Carbon Tax Policy under Renminbi Appreciation: a Financial CGE Model Analysis

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1 Introduction

1.1 Background

In the 20th century, Chinese economy faced problems coming along with double favorable balance. Cases of trade frictions are growing. So does the international pressure on Chinese government to allow RMB appreciation. On the other hand, the monetary authority had to give up part of the independence and flexibility of monetary policies, limited to the dollar peg, to respond to the rapid increasing of exchange reserves. There had been growing pressure on exchange rate policy reform and RMB appreciation.

Chinese government has promoted RMB exchange rate reform since 2005. RMB has appreciated over 30% since then. The appreciation of RMB increases the prices of exports and decreases the prices of imports. Since energy intensive exports accounts for a large proportion of the total exports, Trade structure is changing too.

RMB appreciation might have positive effects on carbon emission reduction.

Meanwhile, a carbon tax policy is under consideration to achieve environmental targets in China. Carbon tax charged in tradable goods industries would have impacts on trade surplus. Thus, carbon tax policy might help to reduce the pressure of RMB appreciation.

In the existing literature, there have been studies on carbon tax policy. But few of them are discussing carbon tax policy under exchange rate fluctuation. This paper

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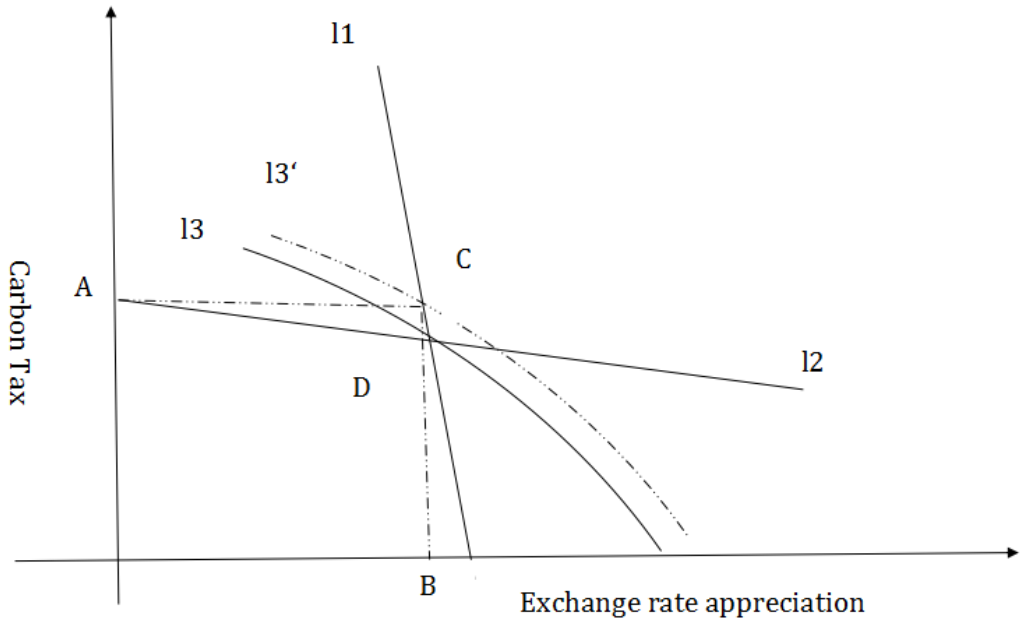
tries to fill this gap and to study the difference of carbon tax policy when exchange rate is stable and appreciating.

