ETS (Ekins 2009).⁸ One way of dealing with this complexity is to turn the trading scheme into a hybrid instrument, combining emissions trading with features of a tax. In practical terms, a floor and a ceiling may be added to the scheme, protecting against both undesirably high and low permit prices. In practice, this would mean that the government (represented by a 'carbon bank') would commit to buying or selling part of its own stock of licences when the price goes beyond the floor or ceiling level (Hepburn 2006; Ekins 2009).

The final perspective is the impact on innovation and the diffusion of pollution abatement technologies. Montero (2002a) and Coria (2009) examined the incentives for adoption under the tax and trading regimes, assuming firms engage in imperfect competition in the output market. Both authors break down the policy impacts into two effects: direct effects and indirect strategic effects. The former suggests that, if firms compete in quantities sold, research and development (R&D) will allow investors to reduce the marginal cost of abatement, with the result that the direct effects are positive and investors' abatement savings do not affect the other firms' choice of output. Assuming imperfect competition, there is one more effect imposed upon this direct effect: the strategic effects would be negative for innovation and diffusion since investors' decisions affect the *ex post* behaviour and profits of their rivals. Montero (2002a) argues that tradable permits offer fewer incentives than the tax if the regulator is myopic and does not adjust the tax rate or cap in response to the availability of new technologies. However Coria (2009) adopts a more dynamic approach: by assuming that the regulator commits to the *ex post* optimal environmental policy, she shows that the ranking of the tax and tradable permits depends on the elasticity of output demand. If output demand is more elastic, direct effects will be larger under the permits than under the tax and the regulator speeds up the entire sequence of adoption by using auctioned permits.

In summary, choosing the optimal instrument for climate mitigation policy is a complex matter. On the one hand, a small majority of scholars find that, given the characteristics of the climate problem, the features of the different markets involved and the available knowledge with regard to multiple evaluation criteria, a tax may be the most efficient choice for climate change mitigation policies. On the other hand, the choice that policymakers have in reality is often restricted by contextual factors, such as political support and reliability of emissions data. We will discuss this question in more detail in the case of China.

CHINA'S DOMESTIC CLIMATE POLICY

Climate Policies in China

China has implemented various policy options in the 11th Five-Year Plan period (2006–2010), in order to reach its energy intensity target of 20 per cent by the end of 2010,⁹ compared to the benchmark level of 2005. Major policies include:

- Energy intensity target and energy saving responsibility policy: using a top-down energy intensity target break-down method, provincial and local governments and major firms are aligned with energy intensity targets at each level. Achieving the assigned target plays an important role in terms of government officer promotion and enterprise development.
- Technology mandates and shutting down small-scale power plants: various building codes and new emissions standards were adopted in China. In the power sector, 76.8 GW of capacity from small-scale power plants under 100 MW has been phased out.
- Phasing out inefficient production in cement, iron and steel and other energy intensive sectors: shutting down small and pollution-intensive firms in the paper, chemicals and textile sectors, and so on. Meanwhile, the Chinese government also grants subsidies to compensate for the loss.
- Top 1000 energy consuming enterprise programme: the Chinese government has set specific energy saving targets for the selected 1000 highest energy consuming enterprises in the iron and steel, chemicals, electricity power generation, petroleum/petrochemical, construction materials, non-ferrous metals, coal mining, paper and textile industries. Progress is being monitored closely and enforcement is strong. According to a central government report, the top 1000 enterprises

have saved roughly 150 Mtce (Metric tonnes carbon equivalent) between 2005 and 2010, achieving 50 per cent more savings than the required target (Government of China 2011).¹⁰

