INDIRECT TAX INITIATIVES AND GLOBAL REBALANCING

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ABSTRACT

This paper discusses how joint cross country indirect tax initiatives can be used to achieve global rebalancing. This is potentially an important development for G20 discussions which thus far have centered on exchange rates as the instruments to achieve rebalancing. We suggest that if China and Germany (as major surplus countries) switch their present VAT systems from a destination principle to an origin principle, and the US (as the major deficit country) adopts a VAT on a destination principle VAT, jointly these actions can significantly reduce the three countries' joint imbalances and so contribute to global rebalancing. We use a numerical general equilibrium model with a monetary structure incorporating inside money to capture endogeneity of trade imbalances, and to also investigate the potential impacts of such initiatives. These confirm that VAT structures are not only good for global rebalancing but also the changes we consider are beneficial for welfare and revenue collection. Our research is aimed to inject new ideas to the present global rebalancing debate.

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1. Introduction

This paper both sets out a potential non exchange rate based global policy initiative involving indirect tax arrangements in the world's three largest economies (US, Germany and China), and, using general equilibrium techniques, evaluates its potential impact on imbalances both globally and for individual countries. The discussion in this paper is relevant both for current G20 discussions of global rebalancing and also general equilibrium modeling since we use a modeling framework in which the external sector imbalance for each country modeled is endogenously determined rather than being zero or equal to some fixed exogenous amount as is more commonly done.

Following the 2008 financial crisis and the establishment of the G20 in October 2008, successive G20 meetings and declarations have among other things declared the belief of G20 heads of state that global imbalances were a primary contributory factor to the crisis, and that efforts were needed to reduce imbalances. These imbalances were seen as trade and current account imbalances, sharp differences in savings rates across countries, and public sector deficits and debt levels. More concretely, in Pittsburgh in September 2009 the G20 committed themselves to a Framework For Strong, Sustainable, and Balanced Growth in which both external sector deficit and surplus countries committed to broad ranging efforts to lower their imbalances.

Since Pittsburgh the main thrust of the G20 external sector rebalancing discussion has centered on exchange rate policies as the mechanism to achieve rebalancing. This in turn has lead to repeated pressure on China to allow appreciation of the RMB as a

contribution to rebalancing.

Our point of departure is to argue that exchange rate policies are not the only available instrument to achieve global rebalancing, and to focus on an alternative instrument, the value added tax (VAT) and its treatment of cross border transations. Specifically, both China and Germany (and the EU more broadly) operate destination based value added taxes under which imports are taxed but exports leave the country tax free. Both have large trade surpluses of about 5% of GDP. Switching to an origin basis which taxes exports and allows imports tax free entry will, given these significant imbalances, raise taxes and effectively also tax imbalances potentially lowering their size. The long claimed neutrality of origin/destination basis switches for the VAT (see Krauss and Johnson, 1974; Grossman, 1980; Whalley, 1979; Genser, 1996) only holds for balanced trade, and not for today's world. In the US there is no VAT, but revenue pressures given the debt and deficit situation could in the next few years potentially result in its adoption. Were this to happen, given the large US trade deficit a VAT in the US introduced on a destination basis could similarly serve to reduce the US imbalance. We also suggest that an internationally coordinated indirect tax change involving China and Germany switching to an origin based VAT, and the US introducing a destination based VAT could potentially lead to a significant change in global external sector rebalancing.

Having set out this possible initiative, we then turn to an evaluation of the potential rebalancing impact using general equilibrium modeling techniques (see Shoven and Whalley, 1972). We use a conventional Armington multi-country

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multi-product single period trade model (see Whalley, 1985), in which an analytical novelty is to allow the trade imbalance for each country to be endogenously determined. We do this by incorporating into the model both current consumption and expected future incremental consumption from savings using an analytical structure attributed to Patinkin (1947) and also adopted in Archibald and Lipsey (1960) and more recently in Whalley *et al* (2011). In an N good model, we allow preferences to be defined over both N current consumption goods and also 1 argument representing expected future incremental consumption from current period savings. We then use a particular functional form that allows some countries to be savers and others borrowers, and in the Armington trade structure this allows for endogenous determination of trade imbalances. This structure differs from an alternation endogenous trade imbalance simulation for China recently used by Li and Whalley (2011), which does not fit for the US and Germany.

We calibrate this model to 2010 data on consumption, production, and trade, involving goods in each country and use immobile capital and labor as factor inputs. In our calculations we incorporate existing indirect tax structures by country (none federally in the US, and destination basis VATs in Germany and China). We then analyze counterfactuals involving the US adopting a destination based VAT, and China and Germany adopting an origin based VAT, and assess the impacts on imbalances. For a combined three country tax change, imbalances fall significantly, by between 7.3% and 15.9% under different US VAT rates in our central case analysis. We then consider cases where these 3 countries change tax structures separately, and

with different key parameter specifications (elasticity and the size of the upper bound in the inside money formulation). Impacts on imbalances are again significant.

The implication of our analysis are that mechanisms beyond exchange rates can be used to achieve either global or country rebalancing, and one such potential mechanism is lies in the indirect tax area.

2. VATs, VAT Bases and Trade, and Rebalancing

The "value added" embodied in a product is reflected in the difference between the sale price charged to a customer, and the cost of materials and other taxable inputs. A manufacturer remits to the government the tax rate multiplied by the difference between these two amounts, but retains taxes they had previously paid on inputs. A VAT is like a sales tax in that ultimately only the end consumer is taxed, but differs from a sales tax in that, with the latter, the tax is collected and remitted to the government only once, at the point of purchase by the end consumer. With the VAT, remittances to the government, net of credits for taxes already paid are made every time a business in the supply chain sells its products; a multistage rather than a single stage tax.

A VAT system typically uses one of two bases in its treatment of international trade; the destination principle and the origin principle. The destination principle implies that taxes are levied where the products are consumed for both final consumers and producers. Exports are exempt with refund of input taxes (that is, free of VAT) and imports are taxed on the same basis and with the same rates as locally produced goods. This implies that the tax paid is determined by the tax laws in the country of consumption and revenues accrue to the same country. The origin principle implies that goods are taxed where produced, regardless of where they are consumed. This means that exporting countries tax exports on the same basis and at the same rate as domestic supplies, while importing countries apply no VAT on imports.

In summary, under a destination principle imports are taxed while exports are not

taxed. Under the origin principle, exports are taxed while imports are not. In the case of balanced trade, moving between these tax bases has no effect on trade flows since it can be finally accommodated by exchange rate or wage rate changes. In the case where, however, the trade balance is non zero and where trade is unbalanced the destination principle can promote exports more than imports. The result is a larger trade surplus or smaller trade deficit than would occur under an origin basis.

From the view of rebalancing, if a country has a trade surplus, an origin principle in that country for the VAT will help to reduce its surplus and increase revenues; and a destination principle VAT decease deficit and increase revenues if the country has a trade deficit.
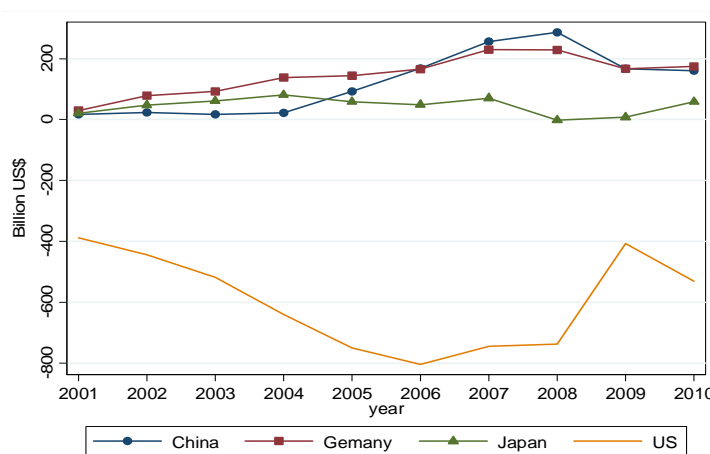
Fig. 1 Trade Imbalance of Some Main Countries within 2001-2010

Source: WTO Statistics Database.