1.2 Theoretical Analysis

As Figure 1 shows, each dot on l2 has the same emission reduction performance. We specifically term this curve as emission reduction equaling line. When the exchange rate is stable, we levy carbon tax at A point to achieve certain emission reduction target. Each dot on l1 has the same trade surplus performance. We call l1 trade surplus equaling line. When no carbon tax is levied, RMB appreciates at B point if we must decrease our trade surplus at certain level in the curve l1. C point means that we levy carbon tax at the same rate as at A point while the exchange rate appreciates the same level as at B point. If we do not consider RMB exchange rate fluctuation when implementing the carbon tax policy, the situation would be at C point. But if we conduct carbon tax policy when there exists currency appreciation pressure, we actually should levy carbon tax as D point shows, which is the crossing of l1 and l2. And each dot on l3 has the same real GDP performance. So do dots on l3'. We call them real GDP equaling lines. We will have better real GDP performance at D point than at C point from Figure 1. The theoretical analysis shows us that the optimal carbon tax rate under RMB appreciation is lower than that when exchange rate is stable.

In this paper, we will use simulation results from a financial CGE model to verify the rationality of the equaling lines in Figure 1.



2. Scenarios and Results

2.1 RMB appreciation and emission reduction

When RMB appreciates 2%, 5%, 10%, real GDP drops by 0.017%, 0.073%, 0.259% respectively. CPI goes down by 0.54%, 1.37% and 2.82%. PPI goes down by 0.63%,

1.59% and 3.25%. Trade surplus decreases by 5.12%, 13.01% and 26.81%. CO2 emission is reduced by 0.228%, 0.572% and 1.146%.

Table1 Macroeconomic impacts of RMB appreciation

	2%	5%	10%
Nominal GDP	-0.245%	-0.613%	-1.221%
Real GDP	-0.017%	-0.073%	-0.260%
CPI	-0.538%	-1.369%	-2.823%
PPI	-0.630%	-1.593%	-3.247%
CO2 Emission	-0.228%	-0.572%	-1.146%

