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# REBALANCING AND THE CHINESE VAT: SOME NUMERICAL SIMULATION RESULTS

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## ABSTRACT

This paper presents numerical simulation results that suggest that China can both reduce its trade imbalance and receive welfare benefits by switching the value added tax (VAT) regime from the current destination principle to an origin principle. With the tax on exports exceeding that no longer collected on imports, revenues rise and exports fall. VAT regime switching is thus a possibility for China to receive a double benefit, rebalancing trade with a welfare gain. This has implications for present G20 discussions on finding ways to adjust global trade imbalances. Under a destination principle, imports are taxed but input taxes are rebated on exports (as currently). Under an origin basis imports are not taxed, but no export rebates are given. Previous VAT literature stresses the neutrality of tax basis switches, which simply reflect moving between consumption and production taxes, but neutrality only holds when trade is balanced. In the unbalanced trade case for countries with a trade surplus, such as China, an origin basis offers a lower tax rate on an equal yield basis and reduced exports. We use a two country endogenous trade imbalance general equilibrium global trade model with endogenous factor supply, a fixed exchange rate and a non-accommodative monetary policy structure which supports the Chinese trade imbalance. We calibrate model parameters to 2008 data and simulate counterfactual equilibria for VAT tax basis switches in which the trade imbalance changes. Our results suggest that given China's trade surplus VAT regime switching to an origin can decrease China's trade surplus by over 50%, and additionally increase Chinese and world welfare. The rest of the world's production and welfare improves simultaneously.

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# Rebalancing and the Chinese VAT: Some Numerical Simulation Results

**Abstract:** This paper presents numerical simulation results that suggest that China can both reduce its trade imbalance and receive welfare benefits by switching the value added tax (VAT) regime from the current destination principle to an origin principle. With the tax on exports exceeding that no longer collected on imports, revenues rise and exports fall. VAT regime switching is thus a possibility for China to receive a double benefit, rebalancing trade with a welfare gain. This has implications for present G20 discussions on finding ways to adjust global trade imbalances. Under a destination principle, imports are taxed but input taxes are rebated on exports (as currently). Under an origin basis imports are not taxed, but no export rebates are given. Previous VAT literature stresses the neutrality of tax basis switches, which simply reflect moving between consumption and production taxes, but neutrality only holds when trade is balanced. In the unbalanced trade case for countries with a trade surplus, such as China, an origin basis offers a lower tax rate on an equal yield basis and reduced exports. We use a two country endogenous trade imbalance general equilibrium global trade model with endogenous factor supply, a fixed exchange rate and a non-accommodative monetary policy structure which supports the Chinese trade imbalance. We calibrate model parameters to 2008 data and simulate counterfactual equilibria for VAT tax basis switches in which the trade imbalance changes. Our results suggest that given China's trade surplus VAT regime switching to an origin can decrease China's trade surplus by over 50%, and additionally increase Chinese and world welfare. The rest of the world's production and welfare improves simultaneously.

**Keywords:** Value Added Tax; Destination Basis; Origin Basis; Numerical Simulation

## 1. Introduction

The Chinese trade imbalance has been extensively discussed globally in recent years, and has been a major topic of discussion at G20 summits under the heading of rebalancing as agreed by the G20 in Pittsburgh in September 2009 in their Framework for Strong Sustainable and Balanced Growth (FSSBG). Despite this, concrete proposals for policy changes to address rebalancing are few. Here we report numerical simulation results which suggest that if China were to switch its value added tax (VAT) regime from the current destination basis (DB) to an origin basis (OB), the effect would be both reduce to significantly reduce China's trade imbalance by over 50% and also increase China's and world welfare. Other instruments than simply exchange rate realignments can thus contribute to rebalancing.

This effect occurs because of China's unbalanced trade and reflects the feature that under a destination basis, imports are taxed while input taxes are rebated (as currently), while under an origin basis, imports enter tax free but exports receive no tax rebate. Existing public finance literature stresses the neutrality for movements between these two bases, but for this to occur trade must be balanced. In the presence of a significant Chinese trade surplus, an equal yield origin basis tax lowers the tax rate, generates efficiency gains, and can also reduce the surplus.