Figure 1 provides data on trade imbalance countries' in terms of the surplus or deficit of major global trading countries from 2001 to 2010. The US is main trade deficit country; China, Germany and Japan are the main trade surplus countries in the world. Global trade imbalances worsened rapidly after 2001. The financial crisis in 2008/2009 relaxed the imbalance situation, but it worsened again in 2010. The

Japanese trade surplus decreased in the last decade and now its imbalance is not severe.

After the financial crisis in 2008, global economic recovery and rebalancing became an important topic of debate. Most debate focused on exchange rate adjustments to rebalance global trade. We develop the idea that exchange rate adjustment is not the only path to realizing rebalancing. VAT regime switching can also have impacts on rebalancing. China and Germany currently use a destination principle VAT, and the US has no VAT. Thus if China and Germany were to switch their VAT regime from a destination principle to an origin principle, and the US adopted a VAT (which they currently do not have) with an origin principle VAT, the total imbalance can be reduced with increased revenues for each country (or reduced tax rates) which also may increase each country's welfare.

3. Endogenous Trade Imbalance Model Description

We use a four country general equilibrium model with international trade in goods to which monetary structure using inside money is added following Whalley *et al* (2011). This allows for the endogenous determination of trade imbalances for trade in goods, which is offset through inter-temporal trade across countries in money. The monetary structure builds on Azariadis (1993) where there is extensive discussion of simple overlapping generation models with inside money. In analyzing trade interactions between monetary structure and commodity trade are needed, and hence models with simultaneous inter-temporal and inter-commodity structure.

In our general equilibrium model with monetary structure, we assume there are two goods in each period and allow inter-commodity trade to co-exist within the period along with trade in debt in the form of inside money. We use a single period model where either claims on future consumption (money holding) or future consumption liabilities (money insuance) enter the utility function as incremental future consumption from current period savings. This is the formulation of inside money used by Patinkin (1947, 1971) and Archibald and Lipsey (1960). This can also be used in a multi-country model structure with trade in both goods and inside money.

The general equilibrium model has four countries, and each country produces two goods with two factors. These four countries are China, US, Germany and the rest of the world (ROW), all trade imbalance countries in the global economy. The two goods are tradable goods and non-tradable goods. The two factors are labor and capital.

On the consumption side, we use the Armington assumption of product

heterogeneity across countries, and assume claims on future consumption enter preferences and are traded between countries. Each country can thus either issue or buy claims on future consumption using current period income. We use a nested CES utility function to capture consumption

$$U_i(X_i^T, X_i^{NT}, Y_i) = [\alpha_{i1}^{\frac{1}{\sigma_i}}(X_i^T)^{\frac{\sigma_i-1}{\sigma_i}} + \alpha_{i2}^{\frac{1}{\sigma_i}}(X_i^{NT})^{\frac{\sigma_i-1}{\sigma_i}} + \alpha_{i3}^{\frac{1}{\sigma_i}}(Y_i)^{\frac{\sigma_i-1}{\sigma_i}}]^{\frac{\sigma_i}{\sigma_i-1}}, \quad i = country \quad (1)$$

Where X_i^{NT} denotes the consumption of non-tradable goods in country i, X_i^T denotes the consumption of Armington composite tradable goods in country i, Y_i denotes the inside money for country i. Additionally α_{i1}, α_{i2} and α_{i3} are share parameters and σ_i is the elasticity of consumption substitution.

We summarize the nesting structure used in consumption and production in Figure 2. The composite of tradable goods define another nesting level reflecting the country from which goods come. We assume this level 2 composite consumption is of CES form and defined as,

$$X_i^T = [\sum_j \beta_{ij}^{\frac{1}{\sigma_i'}} x_{ij}^{T^{\frac{\sigma_i'-1}{\sigma_i'}}}]^{\frac{\sigma_i'}{\sigma_i'-1}}, \quad j = country \quad (2)$$

Where x_{ij}^T is the consumption of tradable goods from country j in country i. If $i = j$ this country consumes its domestic produced tradable goods. β_{ij} is the share parameter for country $j's$ tradable goods consumed in country i. σ_i' is the elasticity of substitution in level 2 in country i.

For a representative consumer in country i their income is I_i, and maximizing utility subject to budget constraint yields

$$X_i^T = \frac{\alpha_{i1} I_i}{(P_i^T)^\sigma [\alpha_{i1}(P_i^T)^{1-\sigma} + \alpha_{i2}(pc_i^{NT})^{1-\sigma} + \alpha_{i3}(pc_i^Y)^{1-\sigma}]}$$

$$X_i^{NT} = \frac{\alpha_{i2} I_i}{(pc_i^{NT})^\sigma [\alpha_{i1}(P_i^T)^{1-\sigma} + \alpha_{i2}(pc_i^{NT})^{1-\sigma} + \alpha_{i3}(pc_i^Y)^{1-\sigma}]} \qquad (3)$$

$$Y_i = \frac{\alpha_{i3} I_i}{(pc_i^Y)^\sigma [\alpha_{i1}(P_i^T)^{1-\sigma} + \alpha_{i2}(pc_i^{NT})^{1-\sigma} + \alpha_{i3}(pc_i^Y)^{1-\sigma}]}$$

Where P_i^T, pc_i^{NT} and pc_i^Y are separately consumption prices of composite tradable goods, non-tradable goods and inside money in country i. For the composite tradable goods, they enter the second level and come from different countries, and the country specific demands are

$$x_{ij}^T = \frac{\beta_{ij}(X_i^T P_i^T)}{(pc_{ij}^T)^{\sigma_i'} [\sum_j \beta_{ij}(pc_{ij}^T)^{(1-\sigma_i')}]} \qquad (4)$$

where pc_{ij}^T is the consumption price of tradable goods in country i from country j (produced in country j), $X_i^T P_i^T$ is the total expenditure on tradable goods in country i. The consumption price for the composite of tradable goods is

$$P_i^T = [\sum_{j=1}^4 \beta_{ij}(pc_{ij}^T)^{(1-\sigma_i')}]^{\frac{1}{1-\sigma_i'}} \qquad (5)$$

On the production side, we also assume CES technology for production of each good in each country (Figure 2)

$$Q_i^l = \phi_i^l [\delta_i^l (L_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}} + (1-\delta_i^l)(K_i^l)^{\frac{\sigma_i^l - 1}{\sigma_i^l}}]^{\frac{\sigma_i^l}{\sigma_i^l - 1}}, \qquad i = country, l = industry \qquad (6)$$

where Q_i^l is the output of the *lth* industry (including tradable goods and non-tradable goods) in country i, L_i^l and K_i^l are the labor and capital inputs, ϕ_i^l is the scale parameter, δ_i^l is the distribution parameter and σ_i^l is the elasticity of factor substitution. First order conditions for cost minimization imply the factor input demand equations,

$$K_i^l = \frac{Q_i^l}{\phi_i^l}[\delta_i^l[\frac{(1-\delta_i^l)w_i^L}{\delta_i^l w_i^K}]^{(1-\sigma_i^l)} + (1-\delta_i^l)]^{\frac{\sigma_i^l}{1-\sigma_i^l}} \tag{7}$$

$$L_i^l = \frac{Q_i^l}{\phi_i^l}[\delta_i^l + (1-\delta_i^l)[\frac{\delta_i^l w_i^K}{(1-\delta_i^l)w_i^L}]^{(1-\sigma_i^l)}]^{\frac{\sigma_i^l}{1-\sigma_i^l}} \tag{8}$$

Where w_i^K and w_i^L are the prices of capital and labor in country i.