- Preferential tax rates for renewable energy and energy conservation technology ventures: the new Enterprise Income Tax Law (EIT) came into force on 1 January 2008. This law introduces preferential treatment for industries and projects in the areas of environmental protection, energy conservation, water conservation, technology transfer and nuclear development by reducing enterprise income tax and providing tax holidays. In addition to qualifying for the EIT benefits, energy service companies are also exempt from business tax and value added tax (Montero 2002b).
- Tariff adjustment: the Chinese government has reduced import tariffs on resource-efficient and advanced technology commodities but increased export tariffs and removed export rebate subsidies on energy-intensive, pollution- and resource-intensive commodities during the 11th Five-Year Period.
- Fuel tax reform: the Chinese government launched a fuel tax reform in 2009, which set the petrol tax at 1.0 yuan/l and the diesel tax at 0.8 yuan/l.
- Resource tax reform: the Chinese resource tax was reformed in October 2011. Under the new regime, crude oil and natural gas taxes have been shifted from a unit tax to an ad valorem tax, that is, the tax will be based on sales rather than on production. In addition, coking coal and rare earths were also subject to higher tax rates (China Briefing 2011).
- Green credit policy: launched in July 2007, the Green Credit Policy has become an important climate financing tool in China, with three government agencies sharing implementation responsibilities – the Ministry of Environmental Protection (MEP), the People's Bank of China (PBOC) and the China Banking Regulatory Commission (CBRC). This policy implements a shift in credits from polluting and energy-intensive enterprises and projects towards conservation and emissions-abating projects. Under this policy, the share of energy saving environmental project loans has grown from 1.87 per cent of total loans granted by Chinese banks in 2005 to 8.93 per cent in 2009 (China Banking Association 2012).
- Carbon sinks: the State Forestry Administration launched three major programmes to increase carbon sinks in China: (1) major programmes such as the natural forest protection programme, the sloping land conversion programme and the Beijing–Tianjin sand control programme; (2) Clean Development Mechanism (CDM)

carbon sink projects; and (3) the voluntary afforestation programme under the China Green Carbon Foundation.

In summary, the major policy interventions adopted by the Chinese government during the 11th Five-Year Plan are predominantly command-and-control policies. Although some innovations regarding market-based instruments have been adopted on a supplementary basis, most of these are adjustments to trade tariffs, banking policies and preferential tax treatments.

In the 12th Five-Year Plan (2011–2015), the Chinese government announced a 16 per cent energy intensity reduction target,¹¹ a 17 per cent carbon intensity reduction target (NDRC 2012), an (absolute) energy consumption target of 4.1 billion tce and a coal consumption target of 3.9 billion tonnes.¹² However these targets seem difficult to achieve, especially the coal target, since coal consumption has already grown to 3.8 billion tonnes in 2011 (Bloomberg 2012), meaning that it can only increase by 0.1 billion tonnes for the next five years. Furthermore, even given the condition to limit total energy use to under 4.1 billion tce, China's fossil fuel-related carbon emissions would reach 8.5 billion tonnes in 2015, which would surpass United States (US) emissions by about 50 per cent (Montero 2002a). With the further stringent targets for the 12th Five-Year Plan, there is a growing understanding that the existing command-and-control policies will be largely insufficient. As a consequence, the importance of economic instruments in the climate policy debate is growing.

Environmental Taxation in China

The debate on environmentally related taxes in China is not a new one. In 1982, the pollution levy system was put in place to curb industrial pollution relating to water, air, noise and solid waste (Wang and Wheeler 2000). This comprehensive reform also introduced the new resource tax, the vehicle tax and the land use tax. One year later, the fuel tax, levied on petrol and diesel, was added. In 1985, the urban construction and maintenance tax followed and in 1988, a tax on land use was imposed. The 1994 tax reform was aimed at making the tax system more consistent with the needs of the market economy (Xu 2011). It reformed the resource tax and launched the consumption tax, which was levied on 14 types of consumer goods, including transport fuel, disposable chopsticks, tobacco, alcohol and cars. The consumption tax included a new vehicle tax, which was divided into the one-off vehicle acquisition tax at purchase and the annual vehicle and vessel tax. In 2003, the industrial levy was reformed and replaced by a pollution tax.¹³ Although the reform involved a significant

increase in the tax rates, they were still too low to have the desired impact (Xu 2011). Further reforms were implemented after this, including the fuel tax reform in 2009, which had been under debate for 15 years before finally being adopted (Bachus and Cao 2011).

In 2010, China's environmental tax revenues accounted for 6.7 per cent of total tax revenues, which is slightly higher than the average for the EU27 (6.3 per cent) (European Commission and Eurostat 2011; National Bureau of Statistics of China 2012). However expressed as a percentage of gross domestic product (GDP), these revenues are 1.2 per cent, significantly lower than the EU's (2.4 per cent). This difference can be explained by the much lower general tax level in China (Bachus and Cao 2011). Another measure is the tax rate excluding value-added tax (VAT) on petrol, which was €0.11 per litre in China, compared to €0.08 in the US, €0.66 in Germany, €0.62 in the UK and €0.61 in France (European Commission 2012; Ministry of Finance 2012).