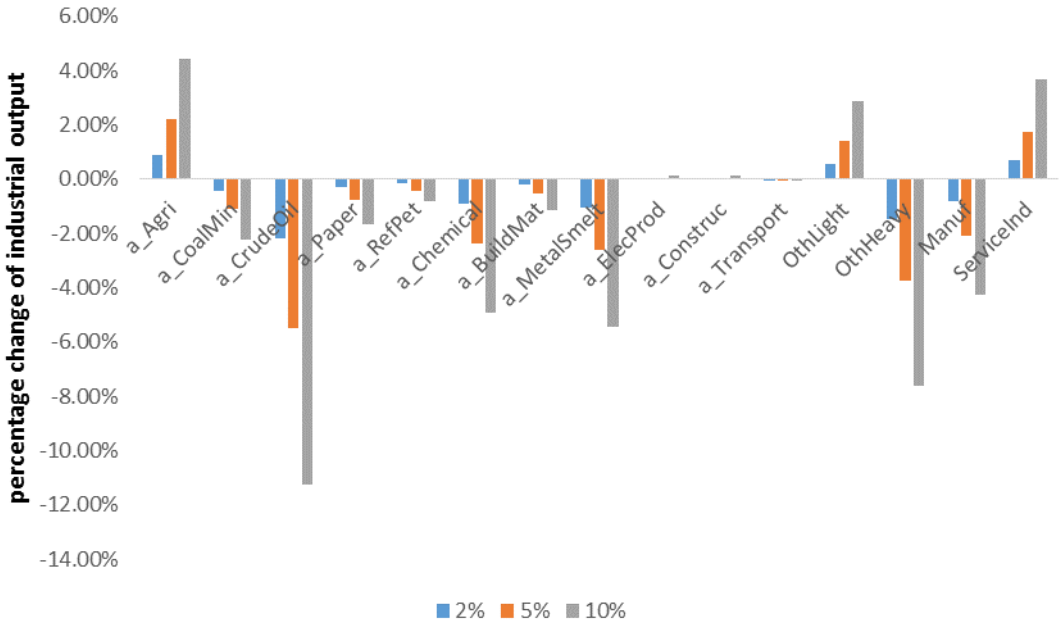


Figure 1 percentage change of industrial output under RMB appreciation

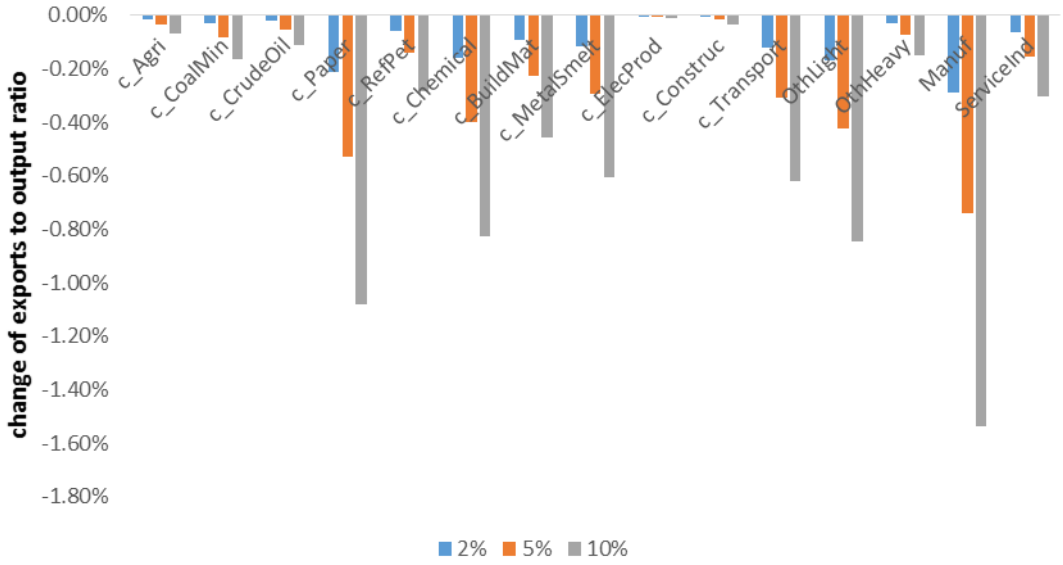


Figure 2 change of exports to output ratio under RMB appreciation

2.2 Carbon tax simulation

The results show that when 20 yuan/tCO2, 50yuan/tCO2 and 100yuan/CO2 carbon tax is levied, real GDP drops by 0.071%, 0.190% and 0.415% respectively. CPI goes up by 0.35%, 0.85% and 1.66%. PPI goes up by 0.63%, 1.54% and 2.98%. Trade surplus decreases by 0.57%, 1.42% and 2.81%. CO2 emission is reduced by 2.14%, 5.12% and 9.57%.

Table2 Macroeconomic impacts of carbon tax policy

	20 yuan/tC	50 yuan/tC	100 yuan/tC
Nominal GDP	0.495%	1.203%	2.302%
Real GDP	-0.071%	-0.190%	-0.415%
CPI	0.350%	0.859%	1.668%
PPI	0.634%	1.548%	2.985%
CO2 Emission	-2.138%	-5.118%	-9.567%