Fig. 2 Nesting Structure of Production and Consumption Functions Used in The Model
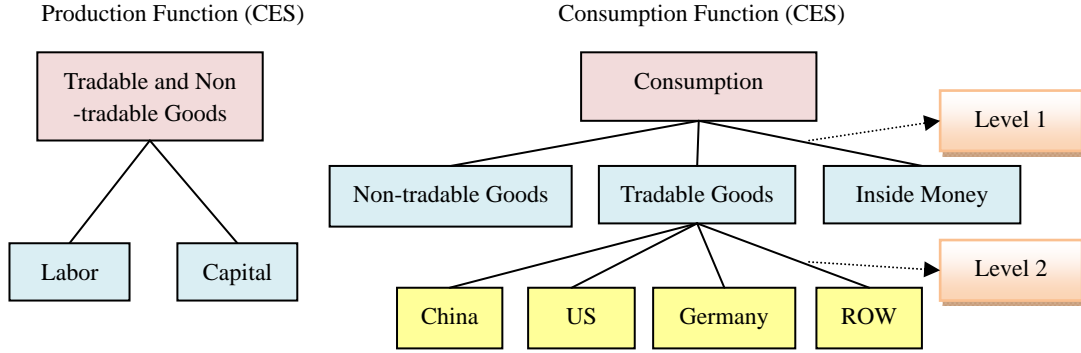
If these countries in our model adopt a VAT, each country will receive revenues denoted as R_i. We assume country $i's$ capital and labor endowment are $\overline{K}_i$ and $\overline{L}_i$. The total income of country i is thus given by

$$w_i^K \overline{K}_i + w_i^L \overline{L}_i + R_i = I_i \tag{9}$$

Budget constraints apply for each country i as

$$P_i^T X_i^T + pc_i^{NT} X_i^{NT} + pc_i^Y Y_i = I_i \tag{10}$$

Here, inside money Y_i also represents country $i's$ trade imbalance. $Y_i > 0$ implies a trade surplus (or claims on future consumption); $Y_i < 0$ implies a trade deficit or future consumption liabilities (money issuance), and $Y_i = 0$ implies trade balance.

For trade deficit countries, utility will decrease in inside money since they are issuers. In order to capture this, we use an upper bound Y^0 in the utility function in a term $[Y^0 + Y_i]$ following Whalley *et al* (2011) and assume that Y^0 is large enough to ensure that $Y^0 + Y_i > 0$. We use the transformation $y_i = Y^0 + Y_i$ to solve the

optimization problem, and the utility function and budget constraint become

$$MaxU_i(X_i^T, X_i^{NT}, Y_i) = [\alpha_{i1}^{\frac{1}{\sigma_i}}(X_i^T)^{\frac{\sigma_i-1}{\sigma_i}} + \alpha_{i2}^{\frac{1}{\sigma_i}}(X_i^{NT})^{\frac{\sigma_i-1}{\sigma_i}} + \alpha_{i3}^{\frac{1}{\sigma_i}}(y_i)^{\frac{\sigma_i-1}{\sigma_i}}]^{\frac{\sigma_i}{\sigma_i-1}} \tag{11}$$
$$s.t. \ P_i^T X_i^T + pc_i^{NT} X_i^{NT} + pc_i^Y y_i = I_i + pc_i^Y Y^0 \equiv I_i^*$$

The solutions to (11) are as in (3), but changing Y_i to y_i. For global trade (or money)

clearance, we have

$$\sum_i Y_i = 0 \tag{12}$$

Equilibrium in the model in then given by market clearing prices for goods and

factors in each country such that

$$\begin{cases} Q_i^T = \sum_j x_{ji}^T \\ Q_i^{NT} = X_i^{NT} \end{cases} \tag{13}$$

$$\begin{cases} \sum_l K_i^l = \overline{K}_i \\ \sum_l L_i^l = \overline{L}_i \end{cases} \tag{14}$$

Where Q_i^T and Q_i^{NT} are separately output of tradable goods and non-tradable goods

in country i. The zero profit condition must be satisfied in each industry in each

country, such that

$$p_i^l Q_i^l = w_i^K K_i^l + w_i^L L_i^l \qquad l = T, NT \tag{15}$$

Where p_i^l is the producer price of goods l in country i. In this structure we can

then introduce VAT. We use t_i to denote the VAT rate in country i. A destination

basis VAT implies that

$$pc_{ij}^{T} = (1+t_i)p_j^{T}, \quad i \neq j \quad imports \ taxed$$

$$pc_{ji}^{T} = p_i^{T}, \quad i \neq j \quad exports \ not \ taxed$$

$$pc_{ji}^{T} = (1+t_i)p_i^{T}, \quad i = j \quad domestic \ goods \ taxed \qquad (16)$$

$$pc_i^{NT} = (1+t_i)p_i^{NT} \quad domestic \ goods \ taxed$$

$$pc_i^{y} = pc^{y} \quad inside \ money \ not \ taxed$$

If the VAT regime is on an origin basis,

$$pc_{ij}^{T} = p_j^{T}, \quad i \neq j \quad imports \ not \ taxed$$

$$pc_{ji}^{T} = (1+t_i)p_i^{T}, \quad i \neq j \quad exports \ taxed$$

$$pc_{ji}^{T} = (1+t_i)p_i^{T}, \quad i = j \quad domestic \ goods \ taxed \qquad (17)$$

$$pc_i^{NT} = (1+t_i)p_i^{NT} \quad domestic \ goods \ taxed$$

$$pc_i^{y} = pc^{y} \quad inside \ money \ not \ taxed$$

Using this general equilibrium model with inside money, deficits and surpluses in goods trade are endogenously determined. We can then calibrate this structure to a base case equilibrium data set and simulate counter factual cases where China and Germany switch their present destination principle VAT regime to an origin principle regime and the US adopt a destination basis VAT.

4. Data and Parameters Calibration

We use 2010 as our base year in building a benchmark general equilibrium dataset for use in calibration and counterfactual simulation (Shoven and Whalley, 1992). There are four countries China, US, Germany and ROW in our model, and ROW data is obtained by using total world value minus values for China, US and Germany. For the two tradable goods and non-tradable goods, we assume secondary industry (manufacturing) reflects tradable goods, and primary and tertiary industry (agriculture, extractive industries, and services) yield non-tradable goods. For the two factor inputs, capital and labor, we use total labor income (wages) to denote labor values for inputs by sector, but not labor amount. All data are in billions of US dollars. We adjust some of the data values for mutual consistency for calibration purposes.

The data we use in model calibration as the base case equilibrium are displayed in Tables 1 and 2. Chinese data are from China data online. We use production and capital values to determine labor values by residual for China. US data are from the Statistics Database of Bureau of Economic Analysis (BEA), capital and labor are from the input-output table. German data are from OECD statistics and the database of Germany Federal Statistical Office (www.destatis.de). Total World data are from the World Economic Outlook (WEO) database of IMF, and World Development Indicators (WDI) of World Bank. From the total world data we can calculate ROW data as a residual.

Trade data between each country are from the UN interactive graphic system of international economic trends (SIGCI Plus) database (Table 2). We use total export

and import values for China, US and Germany to calculate these countries' exports and imports with the ROW. From production and trade data, we can then determine each country's consumption value. The VAT rates are from Wikipedia (http://en.wikipedia.org) information data. Inside Money is given by each country's trade imbalance and calculated from trade data in Table 2. Endowment data are calculated from factor input data.

