China Urbanisation and Carbon Tax

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Carbon tax is a tax on carbon-based fuels. In the policy evaluation framework, the social cost of carbon (SCC) is usually used to denote whether a climate policy can cost-effectively abate carbon emissions. In other words, the SCC stands for the costs of the emissions of an additional tonne of carbon dioxide, and thus it is used to denote the marginal welfare impact of the emissions.

Keywords: urbanisation ; carbon tax ; CGE model ; ARDL model

1. Overview

In the literature, very few studies have focused on how urbanisation will influence the policy effects of a climate policy even though urbanisation does have profound socioeconomic impacts. This paper has explored the interrelations among the urbanisation, carbon emissions, GDP, and energy consumption in China using the autoregressive distributed lag (ARDL) model. Then, the unit urbanisation impacts are inputted into the policy evaluation framework of the Computable General Equilibrium (CGE) model in 2015–2030. The results show that the urbanisation had a positive impact on the GDP but a negative impact on the carbon emissions in 1980–2014. These impacts were statistically significant, but its impact on the energy consumption was not statistically significant. In 2015–2030, the urbanisation will have negative impacts on the carbon emissions and intensity. It will decrease the GDP and the household welfare under the carbon tax. The urbanisation will increase the average social cost of carbon (ASCC). Hence, the urbanisation will reinforce the policy effects of the carbon tax on the emissions and welfare.

2. Socioeconomic Impacts of the Urbanisation

China has been experiencing rapid urbanisation for decades. The percentage of the urban population increased from 18% in 1978 to 56% in 2015 [1]. The urban population was projected to reach one billion by 2030 [2]. Rapid urbanisation may increase energy consumption because cities are the main contributors to fossil-fuel energy consumption [3]. For example, a one-way positive causal relationship exists from the urbanisation to the energy consumption in China [4]. Conversely, urbanisation could also reduce energy consumption because it saves energy use in transport. For example, the urbanisation was empirically found to reduce the residential energy use in the 12 transition economies [5].

Although a long-term correlation between urbanisation and carbon emissions was already confirmed in the literature [6], urbanisation impacts on carbon emissions are complicated: on the one hand, urbanisation-induced industrialisation results in intensive use of energy, which increases carbon emissions; on the other hand, geographical concentration may enhance energy use efficiency, which decreases carbon emissions. Although previous researchers studied how the Chinese urbanisation affected the historical emissions [7][8][9], the projected urbanisation impacts during the period 2015–2030 remain to be researched in China.

In addition to the environmental impacts, rapid expansion of urban areas could generate profound economic impacts. Urbanisation can generate both positive economic externalities, such as the creation of new jobs and promotion of new technologies, and negative externalities, such as public insecurity and social inequality [10][11].

Hence, urbanisation affects energy consumption, carbon emissions, and economic growth altogether. Studies that partially omit the urbanisation impacts tend to be biased, owing to the omission of an explanatory variable. For example, Zhao and Zhang [3] only focused on the bidirectional impacts of the urbanisation on the energy consumption in China during the years 1980–2010. As Zhao and Zhang [3] excluded the direct urbanisation impacts on the emissions, their results might be biased, owing to the fact that the urbanisation could affect the emissions directly [12]. In contrast, Al-mulali, Sab [13] and Wang, Fang [4] neglected the urbanisation impacts on the economic growth. With the omission of an influential explanatory variable, these studies may not give full understanding of the urbanisation impacts. In comparison

to the results in Zhang, Yi et al. [14] could be much more trustworthy, as they fully studied the relation between the urbanisation and its three influential factors.

The complicated socioeconomic impacts of the urbanisation are likely to change the policy effects of the Chinese climate policies. Nevertheless, very few previous studies have modelled urbanisation impacts on the policy effects. Neglecting the urbanisation impacts is likely to cause a misunderstanding regarding climate policies because the structural transition in urban population has a significant influence on efforts to mitigate carbon emissions [15]. Therefore, it is important that the urbanisation impacts should be modelled in the evaluation of climate policies. In the policy evaluation framework, the social cost of carbon (SCC) is usually used to denote whether a climate policy can cost-effectively abate carbon emissions. In other words, the SCC stands for the costs of the emissions of an additional tonne of carbon dioxide [16], and thus it is used to denote the marginal welfare impact of the emissions [17].