Chinese environmental tax policies have been especially criticized for their low tax rates. As most of the revenues are used for pollution abatement, the tax rates are calculated to cover only the abatement costs. Experience has shown that this level is too low to be an incentive for companies to invest in emissions reductions, as it is cheaper to pay the tax than to abate (Bachus and Cao 2011). Secondly, due to China's complex institutional structure, problems of conflicting interests between local and central governments frequently occur, leading to collection rates that are much lower than could be expected given the tax rates. Local governments are often zealous for local economic growth, which makes it hard to adopt and implement any environmental tax that may conflict with these targets (Xu 2011). The 2009 fuel tax reform may seem like a significant step forward, but the increase was the first one in 26 years. Other taxes, such as the independent environmental tax and the carbon tax, remain to be realized (Wang et al. 2011).

Emissions Trading Experience in China

To date, China has not yet had a comprehensive system of emissions trading (Chang and Wang 2010). However the severe problems in China with sulphur dioxide (SO₂) from coal have raised strong awareness, leading to a search for effective policy instruments to deal with the air pollution problem. SO₂ emissions trading has been the focus of serious attention for the last 20 years. As early as 1994, emissions trading pilot projects were launched in six cities (Yang and Schreifels 2003). In the late 1990s, China implemented a number of pilots with the help of the US and several international institutions (Chang and Wang 2010). This led to an

upscaling in the early 2000s, with experiments in four provinces, three cities and one power production company. Different types of trading were tested during these experiments. The pilots revealed a number of barriers and challenges for effective implementation of emissions trading on the national level (Chang and Wang 2010). The first was effective emission monitoring capacity, which was lacking. The second was a solid legal system, which was insufficient. Thirdly, many institutions from local and central government need to be engaged, making the ETS a very complex system. Finally, compatibility with other regulations and policies needs to be addressed carefully. Although much has been learnt from the pilots and some local trading schemes are still operational today, they have not entailed a national cap-and-trade system and most authors consider them as having failed (Han et al. 2012).

Carbon trading entered China in 2004, when it embarked upon the Clean Development Mechanism (CDM). It quickly became the world's most dominant CDM carbon credit supplier, accounting for 58 per cent of global certified CDM emissions reductions at the end of 2011 (UNEP Risø Centre 2012). Next to the CDM, carbon trading is also present in China through the 'carbon trade exchanges', such as the China Beijing Environment Exchange (CBEEEX) and the Shanghai Environment and Energy Exchange (SEEEEX). Although today these initiatives only trade CDM and Voluntary Emissions Reductions, Han et al. (2012) see them as a way of providing a basic infrastructure for future carbon trading on a larger scale.

However the most important initiative recently taken with regard to carbon trading in China is the decision, in 2011, by the National Development and Reform Commission (NDRC) to launch pilot carbon trade projects in two provinces and five cities.¹⁴ Implementation is set to start in 2013 and it should pave the way for a nationwide system by 2016.¹⁵ Some governments in the pilot areas will implement a pure cap-and-trade scheme, meaning they will launch an absolute cap. Other areas' governments will opt for efficiency-based or project trading schemes due to their opposition to an absolute cap (Wu 2011). Chinese trading is quite different from the EU ETS or US sulphur trading regime. In fact, since the central government allows each member province or city to design its own trading regime, they all have their own plans and systems. For instance, in the case of Beijing, all firms with average annual carbon emissions of 10 000 tonnes and up are obliged to join the trading programme (roughly 600 firms) (China Daily 2012). The remaining firms can join on a voluntary basis. The cap is not an absolute carbon emissions cap, but a carbon intensity target of 17 per cent, which is the 12th Five-Year Plan target for Beijing. The quotas are distributed through grandfathering, depending on firms' historical emissions, technology and the city's industrial structure. Since

trading prices may be quite volatile, the government may set a price floor if the trading price is too low or may provide more quotas via auctioning if the price is too high. The absence of an absolute cap, and the uncertainty in the economy, give rise to doubts as to the functioning of the pilots, but they leave room for trial and error adjustments.

Unlike Beijing, which covers all the energy-intensive sectors, Guangdong plans to start with electricity, building materials and the chemical sector and expects to implement trading in 2014 (Lunsford and Loh 2012). As Guangdong's 12th Five-Year Target is 19.5 per cent, the provincial government further translates its target into a cap on the level of the firm, so that firms can trade to achieve their own target.