Table 1 Base Year Data Used for Calibration and Simulation (2010 Data)

Item / Country		China	US	Germany	ROW
Production	Total	5931.2	14526.5	3071.3	38434
	Tradable Goods	2768.1	4832.5	1400.2	7171.5
	Non-tradable Goods	3163.1	9694	1671.1	31262.5
Capital	Tradable Goods	2281.5	4158.3	989.8	2611.6
	Non-tradable Goods	1827	3950.7	407.3	11384.6
Labor	Tradable Goods	486.6	674.2	410.4	4559.9
	Non-tradable Goods	1336.1	5743.3	1263.8	19877.9
Inside Money	Y_i	181.8	-689.4	204.3	303.3
	Y^0	1000	1000	1000	1000
	y_i	1181.8	310.6	1204.3	1303.3
Endowment	Capital	4108.5	8109	1397.1	13996.2
	Labor	1822.7	6417.5	1674.2	24437.8
VAT Rate		17%	0%	19%	0%

Notes: (1) Units for production, capital, labor, inside money and endowment are all billion US$, and labor here denotes factor income (wage). (2) We use world values minus China, US and Germany to generate ROW values. (3) Factor demand data reflect all factor and production prices being assumed to equal 1 in the base case equilibrium.

Source: Chinese data from China data online; US data from the statistics database of Bureau of Economic Analysis (BEA); German data from OECD Statistics and database of German Federal Statistical Office; The World data from the World Economic Outlook database of IMF, and World Development Indicators (WDI) of the World Bank. The VAT rate data from Wikipedia (The free encyclopedia).

Table 2 Trade between Countries in 2010 (Unit: billion US$)

Trade / Country		Importer			
		China	US	Germany	ROW
Exporter	China	/	283.8	68	1226
	US	102.7	/	48	1126.4
	Germany	74.3	84.4	/	1112.4
	ROW	1219	1598.3	950.8	/

Note: We use each country's total export and import value minus values between other countries to yield trade with the ROW. We assume production and factor prices equal 1.

Source: UN interactive graphic system of international economic trends (SIGCI Plus), http://www.eclac.org/comercio/ecdata2/index.html.

We choose the upper bound Y^0 value to equal 1000 in all countries. We change this value in later sensitivity analysis to check its influence on counterfactual simulation results. There are no available estimates of elasticities for each country on the demand and production side for the elasticities in our CES production and consumption functions. Many of the estimates of domestic and import good substitution elasticity are around 2 (Betina *et al*, 2006), so we set all of these elasticities in our model to 2 (Whalley and Wang, 2010). We change these elasticities later to check their sensitivity influence on simulation results.

Table 3 reports the model parameters generated by calibration. When used in model solution these will regenerate the benchmark data as an equilibrium for the model. Then, using these parameters we simulate the effects of Chinese and German VAT regime changes from the destination principle to an origin principle and US adopting an origin principle VAT system.

Table 3: Parameters Generated by Calibration

Variable/Country		China		US		Germany		ROW	
		T.	N-T.	T.	N-T.	T.	N-T.	T.	N-T.
Share Parameters in Production	K	0.684	0.539	0.713	0.453	0.608	0.362	0.431	0.431
	L	0.316	0.461	0.287	0.547	0.392	0.638	0.569	0.569
Scale Parameters in Production		1.761	1.988	1.693	1.983	1.910	1.859	1.962	1.962
		Consumption Side							
		China		US		Germany		ROW	
Consumption Share Parameters of Level 2	China	0.460		0.051		0.057		0.179	
	US	0.040		0.645		0.040		0.164	
	Germany	0.029		0.015		0.108		0.161	
	ROW	0.471		0.289		0.795		0.496	
Consumption Share Parameters of Level 1	Composite T.	0.391		0.356		0.321		0.174	
	N-T.	0.478		0.624		0.450		0.793	
	Inside Money	0.131		0.020		0.229		0.033	

Note: T denotes tradable goods; N-T denotes non-tradable goods.

Source: Calculated using the model structure above and calibration method cited above by the authors.

5. Simulation Results

We next perform counter factual simulations and report their results. Following the discussion above, we explore the effects of Chinese and German VAT regime switching from the present destination principle to an origin principle, and of US adopting a destination principle VAT. We assess VAT switching effects on imbalances, production, welfare and revenue both from the whole world and individual countries.

We generate results for four different scenarios. The first is where China, US and Germany make changes simultaneously, that is China and Germany switch to an origin principle VAT and US adopt a destination principle VAT. The second is US separately adopting a destination principle VAT. The third is China's single switch to an origin principle VAT. The last is Germany's single switching to an origin principle VAT. China and Germany currently have a destination principle VAT and we assume they use an equal tax rate switching method, which means they keep their present VAT rates; just switching the VAT basis. This raises revenues. The switch could be analyzed on an equal yield basis which lowers rates. In US, there is no VAT system used at present, and we alternatively assume its VAT rate is set at 5%, 10%, 15% and 20% in four separate cases. Since imbalances (total export minus total import) can be negative in some countries, we add all four countries' absolute value of imbalances; to yield the total world imbalance.

5.1 Simultaneous VAT Changes in All Three Countries

We first consider the case where China and Germany switch their destination principle VAT to an origin basis and the US adopts a destination principle VAT. We

compare outcomes to the base case equilibrium to get results. We assume the US VAT

rate is 5%, 10%, 15% and 20% alternatively. Table 4 and Figure 3 report the results.

Table 4: Effects of Three Countries Simultaneously Modifying Their VAT Arrangements

| Items / Countries		China	US	Germany	ROW	TOTAL[1]
US VAT=5%	△Imbalance (%)	-6.603	-7.251	-95.708	51.945	-7.251
	△Production (%)	-0.00108	-0.00001	-0.11161	0	-0.00564
	△Welfare (%)	2.674	-0.763	2.064	-0.082	0.178
	△Revenue (%)	3.462	761.351[2]	1.400	/	52.743
US VAT=10%	△Imbalance (%)	-7.095	-11.087	-100.614	46.825	-10.905
	△Production (%)	-0.00123	0	-0.12516	0	-0.00632
	△Welfare (%)	2.816	-0.855	2.145	-0.082	0.176
	△Revenue (%)	3.484	1514.143[2]	1.153	/	102.125
US VAT=15%	△Imbalance (%)	-7.595	-15.088	-106.011	41.666	-13.307
	△Production (%)	-0.00142	-0.00001	-0.14219	0	-0.00719
	△Welfare (%)	2.961	-0.882	2.226	-0.082	0.190
	△Revenue (%)	3.507	2260.458[2]	0.883	/	151.074
US VAT=20%	△Imbalance (%)	-8.133	-19.187	-111.145	36.129	-15.885
	△Production (%)	-0.00162	-0.00002	-0.15879	0	-0.00803
	△Welfare (%)	3.116	-0.839	2.326	-0.089	0.218
	△Revenue (%)	3.532	3001.872[2]	0.636	/	199.711

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance; (2) The US △Revenue here is the absolute value, not variation percentage (The reason is the US VAT revenue in base case is zero and we cannot calculate variation percentage).

Source: Calculated by authors.

On the imbalance side, we find that China, US, Germany and the total for the

world show a decrease; only the ROW has an increase. These results thus suggest that

simultaneous VAT changes can reduce both all individual countries' and the global

trade imbalance, and hence contribute to global rebalancing. Compared with the base

case data, total world imbalances separately decrease by 7.3%, 10.9%, 13.3% and

15.9% when the US VAT rate used is 5%, 10%, 15% and 20%. For China, its

imbalance decreases are larger the higher the US VAT rate, with changes of between

-6.6% and -8.1%. For the US, its imbalance changes increase as its VAT rate increases,

with changes of between -7.3% and -19.2%. For Germany, its imbalance reduces

substantially after the changes, decreasing from between 95.7% to 111.1% and

moving into a deficit. The reason for this is that Germany is a highly trade dependent country (Figure 4) and its existing VAT rate is high (19%). Its degree of dependence on trade is 76.1% in 2010 in our base case data, much higher than China (50.1%), US (22.3%) and the ROW(18.8%). For the ROW, imbalances will be improved after switching because of trade diversion effects.