The analytical novelty in the paper is to work with a multi good trade model with an endogenous rather than an exogenous trade imbalance, as such

models are little used in the literature. Our 3 commodity 2 country 2 factor numerical general equilibrium trade model for China with an endogenous trade imbalance reflects China's basket fixed exchange rate regime and non accommodative monetary policy. We present a monetized extension to a conventional trade model which builds on Whalley and Wang (2010) and in which the reminbi is inconvertible while at the fixed exchange rate (given monetary policy) the central bank accumulates reserves. We calibrate the model to 2008 data before performing basis switching counterfactual analyses. Data from the Chinese State Administration of Taxation show the VAT to be the largest revenue source for the national government in China, accounting for nearly 47% of Chinese total tax revenue in 2008 (CSY, 2009). Because of the size of the Chinese trade surplus, if the Chinese VAT regime were changed from a destination basis to an origin basis, the price of Chinese produced goods abroad would increase and that of foreign produced goods in China would decrease, and the trade surplus will fall. Under an equal yield tax change a consumer surplus gain would accompany the change due to a lower tax rate.

Earlier literature discussion of VAT basis switches emphasizes that a switch from a destination based commodity tax to an origin based production tax has no real effects under conditions of trade balance and price flexibility (Whalley, 1979; Grossman, 1980; Berglas, 1981; Lockwood et al, 1994); but is not neutral if a trade imbalance exists (Lockwood et al, 1994; Genser, 1998). The VAT is usually thought of as a consumption tax, based on the added value at each stage

of a products manufacturing or distribution. Credits apply to taxes paid by purchasers, and so it is ultimately passed on to the consumer who is ineligible for tax credits.

Other related literature argues for the superiority of origin based taxes and these arguments are also relevant to the Chinese case. Berglas (1981), for instance, compares three different taxation bases, destination, origin and restricted origin. His results suggest that the origin basis is the superior one. He argues that the origin basis is as efficient as the other two; but the origin basis has lower administrative costs and it can be applied in different countries at a different rate which provides freedom for countries within the union wanting to pursue independent fiscal policies requiring a different fraction of the GDP as tax revenue. Georgakopoulos and Hitiris (1992) argue that in a second-best world, the restricted origin basis can be superior to the destination basis and differs from the analysis in Dosser (1967), Shibata (1967) and Shoup (1969), Lockwood et al (1995). The origin basis can also eliminate problems associated with the potential for cross-border shopping. Lastly, Keen and Lahiri (1998) compare destination and origin bases under conditions of imperfect competition, and find that in this case the origin basis gives exchange efficiency relative to the destination basis.

Our numerical simulation results suggest that it could be advantageous for China to switch the VAT from a destination to an origin basis. China can not only reduce its trade surplus, but also either collect more tax revenue or on an

equal yield basis lower tax rates and improve welfare. The general equilibrium model we use employs a structure with a labor-leisure choice to provide endogeneity of factor supply, a fixed exchange rate and an endogenously determined trade surplus.

The paper is organized as follows. Part 2 briefly discusses the Chinese VAT and discusses the potential impacts of basis switches for rebalancing. Part 3 presents the model and outlines its calibration. Part 4 presents simulation and sensitivity analysis results. The last part presents conclusions.

## 2. The Chinese VAT Regime, Rebalancing, and Destination and Origin Bases

China is unique in having two separate components of their VAT; one applying to domestic transactions (or domestic VAT) and one applying to international trade transactions (import VAT and export refunds). VAT, introduced in 1994, is one of the most Chinese important taxes in revenue terms. VAT revenues increased very quickly after its 1994 introduction, and VAT has been the largest tax revenue source in China in recent years. According to data from the State Administration of Taxation, Chinese domestic VAT revenues increased from 233.86 billion RMB in 1994 to 1799.69 billion RMB in 2008, increasing on average by 47.83% annually. Import VAT revenues increased from 32.28 billion RMB in 1994 to 739.11 billion RMB in 2008, an on average increase of 156.4% (Figure 1). In 2008, Chinese domestic VAT and import VAT shares of total tax revenue were respectively 33.19% and 13.63%. These two parts of the VAT thus provide nearly 47% of national government revenues (Figure 2).