For all pilot cases, it can be said that, since trading is limited to the city or provincial jurisdiction, the trading market is potentially very thin, meaning that transaction costs may be quite high. In the case of Beijing, only 600 firms are included and in the case of Guangdong, only three sectors are allowed for trading purposes, with the result that the trading volume might be too low to ensure efficient trading.

POLICY CHOICE FOR CHINA

A Chinese Cap or a Carbon Tax?

In the previous sections we discussed the theoretical debate over the cap-and-trade and carbon tax and we reviewed the current experiences of China with regard to climate policy, environmental taxation and emissions trading. In this section, we apply these discussions to the Chinese perspective.

Firstly, from the perspective of administrative efficiency, a carbon tax clearly has the edge on allowance trading. According to Ye and Wang (2009), a carbon tax would be relatively easy to implement as the tax can be collected indirectly based on the carbon content of the fuel. In this way, the tax could be set up by tax authorities, even without the technical support of the environmental department. Moreover, Ye and Wang (2009) see no major departmental obstacles. On the other hand, emissions trading in China requires a prodigious administrative framework and a transparent and accurate carbon accounting system. Notwithstanding the initial preparations for emissions trading described in the previous section, a sound emissions trading market in China is still in its infancy (Han et al. 2012). The same can be said for the pilot projects that have been launched recently. One field that needs solidification is the legal framework, particularly in the area of enforcement (Cheng and Zhang

2011). According to Han et al. (2012), there is a lack of reliable emissions data,¹⁶ and setting emissions caps¹⁷ and allocating permits would be particularly challenging. Thus, despite the efforts already made, the capacity to implement a large-scale carbon trading scheme is not yet present. It will take time for both private firms and local governments to learn from the pilot trading market and to bring down the transaction costs of any new system and shift the trading market from a thin market to a thick market to assure trading efficiencies (Cao 2010a).

Secondly, as in most countries, political factors are likely to be a crucial factor in the choice between taxing and trading. People naturally have an aversion to any tax, as China's tax burden has risen sharply in the past 15 years.¹⁸ Moreover, the excessive zeal for economic growth,¹⁹ especially at the local level, is expected to raise opposition to the introduction of a carbon tax (Li et al. 2011). China lacks a sound, efficient and transparent budgeting and accounting system for public money, which has led to a general distrust and suspicion by citizens and business that government would waste any new tax revenues (Xu 2011). The experience of the 2008 fuel tax reform, which had less impact than a carbon tax would, has taught that such tax reforms in China face a very long and difficult political process before implementation (Wang 2009). Surprisingly, a survey cited by the Asian Development Bank (2007) reported that 99 per cent of the public support 'collection of environmental taxes'. However Ye and Wang (2009) believe that taxpayers will certainly resist the carbon tax. Liang et al. (2007) estimated the impact of several carbon tax scenarios for China. They estimate that only a scenario involving total exemption for energy-intensive sectors can be expected to be politically feasible.

As a developing economy, China is resistant to an absolute national emissions cap, as it may curb its economic growth (Cooper 2008). According to Wu (2011), China can benefit economically from domestic emissions trading, but a lack of political will for pricing carbon has hampered progress; moreover, an emissions ceiling reducing over time is just as politically unacceptable. However current practices show that the idea of an ETS has gained momentum in recent years and now seems the preferred option for the Chinese government, as a new carbon tax may lead to more resistance (Wu 2011). Similar to the EU ETS, it is likely that China will start from grandfathered allocation, to gradually shift to a combined grandfathered-auctioned type of allocation. It will be interesting to see how the policy reforms will change power divisions within the central government. The Ministry of Finance (MOF) would prefer a tax if the revenue is added to the general budget, but the MOF would have a neutral attitude if the carbon tax revenue is fully recycled by lowering other taxes. However the NDRC would prefer a trading regime, since it is responsi-

ble for determining and allocating the caps. Local governments would support a trading regime as well, as the (local) pilot trading programme currently implemented in China gives them the power to design the trading regime. Consequently, local governments can design the policies so that they hinder local economic growth as little as possible. Of course, such design power will be lost in the event of a nationwide system.

The third criterion in the instrument choice discussion is effectiveness. Several studies have been conducted on the effectiveness of different carbon tax scenarios. All studies agree that there is no doubt that a carbon tax would be an effective instrument for Chinese climate mitigation policies (Cao 2010b; Cao 2010a; Wang et al. 2009; Liang et al. 2007). An auction-based cap-and-trade scheme is likely to achieve similar performance in emissions abatement since the permit price will send similar price signals. A grandfathered trading regime would depend on the cap-setting and the features of the trading market but is likely to yield suboptimal results.