Fig. 3 Imbalance Comparisons Before and After Simultaneous VAT Changes (Variations across Assumed US VAT Rate)
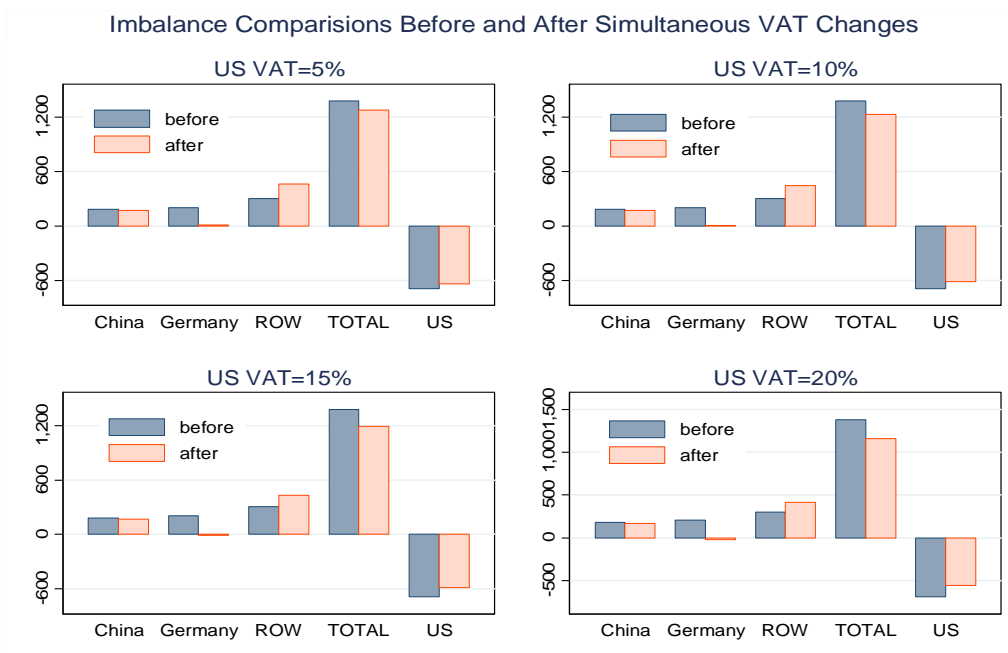
Notes: The unit is billions US$; Total imbalance equals the sum of each country's absolute value of imbalances.
Source: By authors.

Fig. 4 The Degree of Dependence On Trade For Individual Country (2010 Data)
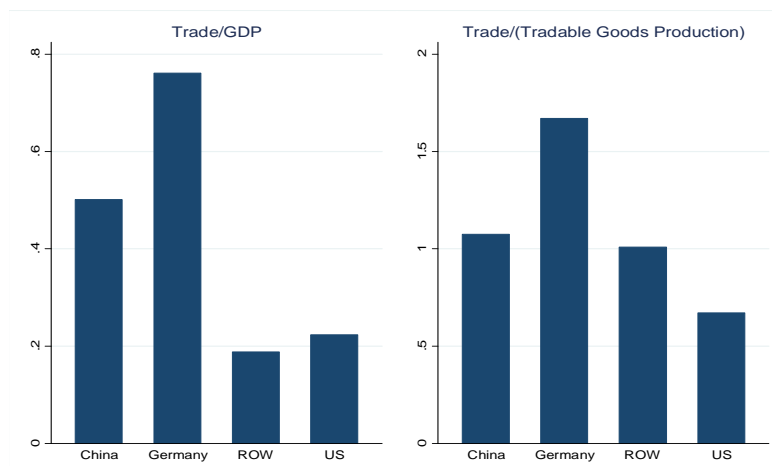
Source: Calculated with the data in Table 1 and Table 2.

On the production side, changes for the world total and most individual countries are negative, because the VAT regime change increases trade prices and hurts trade between these countries and reduces their total production. The reduction is, however, small. On the welfare side, China and Germany benefit from these changes. Their welfare increases by 2%-3%; US welfare falls by about -0.76% and -0.83% when US VAT rates are 5% and 20%, because of reduced consumption. Total world welfare improves by between 0.176% and 0.218% after these changes. On the revenue side, all countries gain, and especially so the US. If US uses a 5% destination principle VAT, its revenue will increase 761.4 billion US$; a 10% destination principle VAT will collect 1514.1 billion US$ and a 20% destination principle VAT will collect 3001.9 billion US$. These revenues could offset the present US government deficit.

We have also performed sensitivity analysis for the above simulation results. We change elasticities in production and consumption to separately equal 0.6, 1.6 and 2.6, and change the upper bound for Y^0 to 2000, 3000 and 4000. We then recalibrate parameters and simulate simultaneously VAT change effects. Here we check the sensitivity for cases where the US VAT rate equals 15%. These results are reported in Table 5. We find that results do not change much compared with base model simulation results. Most changes are increasing in elasticities, and increase as the upper bound inside money value increase.

In general, if China and Germany switch their VAT system from the present destination principle to an origin principle and the US adopts a destination principle VAT, the combined effect is to reduce imbalances for the whole world and also for all

these three individual countries so that it is good for global rebalancing. These changes also improve China's and Germany's welfare and increases all three countries' revenue.

Table 5: Sensitivity Analysis for Simultaneously Switching Results (US VAT=15%)

Items / Countries		China	US	Germany	ROW	TOTAL[1]
σ =0.6	△Imbalance (%)	5.223	-2.810	-23.481	6.297	-2.810
	△Production (%)	-0.00238	-0.00063	-0.11972	0	-0.00631
	△Welfare (%)	3.372	-0.846	3.521	-0.113	0.303
	△Revenue (%)	2.391	2247.140[2]	-0.141	/	149.116
σ =1.6	△Imbalance (%)	-3.896	-11.426	-83.195	32.403	-11.426
	△Production (%)	-0.00047	-0.00008	-0.11992	0	-0.00601
	△Welfare (%)	2.972	-0.904	2.312	-0.092	0.185
	△Revenue (%)	3.382	2261.877[2]	0.764	/	151.045
σ =2.6	△Imbalance (%)	-13.971	-19.609	-129.505	51.035	-10.866
	△Production (%)	-0.00357	-0.00012	-0.12229	0	-0.00643
	△Welfare (%)	3.047	-0.754	2.308	-0.130	0.206
	△Revenue (%)	3.654	2254.763[2]	1.500	/	151.015
Y^0 =2000	△Imbalance (%)	-17.036	-34.815	-148.380	31.023	-20.478
	△Production (%)	-0.00207	-0.00021	-0.15879	0	-0.00812
	△Welfare (%)	17.932	5.972	28.174	2.320	6.404
	△Revenue (%)	3.582	2212.936[2]	1.698	/	148.292
Y^0 =3000	△Imbalance (%)	-24.791	-43.880	-168.289	28.480	-23.643
	△Production (%)	-0.00206	-0.00032	-0.15879	0	-0.00814
	△Welfare (%)	32.456	12.508	53.391	4.811	12.505
	△Revenue (%)	3.581	2193.693[2]	2.312	/	147.247
Y^0 =4000	△Imbalance (%)	-31.544	-49.704	-180.550	27.546	-25.834
	△Production (%)	-0.00194	-0.00029	-0.15879	0	-0.00812
	△Welfare (%)	46.905	18.974	78.372	7.325	18.580
	△Revenue (%)	3.568	2182.153[2]	2.704	/	146.621

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance; (2) The US △Revenue here is the absolute value, not variation percentage (The reason is the US VAT revenue in base case is zero and we cannot calculate variation percentage).

Source: Calculated by authors.

5.2 US Single Switching to Take A Destination Principle VAT

We also simulate the effects of a US single adoption of a destination principle VAT. We again examine cases where the US VAT rate separately equals 5%, 10%, 15% and 20%. Results are presented in Table 6 and Figure 5.

These results show that the world total and all individual country's imbalance

will decrease. If US VAT rate equals 10%, the whole world total imbalance will decrease 7.47%, and China, US, Germany and the ROW will separately reduce their imbalance by 0.87%, 7.47%, 11.22% and 8.91%. Hence, if US adopts a destination principle VAT, it can not only reduce its own trade imbalance, but also benefit global rebalancing.