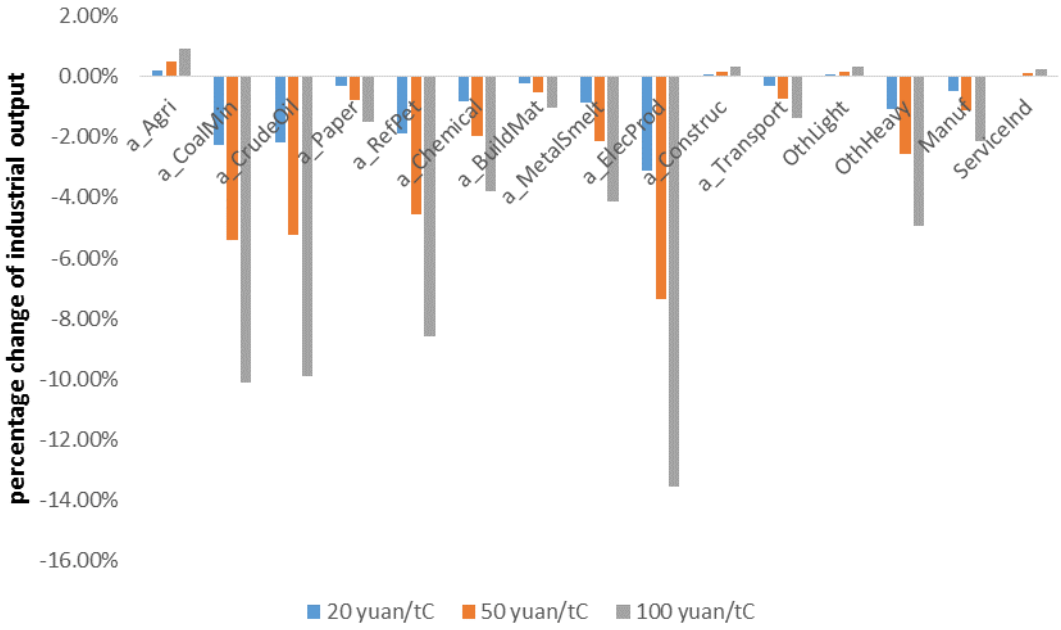


Figure 3 percentage change of industrial output under carbon tax policy

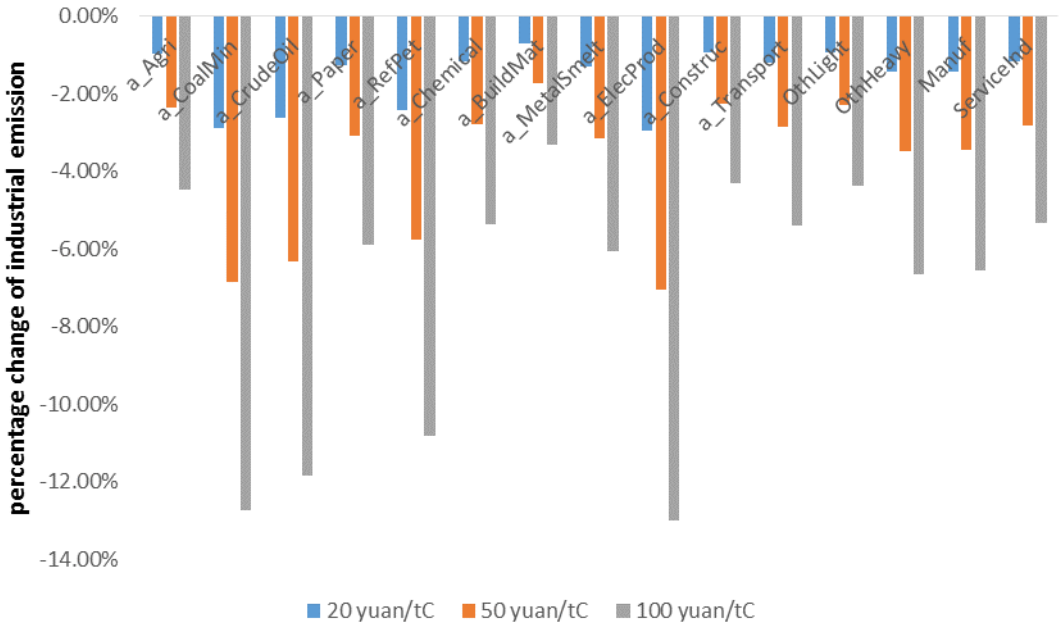


Figure 4 percentage change of industrial emission under carbon tax policy

2.3 Carbon tax under RMB appreciation

Then we draw the trade surplus equaling line, the emission reduction equaling line and the GDP equaling line of carbon tax rate and RMB appreciation. It turns out that all the slopes of three curves are negative. And the GDP equaling line is convex.

Thus the results confirm the theoretical analysis in Figure 1.