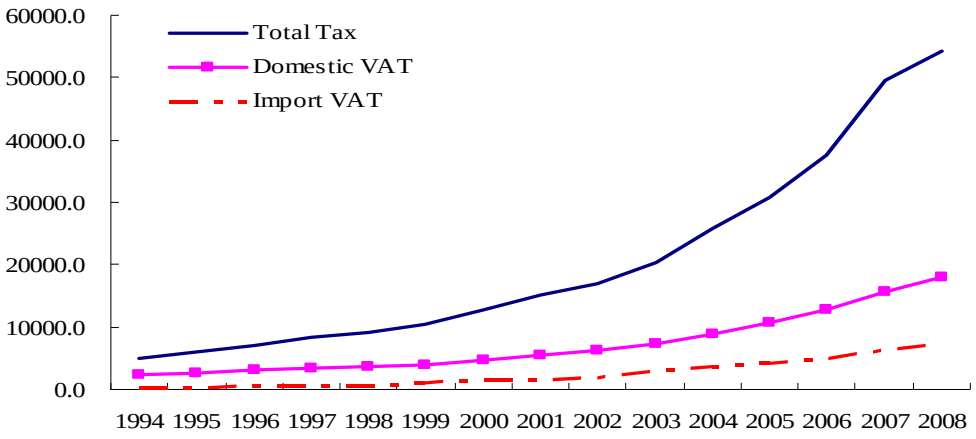



**Fig. 1 Chinese Total Tax and VAT Income (Unit: 100 Million RMB)**

Data Source: Statistics of State Administration of Taxation

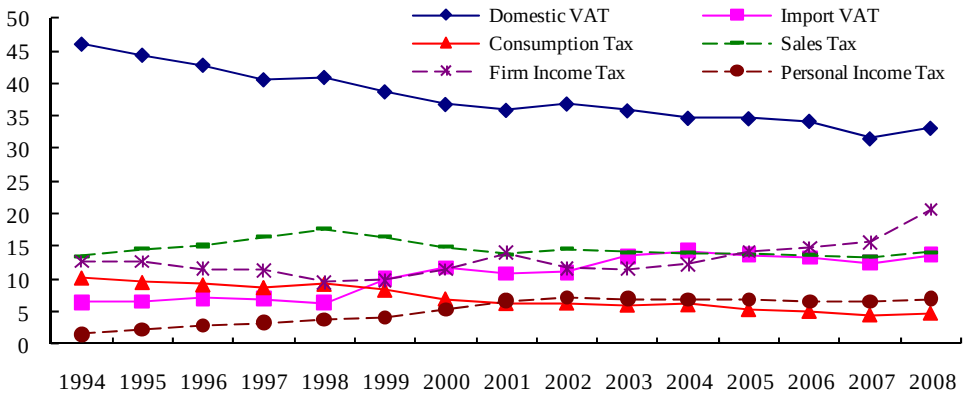



**Fig. 2 Main Categories of Tax Revenues in China (Unit: %)**

Data Source: Statistics of State Administration of Taxation

China's VAT is administered by the State Administration of Taxation (the import VAT is collected by customs on its behalf), and the revenues are shared between the central government (75%) and local governments (25%). According to the Provisional Regulation of P.R.C on VAT, value-added tax, as in other countries, is to be paid by enterprises or individuals who sell merchandise, provide processing, repair, or assembling services, or import goods into the People's Republic of China. It is based on the added value derived from production, selling of merchandise, and providing industrial repairing or assembling service. For different taxable goods and services, different tax rates (including zero rates) apply, as listed in Table 1. VAT is the major source of revenue for all government levels in China, and particularly the central government.

China's VAT began on an experimented basis in the 1980s in selected provinces, when China began to implement VAT on 24 specified taxable items. In 1994, with the goal of building up the socialist market economy and following

guidelines of "unification of taxation management, equity of tax burden, simplification of tax system, personalization of revenue distribution relations and guarantee of the financial revenue", the taxation system was changed. A State Council decree enacting a broader VAT on "The Provisional Regulation of the People's Republic of China on Value Added Tax" then went into effect on January 1, 1994.