US production shows no change but its welfare and revenue will increase. China's welfare and revenue both increase and production shows nearly no change. Germany's welfare and revenue will increase, but its production decreases a little. World welfare and revenue increase and production declines.

Table 6: Effects of US Adopting A Destination Principle VAT

Items / Countries		China	US	Germany	ROW	TOTAL[1]
VAT=5%	△Imbalance (%)	-0.428	-3.649	-5.347	-4.436	-3.649
	△Production (%)	0	0	-0.00029	0	-0.00001
	△Welfare (%)	0.122	0.002	0.081	-0.003	0.015
	△Revenue (%)	0.023	757.386[2]	0.205	/	49.846
VAT=10%	△Imbalance (%)	-0.865	-7.471	-11.215	-8.908	-7.471
	△Production (%)	-0.00002	0	-0.00147	0	-0.00007
	△Welfare (%)	0.246	0.059	0.162	-0.006	0.046
	△Revenue (%)	0.046	1509.272[2]	0.438	/	99.341
VAT=15%	△Imbalance (%)	-1.313	-11.466	-17.571	-13.439	-11.466
	△Production (%)	-0.00005	0	-0.00381	0	-0.00019
	△Welfare (%)	0.374	0.174	0.245	-0.010	0.089
	△Revenue (%)	0.069	2257.324[2]	0.702	/	148.596
VAT=20%	△Imbalance (%)	-1.773	-15.633	-24.379	-18.049	-15.633
	△Production (%)	-0.00008	-0.00001	-0.00785	0	-0.00040
	△Welfare (%)	0.506	0.336	0.335	-0.015	0.144
	△Revenue (%)	0.094	3002.862[2]	0.999	/	197.698

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance; (2) The US △Revenue here is the absolute value, not variation percentage (The reason is the US VAT revenue in base case is zero and we cannot calculate variation percentage).

Source: Calculated by authors.

We can again change elasticity values and the upper bound on inside money Y^0 and do sensitivity analysis. We choose elasticities to equal 0.6, 1.6 and 2.6, and the upper bound for inside money to equal 2000, 3000 and 4000 to separately check

simulation results. Table 7 gives these results. These results do not change much compared with base model simulation results.

Fig. 5 Imbalance Comparison Before and After US Adopting A Destination Principle VAT (Unit: Billion US$)
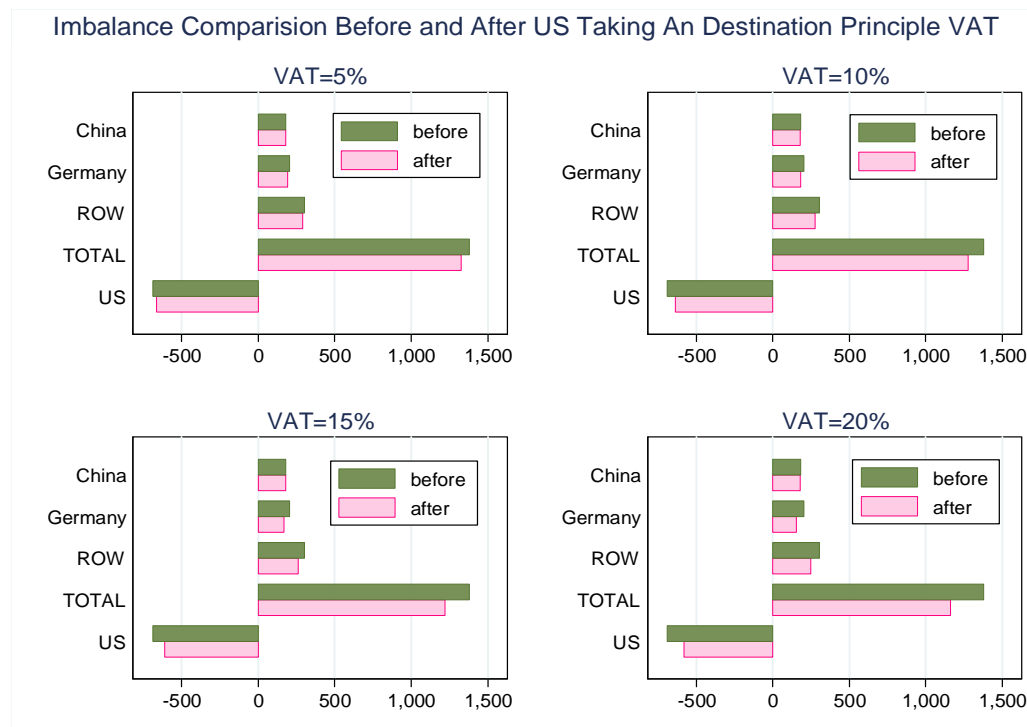
Notes: Total imbalance equals the sum of each country's absolute value of imbalances.

Source: By authors.

Table 7: Sensitivity Analysis for US VAT Adoption Results (VAT=10%)

Items / Countries		China	US	Germany	ROW	TOTAL[1]
σ =0.6	△Imbalance (%)	0.335	-2.364	-4.158	-2.774	-2.364
	△Production (%)	-0.00002	0	-0.00081	0	-0.00004
	△Welfare (%)	0.449	0.108	0.447	-0.013	0.092
	△Revenue (%)	-0.034	1516.131[2]	-0.163	/	99.526
σ =1.6	△Imbalance (%)	-0.516	-5.940	-8.973	-7.149	-5.940
	△Production (%)	0	0	-0.00120	0	-0.00006
	△Welfare (%)	0.303	0.066	0.253	-0.007	0.058
	△Revenue (%)	0.030	1510.606[2]	0.275		99.361
σ =2.6	△Imbalance (%)	-1.406	-9.837	-14.681	-11.628	-9.837
	△Production (%)	-0.00003	0	-0.00182	0	-0.00009
	△Welfare (%)	0.167	0.050	0.031	-0.005	0.028
	△Revenue (%)	0.067	1507.340[2]	0.686	/	99.317
Y^0 =2000	△Imbalance (%)	-2.741	-20.352	-25.346	-27.544	-20.352
	△Production (%)	-0.00005	-0.00003	-0.00576	0	-0.00030
	△Welfare (%)	14.733	6.480	24.900	2.545	6.122
	△Revenue (%)	0.118	1490.457[2]	1.381	/	98.489

$Y^0 =3000$	△Imbalance (%)	-3.975	-27.674	-29.860	-40.407	-27.674
	△Production (%)	-0.00005	-0.00012	-0.00716	0	-0.00039
	△Welfare (%)	29.078	12.855	49.526	5.102	12.169
	△Revenue (%)	0.157	1480.999[2]	1.790	/	98.039
$Y^0 =4000$	△Imbalance (%)	-4.864	-32.751	-31.431	-50.357	-32.751
	△Production (%)	-0.00005	-0.00024	-0.00746	0	-0.00043
	△Welfare (%)	43.415	19.234	74.125	7.657	18.214
	△Revenue (%)	0.183	1474.797[2]	1.971	/	97.713

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance; (2) The US △Revenue here is the absolute value, not variation percentage (The reason is the US VAT revenue in base case is zero and we cannot calculate variation percentage).

Source: Calculated by authors.

These analyses reveal that the US adopting a destination principle VAT is good for global rebalancing. In the meanwhile, it can increase global total and individual countries' welfare and increase their revenues. These effects are especially significant for the US.

5.3 China Single Switching VAT from Destination to Origin Principle

We also report results for China alone switching its VAT system from a destination principle to an origin principle. We focus on the influence on imbalances, production, welfare and revenue. Table 8 and Figure 6 show these results.

As for effects on China, its imbalance decreases by 15.28%, welfare increases by 5.20%, revenue increases by 3.86% and total production decreases by about 0.005%. So China's VAT system switching benefits China not only on the trade balance but also in terms of welfare and revenue.