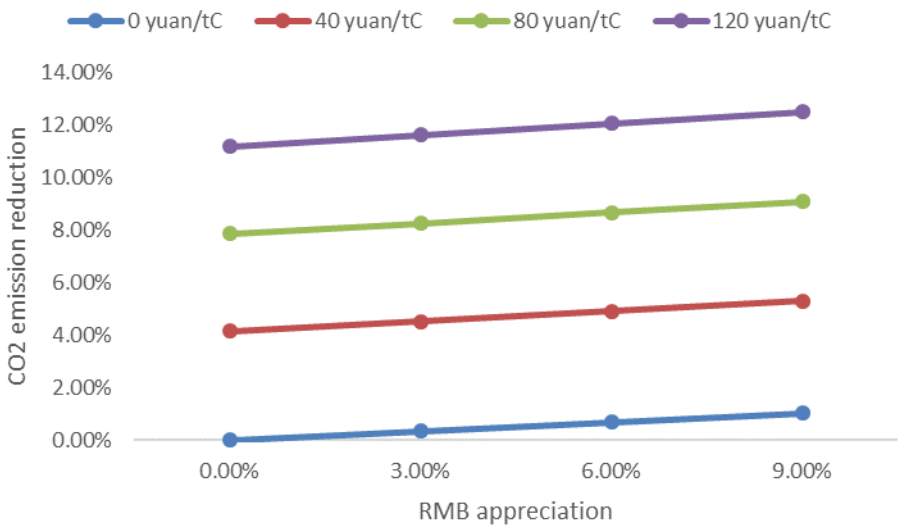


Figure 5 relation between RMB appreciation and CO2 emission reduction

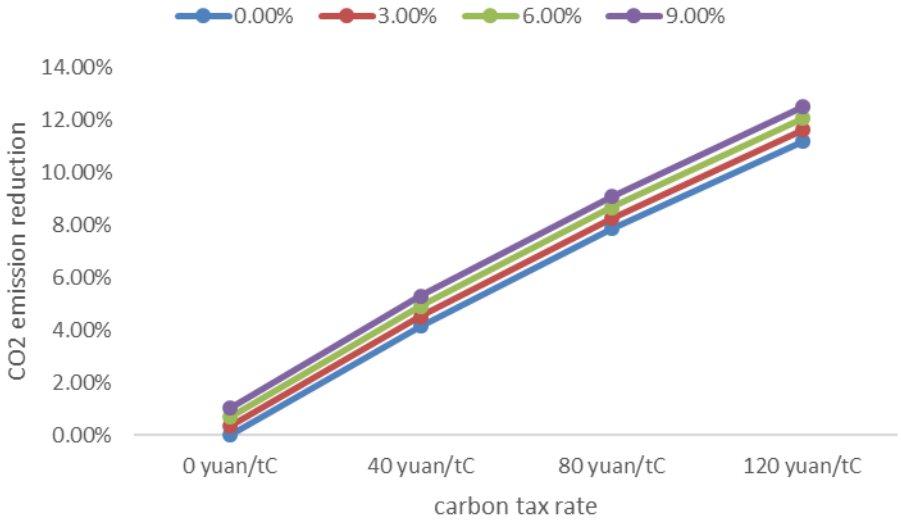


Figure 6 relation between carbon tax rate and CO2 emission reduction

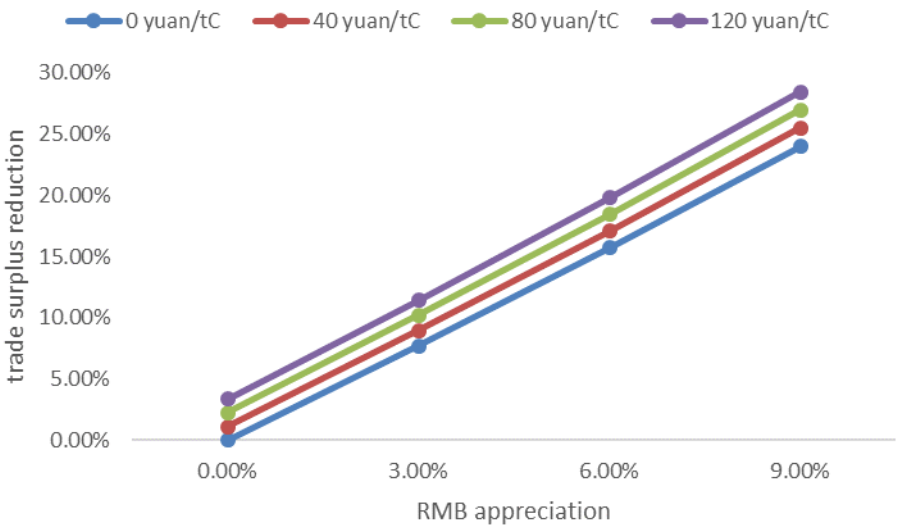