**Table 1 Chinese VAT Taxable Items and Rates**

| **Coverage of Collection** | **Rates** |
|---|---|
| Export of goods (except otherwise stipulated) | 0% |
| 1. Agriculture, forestry, products of animal husbandry, aquatic products;<br>2. Edible vegetable oil and food grains duplicates;<br>3. Tap water, heating, cooling, hot air supplying, hot water, coal gas, liquefied petroleum gas, natural gas, methane gas, coal/charcoal products for household use;<br>4.Books, newspapers, magazines (excluding the newspapers and magazines distributed by the post department);<br>5. Feeds, chemical fertilizers, agricultural chemicals, Agricultural machinery and plastic covering film for farming;<br>6. Dressing metal mineral products, dressing non-metal mineral products, coal. | 13% |
| Crude oil, mine salt and goods other than those listed above, and services of processing, repairs and replacement. | 17% |

Source: Ministry of Finance, PRC, "Provisional Regulations of the People's Republic of China on Value-added Tax".

In 2004, China made further changes to the VAT in Heilongjiang, Jilin and Liaoning with the aim of revitalizing the industrial base of Northeastern China. A scheme of "increment deduction", which shifts the previous production VAT regime to a consumer VAT system allowing enterprises to deduct the full amount of the input tax, was introduced for eight industries: equipment manufacturing, petrochemical, metallurgy, automobile, shipbuilding, new-and high-tech industries, and agricultural products processing. It was then extended to 26 industrial cities in the Central Chinese provinces in 2007 in Henan, Hunan,

Hubei, Shanxi, Anhui and Jiangxi. In the second half of 2008, five areas of eastern Inner Mongolia and the earthquake devastated region of Wenchuan in Sichuan Province were added.

China implemented further VAT changes nationwide in 2009, as a national move from a production-based VAT to one which is consumption-based. With the exception of a few specific industries, all industries in China are now able to offset the full amount of input VAT paid on newly purchased machinery and equipment against VAT collected when they sell their products.

China's VAT is effectively operated on a destination basis, so China imposes not only tariffs but also import-related VAT on goods imported as part of general trade[1]. An import-related consumption tax is also levied on certain goods. For exports, China applies a zero VAT rate with the exception of certain restricted or prohibited goods and technologies. Effectively, there is no VAT on exports, and VAT already paid is refunded as an export tax rebate.

The Chinese government began to implement export tax rebates in April 1985, and a "full refund" principle was established in 1988. After tax reform in 1994, the new VAT was introduced and export goods were to receive a full export rebate reflecting the tax paid on inputs. To implement the initial export tax rebates, the central government earmarked a certain amount of its budget for the purpose, but the obligation turned out to be too large to fulfill. Consequently, in 1995 and 1996 the government twice reduced the export tax

[1] General trade is an administrative designation in China which is differentiated from VAT free processing trade, in which imports are exclusively for production of exports.

rebate rate. From then on, China operated a separate partial export rebate system, disconnected from the domestic VAT, which uses separate export rebate rates which change often (and by product) according to the economic situation.

## 3. Model and Calibration

To analyze the potential impacts of VAT basis switches in China in the presence of China's trade surplus, we use a standard 3 good 2 country 2 factor general equilibrium model, with the added feature that the trade imbalance is endogenously determined and supported by a fixed exchange rate and non-accommodative monetary policy. We use data for 2008 to calibrate model parameters and conduct counterfactual policy analysis. The $3\times2\times2$ static structure incorporates a labor-leisure choice to yield endogeneity of factor supplies, as well as a fixed exchange rate, non-accommodative monetary policy, and a endogenously determined trade surplus. We use the model to simulate possible impacts of Chinese VAT regime changes from a destination basis to an origin basis in both equal yield format with endogenous tax rates for the new regime, and in fixed tax rate format.

### 3.1 Model

The model has two countries, three goods and two factors of production. The two countries are China and the ROW (rest of the world). The two input factors are labor and capital which are immobile across countries, but mobile across sectors. Because VAT rates in China for agriculture goods (13%), manufacture goods (17%) and services (3%) differ, we include three kinds of products in the model, agriculture, manufacturing and services. In reality China employs a credit invoice VAT for manufactures and a noncredit turnover tax for services. Since we do not explicitly model intermediate production, the separate

VAT form used for services does not enter our analysis.