A fourth important element is the impact on the divide between rich and poor in China. The Chinese government aims to reduce this gap and is afraid that rising energy prices may exacerbate inflation and be unfavourable for the poor (Wu 2011). The distributional impact of a carbon tax in China has been calculated by Cao (2010b). She concludes that a carbon tax would indeed be regressive, but also that this effect can be fully neutralized by recycling the tax revenues into the economy. In her simulations, the lump-sum recycling scheme reduces the regressive nature of the tax more than the option in which other distortionary taxes are reduced. The net effect of the tax reform can even be made positive for low-income households, which turns it into a progressive measure. This conclusion is supported by Brenner et al. (2006), who raise the idea of combining a carbon tax with a 'sky trust', a system of carbon charges in which the revenues are recycled to the public on a lump-sum basis. According to this study, such a tax reform will have a progressive distributional impact.

A fifth element is the competitiveness impact. Ye and Wang (2009) and Cao (2010a) indicate that a carbon tax will affect energy prices, which may reduce industrial international competitiveness. Cao (2010a) points out that, if neither instrument is implemented in China, China's exporting industry might be confronted with border taxes in the future,²⁰ which might also hurt China's competitiveness, but without the possibility of recycling the revenues. Wang et al. (2011) confirm that a high carbon tax (100 yuan per tonne of carbon) would necessitate compensation for industry. However a low rate of 10 yuan could be implemented immediately as a first step with hardly any competitiveness impact for any sector expected. Similarly, for the domestic trading scheme, cross-region competitiveness issues may arise as well, especially between trading regions and non-

trading regions. However, with the pilot period, this may be a small issue and will be reduced in the long term when the trading regime expands to the whole country. A domestic carbon tax with the same tax rate across the country can avoid such risks, unless certain sectors are exempt or receive preferential tax rates.

A sixth point of attention is compatibility with other existing policies. A carbon tax may interfere with the resource tax and the consumption tax (fuel tax). In order to avoid double taxation, a serious coordination effort will be required to align the new instrument and make it complementary to the existing measures. The same requirement can be formulated for a tradable permit scheme, which will also need coordination with existing environmental policy measures, such as the existing (unsuccessful) sulphur trading programmes.²¹

A seventh element is the aforementioned trade-off between effectiveness and political feasibility. If the Chinese government decides to implement a comprehensive emissions trading scheme, free allocation of permits should be strongly advised against in order to avoid an erosion of effectiveness. However given China's experiences with difficult and obstructed policy processes such as the energy tax (Wang 2009), the fuel tax reform (Bachus and Cao 2011) and the SO₂ emissions trading policy process (Yang and Schreifels 2003), the government's emphasis on a step-by-step approach and the use of pilot projects (Wang et al. 2011), it is not very likely that in a first phase such an ETS will have a large share of auctioned permits. In addition, it is likely that China's ETS, if adopted, will allow for additional emissions growth, just less than in the business-as-usual scenario (Wu 2011). This decision to allocate free licences will be detrimental for carbon emissions reductions, but may – as a way of compromise – at least generate enough political support for this first step towards the pricing of carbon emissions in China.

The eighth and final difference between cap-and-trading and taxes in China lies in their impact on technology innovation and diffusion. However due to the lack of empirical studies of the impact of the two instruments on R&D and technology innovation and diffusion in China, it is hard to tell which instrument will give more incentives.

Recommendations for the Optimal Design of a Cap or a Carbon Tax in China

Regardless of whether emissions trading or a carbon tax (or both) is chosen, the design of the system will be crucial for its chances of success. In this subsection, we put forward a number of recommendations for designing a carbon tax or a tradable permit system.

In the case of a carbon tax it is important to gradually increase the tax rate over time. This avoids the negative shock effects of a too drastic new tax and the petering out of abatement efforts after a certain time. Since actively raising tax rates on a regular basis is likely to bring about problems with public acceptance, the tax levels should be announced before the start of the programme. Additionally, an automatic link with inflation is advised. The tax reform should be combined with a comprehensive communication campaign explaining the reasons for the reform and transparently reporting on the (financial) impact on all groups of citizens and companies in China. The tax base can be the carbon content of fuels, so exact emission measurement is not required.