Figure 7 relation between RMB appreciation and trade surplus reduction

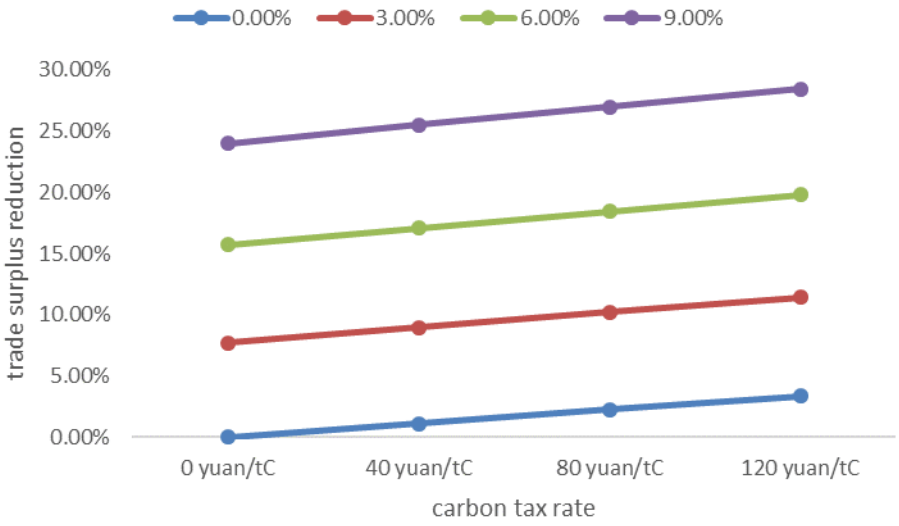


Figure 8 relation between carbon tax rate and trade surplus reduction

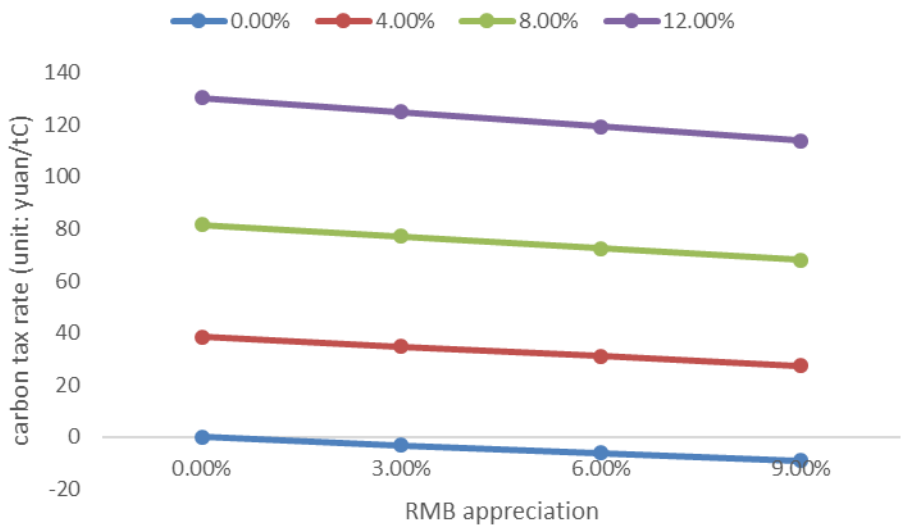


Figure 9 emission reduction equaling line of carbon tax rate and RMB appreciation