On the production side, we assume CES functions for each product in each country:

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

where $Q_i^j$ is the output of the ith industry in country j, $L_i^j$ and $K_i^j$ are the labor and capital inputs, $\Phi_i^j$ is the scale parameter, $\delta_i^j$ is the distribution parameter and $\sigma_i^j$ is the elasticity of factor substitution.

First order conditions for cost minimization imply the factor input demand equations,

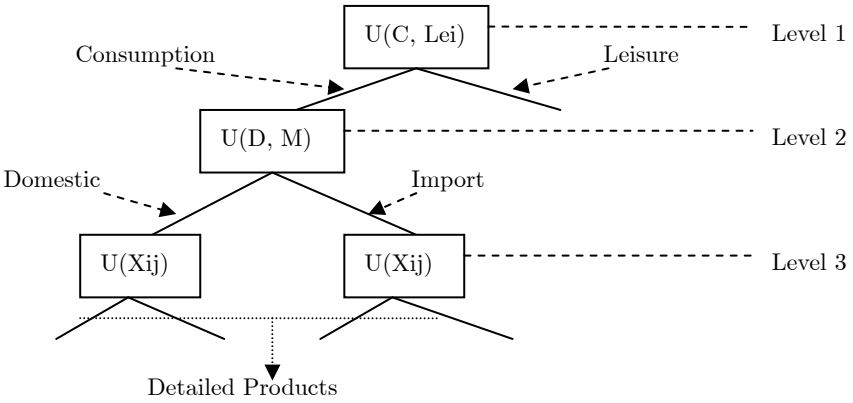
$$K_i^j = \frac{Q_i^j}{\phi_i^j}[\delta_i^j [\frac{(1-\delta_i^j)P_L^j}{\delta_i^j P_K^j}]^{(1-\sigma_i^j)} + (1-\delta_i^j)]^{\frac{\sigma_i^j}{1-\sigma_i^j}} \qquad (2)$$

$$L_i^j = \frac{Q_i^j}{\phi_i^j}[\delta_i^j + (1-\delta_i^j)[\frac{\delta_i^j P_K^j}{(1-\delta_i^j)P_L^j}]^{(1-\sigma_i^j)}]^{\frac{\sigma_i^j}{1-\sigma_i^j}} \qquad (3)$$

where $P_K^j$ and $P_L^j$ are the prices of capital and labor in country j.

On the consumption side, we assume nested CES utility functions with a labor-leisure choice in each country. These nested functions, with three levels, are set out in Figure 3. The first level captures the consumption leisure choice, the second the domestic imported good choice, and the third the more detailed product choice. We use the Armington assumption under which domestic goods and imported goods are heterogenous to accommodate cross hauling in trade data, and to remove specialization problems with the model.

**Fig. 3 Structure of Nested CES Utility Functions**




Equilibrium in this model is then given by market clearing prices for goods and factors in each country such that

$$Q_i^j = D_i^j + M_i^i \qquad \text{i, j=1, 2; } \ \text{i} \neq \text{j} \tag{4}$$

$$\sum_i L_i^j = \overline{L}^j - \sum_i Lei_i^j \qquad \text{j=1, 2} \tag{5}$$

$$\sum_i K_i^j = \overline{K}^j \qquad \text{j=1, 2} \tag{6}$$

where $D_i^j$ and $M_i^j$ are consumption of domestic and imported goods of country i, $\overline{L}^j$ and $\overline{K}^j$ are endowments of labor and capital, and $Lei_i^j$ is leisure consumption by country i.

Imports, $M_i^j$, and exports, $X_i^j$, are the difference between domestic demand and output, and the difference between output and domestic demand respectively.

$$\begin{aligned} M_i^j &= \max\{(D_i^j - Q_i^j), 0\} \\ X_i^j &= \max\{(Q_i^j - D_i^j), 0\} \end{aligned} \tag{7}$$

The net trade surplus $S^j$ in country j is:

$$S^j = \sum_i p_i^j X_i^j - \sum_i p_i^j M_i^j \tag{8}$$

where $p_i^j$ is the producer price of the ith product in country j. If there is trade

balance $\sum_i p_i^j X_i^j = \sum_i p_i^j M_i^j$ .