The most important recommendation for tradable emissions rights is to maximize the amount of paid allocation of allowances. Auctioned allowances increase effectiveness and open the door for revenue recycling, which offers a solution to any undesired incidental impacts of the programme, such as hurting low-income groups and competitiveness issues. Fan et al. (2011) recommend small, frequent auctions to limit the market power of large bidders. Next, a lot of attention should be given to the design of the trading system, much more so than for a carbon tax. Although in the pilot programme different cities and provinces have designed different trading regimes, in the actual implementation the central government will need to implement only one trading regime and allow firms to trade across city or province borders. Last but not least, China should get its house in order regarding the reliability of emissions data before considering a nationwide cap-and-trade system.

The last group of recommendations is valid for both instruments. Firstly, whichever instrument is chosen, the price put on carbon should be high enough in order to have a significant effect on investment and consumption decisions. Secondly, the revenues from the carbon tax or the auctioned permits should be recycled as much as possible into the economy, thus avoiding or at least mitigating to a large extent any undesired regressive or negative competitiveness impacts and simultaneously increasing public support for the reform. Thirdly, exemptions or rebates for individual sectors should be barred or at least kept to a minimum as this leads to suboptimal social welfare. Fourthly, instead of focusing too much on the upsides and downsides of any single policy instrument, it is better to abandon this exclusiveness approach and strive for a policy mix. If well coordinated, it is feasible to combine a tax with an ETS, regulation, subsidy removal, voluntary approaches and other options. Indeed, implementing a carbon tax in China in the short run, and later on complementing it with an ETS that could gradually become the dominant carbon pricing instrument, is probably the most suitable solution (Fan et al. 2011). Alternatively, both

instruments can be applied to different sectors; for instance cap-and-trade could be used for the currently already monitored 10 000 energy-intensive firms, supplemented with the highly regulated sectors, such as electricity, iron and steel and the cement industry. The other sectors and medium or small-scale firms can be regulated with a carbon tax. Such a 'hybrid system' (see above) combines the advantages of both instruments and could be an option worthy of consideration in the case of China.

CONCLUSIONS AND RECOMMENDATIONS

Taking into account all the pros and cons of a tax and an ETS, the conclusion as to the optimal climate change mitigation instrument for China is not entirely straightforward. However an emissions trading scheme will only be able to achieve its theoretical potential if the critical conditions of a sound administration, reliable emissions data and a well-functioning market are achieved. This is regarded to be highly unlikely in the short term. Therefore, a carbon tax may be the most feasible option, at least from an administration and implementation point of view (Cao 2010a; Fan et al. 2011). In the longer term, a cap-and-trade system can replace the carbon tax or supplement it. A hybrid system combines the advantages of both instruments, but the increased complexity may jeopardize implementation. Regardless of which instrument is more effective, efficient or administratively feasible, in practice political considerations will probably end up being the decisive factor. Local and central government institutions' power and other policy priorities, such as safeguarding economic growth and avoiding negative distributional impacts, are likely to play a larger role in practice than effectiveness or efficiency. In our view, choosing which one of the two instruments is most appropriate is not the main challenge for China in the near future. The principal challenge may well be simply reaching a decision to implement at least one ambitious, sound and credible climate policy instrument. China's domestic climate mitigation policy may well be the decisive factor determining whether global climate efforts will reach a turning point or continue to decline in the years to come.

NOTES

1. For tradable permits this is only the case if the allowances are not provided for free but allocated against payment (for example auctioned).
2. Again, this theoretical equivalence only stands in the case of paid allocation of permits (by auction or other). If the allowances are (partially) granted for free ('grandfathered'), emissions trading is less efficient than a tax in any case (Parry 2003).