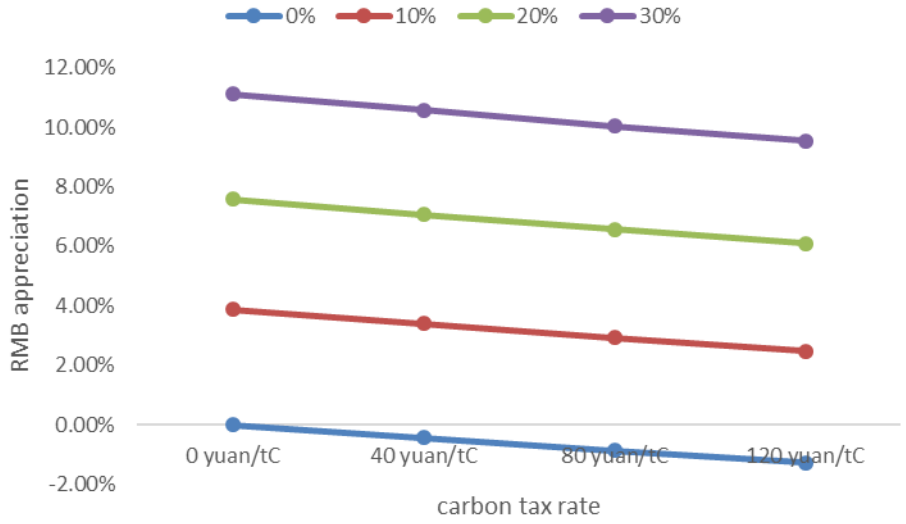


Figure 10 trade surplus equaling line of carbon tax rate and RMB appreciation

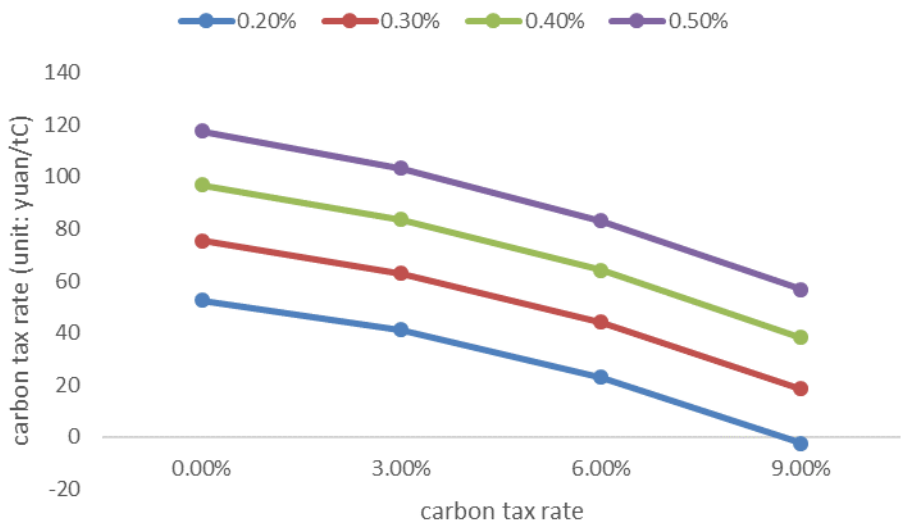


Figure 11 real GDP equaling line of carbon tax rate and RMB appreciation

4 Conclusions and Policy Implications

Results in section 3 verify the theory demonstrated in Figure 1. Figure 9, 10, 11 verify l2, l1 and l3 in Figure 1 respectively.

RMB appreciation helps to reduce CO2 emission. And carbon tax policy would have a negative impact on the trade surplus of China. When we are calculating the optimal carbon tax rate, we should not ignore the exchange rate fluctuation and its impact on the trade structure, industrial structure and the emission reduction amount. If RMB exchange rate keeps rising in the future, the carbon tax rate should be adjusted gradually as well.