As for the influence on the US and Germany, both of their imbalances increases, production decreases and welfare increases. The increase in the US's imbalance is because of China's improved export price through VAT increases on import value, and US importing more from Germany with a higher price compared to China. This suggests that the large US trade imbalance is mainly caused by high US consumption.

Germany's increased imbalance is caused by trade diversion from China. Although China's switching deteriorates both the US and Germany imbalance it improves their welfare. For the world, the trade imbalance increases by 1.54%, total production decreases by 0.0084% and welfare increases by 0.013%.

Table 8: Effects of China's VAT Switching from Destination to Origin

Item / Countries	China	US	Germany	ROW	TOTAL[1]
△Imbalance (%)	-15.276	1.538	81.535	-42.270	1.538
△Production (%)	-0.00551	-0.00002	-0.15886	0	-0.00841
△Welfare (%)	5.202	0.156	3.072	-1.309	0.013
△Revenue (%)	3.863	/	-1.539	/	1.930

Note: (1) Total imbalance equals the sum of each country's absolute value of imbalance.

Source: Calculated by authors.
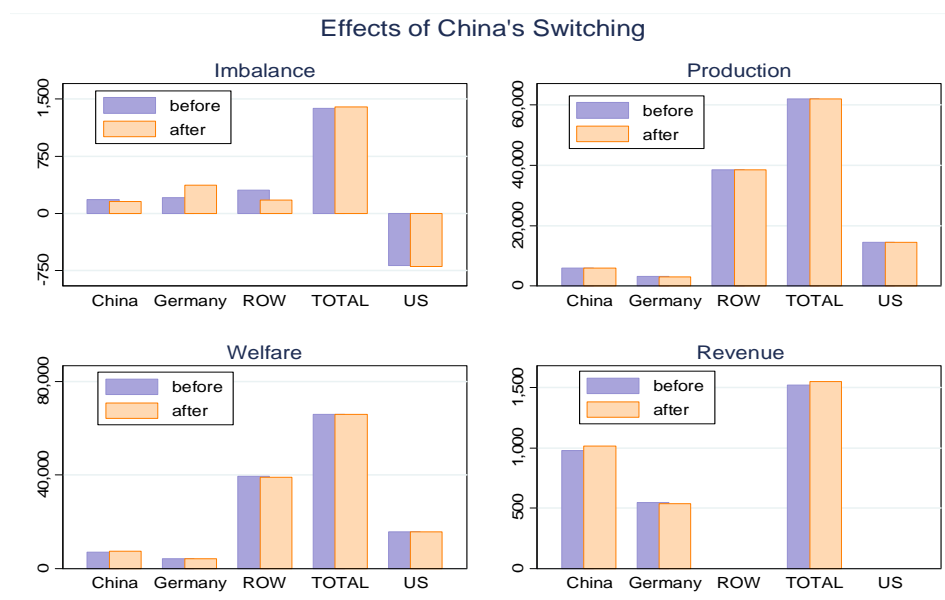
Fig. 6 Effects of China's VAT Switching to An Origin Principle

Notes: Total imbalance equals the summation of each country's absolute value of imbalances.

Source: By authors.

We perform sensitivity analysis on the above results by change elasticity values and upper bound inside money values. Table 9 gives the results. We find that as elasticities increase, China's imbalance will reduce more and more. The US imbalance changes from an increase to a decrease (when $\sigma = 2.6$, US imbalance will decrease 0.28%), the German imbalance changes from an increase to a decrease as well (when

σ =2.6, Germany imbalance will decrease 27.23%). As upper bound inside money increases, China imbalance further decreases (when Y^0 =4000, its imbalance decreases by 29.5%), US imbalance further increases and German imbalance changes to a decrease of about 25%-28%. The main results do not change but are sensitive to elasticities and the upper bound for inside money.

Table 9: Sensitivity Analysis for China VAT Switching Results

Items / Countries		China	US	Germany	ROW	TOTAL[1]
σ =0.6	△Imbalance (%)	8.370	1.538	41.247	-29.306	1.538
	△Production (%)	-0.00620	-0.00735	-0.00023	0	-0.00233
	△Welfare (%)	5.696	1.157	5.469	-1.597	0.250
	△Revenue (%)	1.937	/	1.146	/	1.654
σ =1.6	△Imbalance (%)	-8.350	1.538	68.241	-37.466	1.538
	△Production (%)	-0.00212	-0.00008	-0.11510	0	-0.00593
	△Welfare (%)	5.144	0.179	3.213	-1.362	-0.036
	△Revenue (%)	3.637		-0.971		1.988
σ =2.6	△Imbalance (%)	-17.004	-0.283	-27.232	27.892	-0.283
	△Production (%)	-0.00523	-0.00085	-0.04308	0	-0.00284
	△Welfare (%)	3.595	-0.337	-1.015	-0.087	0.183
	△Revenue (%)	3.763	/	1.237	/	2.859
Y^0 =2000	△Imbalance (%)	-16.999	1.829	-25.270	31.369	1.829
	△Production (%)	-0.00206	-0.00098	-0.02520	0	-0.00168
	△Welfare (%)	17.925	6.098	23.645	2.394	6.199
	△Revenue (%)	3.581	/	1.140	/	2.708
Y^0 =3000	△Imbalance (%)	-23.572	3.412	-27.015	40.082	3.412
	△Production (%)	-0.00187	-0.00116	-0.02403	0	-0.00164
	△Welfare (%)	32.303	12.569	48.244	4.904	12.243
	△Revenue (%)	3.561	/	1.363	/	2.774
Y^0 =4000	△Imbalance (%)	-29.497	4.503	-28.366	47.023	4.503
	△Production (%)	-0.00169	-0.00125	-0.02357	0	-0.00162
	△Welfare (%)	46.696	19.035	72.861	7.420	18.291
	△Revenue (%)	3.541	/	1.514	/	2.816

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance.

Source: Calculated by authors.

China's VAT system switching effects reveal that it is also a good measure for China. It is beneficial for China's rebalancing and welfare. This switching also improves total world welfare but hurts global rebalancing.

5.4 Germany's Single VAT Switch from Destination to Origin Principle

We also explore the effects of Germany's single switch of its VAT system from a destination principle to an origin principle. Table 10 and Figure 7 report the results.

Table 10: Effects of Germany's VAT Switching from Destination to Origin Principle

Item / Countries	China	US	Germany	ROW	TOTAL[1]
△Imbalance (%)	2.949	-2.906	-63.181	34.185	-2.906
△Production (%)	-0.00022	-0.00010	-0.00987	0	-0.00053
△Welfare (%)	-0.890	-0.242	3.387	0.021	0.070
△Revenue (%)	-0.373	/	3.788	/	1.116

Note: (1) Total imbalance equals the sum of each country's absolute value of imbalance.

Source: Calculated by authors.

Fig. 7 Effects of Germany's VAT Switching to An Origin Principle
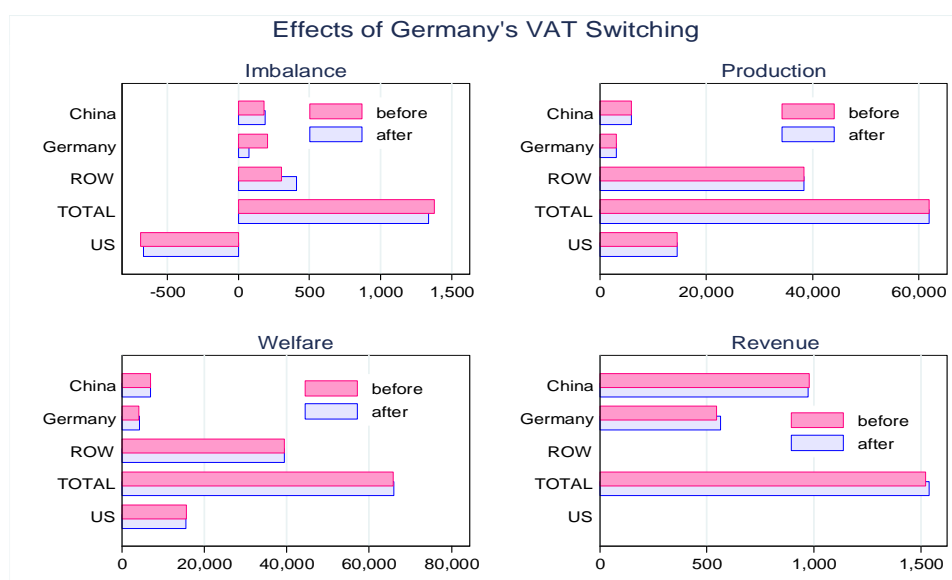
Notes: Total imbalance equals the summation of each country's absolute value of imbalances.