3. Assuming both the marginal cost and the marginal benefit curves are linear functions, following Adar and Griffin (1976).
4. However it is not hard to imagine that the same can be said for a carbon tax. For example, Ireland decided to impose a 'pure' carbon tax (without revenue recycling) as part of its crucial fiscal consolidation package in 2009–2010 (Bergin et al. 2010).
5. For example, the EU Emissions Trading Scheme, the Kyoto mechanism and the New Zealand ETS. One counterexample is the Australian carbon tax, which was introduced after a bumpy, multiple-year political process (Clarke and Waschik 2012).
6. Before the ETS was adopted, a Europe-wide carbon tax had been put on the agenda by the European Commission as early as 1991. See, among others, Wettstad (2005), Ellerman et al. (2010) and Skjærseth and Wettstad (2008). The latter states that 'the tax proposal led to some of the most ferocious lobby activity ever seen in Brussels' (2008: 4). As a result of this lobbying and the unanimity rule, the idea of a common carbon tax was abandoned in 1994.
7. For reasons of susceptibility to manipulation and barriers to new entrants (Hepburn 2006). The optimal design for an efficient ETS system is a complex matter (Woerdman and Weishaar 2010), on which an extensive body of literature has been published which goes beyond the scope of this chapter.
8. The price of the (phase I) European allowances even fell to zero for about one year in 2007, caused by the transition from the first to the second trading period, among other reasons (Ekins 2009).
9. According to Qi (2011), the actual energy intensity reduction achieved at the end of 2010 was 19.06 per cent.
10. The savings mentioned are not absolute reductions, but reductions from a calculated business-as-usual baseline.
11. By the end of 2015 compared to end of 2010 levels.
12. It is the first time that China has proposed an absolute energy and coal target.
13. Therefore, this reform is also called the 'fee-to-tax reform'.
14. The provinces of Guangdong and Hubei and the cities of Beijing, Shanghai, Tianjin, Chongqing and Shenzhen.
15. According to Wu (2011), this is a very ambitious goal, given the number of issues that can be expected to have limited support: (a) opposition from within government; (b) China's energy consumption and prices; (c) expected inflation and potential regressive impact; (d) uncertainty with regard to intensity targets; and (e) lack of experience by industry in measuring and managing emissions.
16. This observation is confirmed by the recently published article by Guan et al. (2012) in *Nature Climate Change*, in which the authors argue that China's official national carbon emissions and the combined total reported by all provinces differ by 1.4 giga tonnes, which is approximately the amount of the fourth-largest emitter in the world, Japan.
17. Including converting the existing carbon intensity targets into an absolute cap.
18. Sun (2012) calculated that the Chinese macro tax burden (that is, including social insurance revenue) has risen from 11.6 per cent of GDP in 1995 to 22.7 per cent in 2010.
19. Especially at the local level.
20. The recent inclusion of aviation in the EU ETS and the subsequent levy for international air carriers can be regarded as the first border tax adjustment. However, the European Commission decided in November 2012 to defer the obligation for airlines to surrender emission trading allowances for flights into and out of Europe, by one year. The aim of the delay is to give a chance to the International Civil Aviation Organisation to come to a global agreement at their 2013 Autumn Council Meeting (source: http://ec.europa.eu/clima/news/articles/news_2012112001_en.htm, accessed 02/05/2013).
21. Sulphur trading is still operating on a local level in seven areas in China (Petherick 2012). Chongqing seems to have the best market; the other areas suffer from low trading volumes.

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6. The governance of the CDM in China: achievements and deficiencies

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In recent decades, rapid economic development based on current patterns of consumption and production has been causing serious harm to nearly all ecosystems worldwide. Natural disasters such as floods, droughts and forest fires are occurring in every region of the planet with increasing frequency. Global climate change, caused by the large-scale emission of greenhouse gases (GHGs) into the atmosphere, seriously aggravates these existing environmental issues, in addition to creating new environmental challenges such as rising sea levels, increased frequency extreme weather events and so forth (IPCC 2007a: 18–28). According to the most optimistic estimates, the risk of severe climate impacts could be mitigated if emissions were stabilized at the level of 445 to 490 ppm (parts per million) of carbon dioxide equivalent (CO₂-eq), limiting the increase in global average temperatures to 2°C. The current level of CO₂-eq in the atmosphere is nearly 430 ppm. In combination with cumulative effects related to the build-up of GHGs in the atmosphere, this requires that total global annual emissions in 2050 be between 50 per cent and 85 per cent lower than in the year 2000 (IPCC 2007b: 67). Mitigating climate change is therefore one of the key environmental, economic and societal challenges facing all countries worldwide (Stern 2007: 63) and particularly those with already high or quickly increasing rates of GHG emissions, such as China.

Faced with such reality and challenges, the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, adopted the United Nations Framework Convention on Climate Change (UNFCCC). The adoption of this ‘umbrella convention’ was underpinned by reports of the Intergovernmental Panel on Climate Change (IPCC), established to group the efforts of thousands of international climate scientists (Biermann 2011: 687; Bodansky 2001; United Nations 1992). The 1997 Kyoto Protocol, a protocol to or ‘legal instrument’