This paper contributes to the literature by incorporating the urbanisation impacts in the evaluation framework of the climate policy. Specifically, I have used an ARDL model to study the historical urbanisation impacts during the period 1980–2014 in China. I assume that the historical ARDL interrelations will remain unchanged in 2015–2030. Based on the projected urbanisation data given by UN [18], the projected urbanisation impacts are inputted into the Computable General Equilibrium (CGE) model for the policy evaluation.

3. Discussion

The negative impact of the urbanisation on the carbon emissions analysed in this paper complies with Liu and Liu [19] who argued that, with the development of the urbanisation, its impact on the emissions would become negative. However, Wang and Wu [20] argued that the urbanisation increased the carbon emissions in China. The resulting difference is caused by the adoption of the different methodology: Wang and Wu [20] used the provincial data to study the urbanisation impacts on the energy consumption and carbon emissions, but they omitted the correlation between the urbanisation and economic growth. In contrast, the urbanisation impact is analysed at the country level including the economic factor in this paper. This is because the social accounting matrix (SAM) of the CGE model is based on the China Input–Output, which does not explore the regional details. As China has recently developed the green, circular, and low-carbon economy [21], the omission of the economic factor is likely to result in a biased evaluation of the urbanisation impact.

This paper empirically shows that the urbanisation will decrease the carbon intensity over time. This finding complies with the previous research showing that the urbanisation contributed to the declines in the carbon intensity [22]. The importance of the urbanisation on the carbon intensity reduction in China was also confirmed by Lin and Zhu [23]. Hence, the urbanisation and emission abatement could be harmonious [22].

The urbanisation will promote the GDP growth in the baseline scenario. This finding agrees with Yang and Liu [24] who showed the urbanisation impact on the economic growth was positive for the 266 Chinese cities in 2000–2010. However, in the tax scenarios, the urbanisation will negatively affect the economic growth. Liddle [25] also found that the urbanisation had a “ladder” impact on the income: it had a strong negative impact on the poorest countries, a less negative to neutral impact on the countries with the moderate incomes, and a reinforcing impact on the wealthy countries. As the carbon tax decreases the national income in China [26], the urbanisation impact on the economic growth could become negative if the tax is imposed.

In this paper, the urbanisation will increase the household welfare loss induced by the carbon tax. Analogously, Miao and Wu [2] empirically found that the urbanisation negatively affected the welfare through the lifestyle changes. For example, the populations experiencing the urbanisation would consume more fat and smoke more frequently [27]. By comparison, Chen, Liu [28] showed the health impact of the Chinese urbanisation was complicated, and, particularly, there existed an inverted U-shaped relationship between the health and urbanisation.

The urbanisation will increase the average social cost of carbon (ASCC), which implies that the emission abatement will become costlier under the urbanisation impacts. This finding agrees with the previous research showing that the urbanisation increased the carbon footprint and thus the social cost of carbon in China [29].

In summary, the urbanisation will decrease the emissions and intensity but induce more GDP loss and welfare loss under the carbon tax. Noticeably, all these mentioned urbanisation impacts are quite minimal, which verifies the exogenous introduction of the urbanisation impacts. However, the exogenous introduction may not fully explore the mechanism that the urbanisation influences the policy effects of the carbon tax. This is because the optimal policy is based on the given inputted parameters describing the urbanisation impacts, but these parameters should vary freely to form the optimal

policy. Hence, future research may lie in the use of detailed urban–rural population dispersion data to endogenously model the urbanisation as an influential factor of the carbon tax.

4. Conclusions

In 1980–2014, the urbanisation had a positive and statistically significant impact on the GDP. In contrast, it had a negative and statistically significant impact on the carbon emissions in China. This negative impact disagrees with Wang and Wu [20], but it complies with Yao and Kou [22] who argued that the Chinese urbanisation and emission abatement could be harmonious. Noticeably, the urbanisation impact on the energy consumption was not statistically significant. In 2015–2030, the urbanisation will reinforce the negative effects of the carbon tax on the carbon emissions and intensity. The urbanisation will increase the GDP loss and household welfare loss under the carbon tax, implying that the urbanisation will strengthen the negative effects of the tax on the GDP and household welfare. Despite this, the carbon tax will have a complicated effect on the average social cost of carbon (ASCC), and the urbanisation will increase the ASCC. Therefore, I conclude that the urbanisation will strengthen the policy effects of the carbon tax on the emissions and welfare.

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