Source: By authors.

For Germany, their imbalance decreases by 63.18%, production decreases by 0.0098%, and welfare and revenue increase separately by 3.39% and 3.79%. So VAT system switching is a good measure for Germany, and not only good for rebalancing but also benefits welfare and revenue. For China, its imbalance increases by 2.95% caused by trade diversion effects. Production, welfare and revenue all change negatively. For the US, the imbalance decreases by 2.91%, production and welfare both slightly decrease. As for the total global changes, imbalances will decrease

2.91%, welfare increases 0.07% and revenue increases 1.12%.

Table 11: Sensitivity Analysis for Germany VAT Switching Results

Items / Countries		China	US	Germany	ROW	TOTAL[1]
σ =0.6	△Imbalance (%)	-0.567	1.195	-1.752	4.235	1.194
	△Production (%)	-0.00003	-0.00016	-0.08654	0	-0.00433
	△Welfare (%)	-0.135	-0.701	5.516	0.044	0.186
	△Revenue (%)	-0.191	/	2.901	/	0.915
σ =1.6	△Imbalance (%)	1.679	-2.021	-47.300	26.260	-2.021
	△Production (%)	-0.00008	-0.00008	-0.01364	0	-0.00070
	△Welfare (%)	-0.805	-0.263	3.588	0.015	0.083
	△Revenue (%)	-0.324		3.752		1.135
σ =2.6	△Imbalance (%)	4.825	-4.193	-86.501	45.844	-4.193
	△Production (%)	-0.00047	-0.00014	-0.00667	0	-0.00041
	△Welfare (%)	-0.988	-0.223	3.174	0.028	0.055
	△Revenue (%)	-0.434	/	3.799	/	1.081
Y^0 =2000	△Imbalance (%)	4.098	-7.505	-99.297	47.371	-7.505
	△Production (%)	-0.00012	-0.00020	-0.03028	0	-0.00156
	△Welfare (%)	13.513	6.160	28.357	2.526	6.120
	△Revenue (%)	-0.395	/	3.709	/	1.074
Y^0 =3000	△Imbalance (%)	4.941	-9.122	-121.857	58.386	-2.645
	△Production (%)	-0.00008	-0.00021	-0.04669	0	-0.00237
	△Welfare (%)	27.879	12.587	53.262	5.039	12.172
	△Revenue (%)	-0.414	/	3.798	/	1.094
Y^0 =4000	△Imbalance (%)	5.562	-9.673	-137.718	67.446	1.505
	△Production (%)	-0.00007	-0.00020	-0.05988	0	-0.00302
	△Welfare (%)	42.253	19.026	78.111	7.557	18.228
	△Revenue (%)	-0.427	/	3.877	/	1.113

Notes: (1) Total imbalance equals the sum of each country's absolute value of imbalance.

Source: Calculated by authors.

We perform sensitivity analysis by changing elasticity values and the upper bound inside money value. Table 11 gives the results. As elasticities increase, all change results increase, but change directions (increase or decrease) do not change.

In conclusion, Germany VAT system switching is good for Germany's own rebalancing and also global rebalancing, and increases world total and Germany welfare.

6. Conclusions

We use a general equilibrium model with monetary structure incorporating inside money to yield an endogenously determined trade surplus, and numerically calibrate it to 2010 data in a 4 country single period global general equilibrium model covering the US, Germany, China, and the Rest of the World. We use it to capture the effects of VAT regime changes (and adoption in the US) on global imbalances; an important issue in current G20 discussions. We simulate four different scenarios to explore the contribution of these VAT changes to global and individual country rebalancing. These are: (1) China and Germany switching their present VAT system from a destination principle to an origin principle, and the US adopting a destination principle VAT; (2) the US individually adopting a destination principle VAT; (3) China individually switching to from a destination to an origin principle VAT; and (4) Germany individually switching to an origin principle VAT.

Our simulations results suggest that any individual country's VAT changes will significantly reduce world total and individual country's imbalances, improve individual country's welfare and increase revenues. The three countries' jointly making these VAT changes can significantly reduce global imbalances and improve world welfare and most individual country's welfare. In general, global imbalances will be reduced most if China and Germany can switch their VATs from their present destination principle to an origin principle and the US adopts a destination principle VAT. Additionally, each country's utility will be increased, and total revenue will increase which can help with government budget deficits.

Reducing global imbalances is one of main tasks in current G20 discussions. Most present discussions are of exchange rate changes, which will produce pressure on individual countries for exchange rate adjustments which may hurt growth and increase unemployment. Our analyses suggest that indirect tax initiatives such as VAT principle switching can be an effective alternative measure for achieving global rebalancing.

References

Archibald, G.C. and R.G. Lipsey. 1960. "Monetary and Value Theory: Further Comment". The Review of economic Studies, 28(1), pp.50-56.

Azariadis, C. 1993. Intertemporal Macroeconomics, Blackwell.

Betina, V.D., R.A. McDougall and T.W. Hertel. 2006. "GTAP Version 6 Documentation: Chapter 20 'Behavioral Parameters'" accessed at https://www.gtap.agecon.purdue.edu/resources/download/2906.pdf.

Genser, B. 1996. "A Generalized Equivalence Property of Mixed International VAT Regimes". The Scandinavian Journal of Economics, 98(2), pp.253-262.

Grossman, G.M. 1980. "Border Tax Adjustments: Do they distort trade?". Journal of International economics, 10, pp.117-128.

Krauss, M.B. and H.G. Johnson. 1974. "General equilibrium Analysis: A micro-economic text". Allen & Unwin (London) Publisher.

Li, C and J. Whalley. 2011. "Rebalancing and the Chinese VAT: Some Numerical Simulation results". NBER Working Paper w16686.

Patinkin, D. 1947. "Multiple-Plant Firms, Cartels, and Imperfect Competition". The Quarterly Journal of Economics, 61(2), pp.173-205.

Patinkin, D. 1971. "Inside Money, Monopoly Bank Profits, and the Real-Balance Effect: Comment". Journal of Money, Credit and Bank, 3, pp.271-275.

Shoven, J.B. and J. Whalley. 1972. "A General Equilibrium Calculation of the Effects of Differential Taxation of income from Capital in the US". Journal of Public Economics, 1, pp.281-321.

Shoven, J.B. and J. Whalley. 1992. "Applying General Equilibrium". Cambridge University Press.

Whalley, J. 1979. "Uniform Domestic Tax Rates, Trade Distortions and Economic Integration". Journal of Public Economics, 11(2), pp.213-221.

Whalley, J. 1985. "Trade Liberalization Among Major World Trading Areas". MIT Press, Cambridge, MA.

Whalley, J. and L. Wang. 2010. "The Impact of Renminbi Appreciation on Trade Flows and Reserve Accumulation in a Monetary Trade Model". Economic Modelling, 28, pp.614-621.

Whalley, J., J. Yu and S. Zhang. 2011. "Trade Retaliation in a Monetary-Trade Model". Global Economy Journal, 11(1), pp.1-28.