To accommodate a trade surplus or deficit as an endogenous variable in this structure, we use a monetized extension of this structure incorporating a fixed exchange rate and non-accommodative monetary policy, similar to that in Whalley and Wang (2010). In this formulation prices are denominated in domestic currency with an exchange rate e between the two domestic moneys. Cross country arbitrage between the country specific prices with no taxes in trade yields:

$$p_i^j = ep_i^i \qquad \text{i, j=1, 2;} \quad \text{i} \neq \text{j} \tag{9}$$

If we only consider the transactions demand for money in each country and for simplicity assume unitary velocity and also assume exporters are paid in their own country currency, the money demand in country j is:

$$\sum_i (\hat{p}_i^j D_i^j + \hat{p}_i^j M_i^j) = \overline{M}^j \tag{10}$$

Where $\hat{p}_i^j$ is the consumer price of product i in country j, and $\overline{M}^j$ is country jth's money supply. In traditional models, money is neutral in the sense that once domestic money supplies are specified, an equilibrium exchange rate is determined independent of the real side, and a fixed exchange rate regime and trade surplus does not occur. And if the exchange rate e is fixed at $\bar{e}$, then the relative domestic money stocks $\overline{M}^i / \overline{M}^j$ need to accommodate to $\bar{e}$ so as to support it as an equilibrium exchange rate.

In the structure we use the monetary regime is non-accommodative to the fixed exchange rate; and in this case the trade surplus will be endogenously

determined. If we denote country 1 as China, country 1 has a trade surplus $S^1$ and country 2 has a trade deficit $D^2$,

$$\begin{aligned} S^1 &= \sum_i p_i^1 X_i^1 - \sum_i p_i^1 M_i^1 \\ D^2 &= \sum_i p_i^2 M_i^2 - \sum_i p_i^2 X_i^2 \end{aligned} \tag{11}$$

Country 1's trade surplus will equal country 2's trade deficit in equilibrium, and country money demands are:

$$\begin{aligned} \overline{M}^1 &= \sum_i p_i^1 Q_i^1 \\ \overline{M}^2 &= \sum_i p_i^2 Q_i^2 + S^1 \end{aligned} \tag{12}$$

Into this structure we can then introduce VAT. We use t to denote the VAT rate and assume that the ROW does not have a VAT. In this world, a destination basis VAT will imply that:

$$\begin{aligned} \hat{p}_i^1 &= e(1+t)p_i^2 \qquad \text{imports taxed} \\ \hat{p}_i^2 &= p_i^1 / e \qquad \text{exports not taxed} \\ \hat{p}_i^1 &= (1+t)p_i^1 \qquad \text{domestic goods taxed} \end{aligned} \tag{13}$$

If the VAT regime is on an origin basis, international arbitrage yields:

$$\begin{aligned} \hat{p}_i^1 &= ep_i^2 \qquad \text{imports not taxed} \\ \hat{p}_i^2 &= (1+t)p_i^1 / e \qquad \text{exports not taxed} \\ \hat{p}_i^1 &= (1+t)p_i^1 \qquad \text{domestic goods taxed} \end{aligned} \tag{14}$$

Using the above trade model with a fixed exchange rate, and non-accommodative monetary policy with an endogenously determined trade surplus, we can then simulate the trade and welfare effects of Chinese VAT regime switching both on the trade imbalance and on welfare. For the VAT rate

under the origin basis, we use revenue equivalent switching such that total revenue is kept equal under the two VAT regimes. In this case, the VAT rate is endogenously determined as we switch bases.

### 3.2 Data and Calibration

We use 2008 as our base year and build a benchmark general equilibrium data set for use in calibration and simulation (see Shoven and Whalley (1992)). There are two countries China and ROW, three sectors agriculture, manufacture and service, and two factors capital and labor in our model. We take the ROW to be a multiple of US data as elsewhere in literature (4.216 times in Dong and Whalley, 2009).

The data we use in model calibration as the base case equilibrium are listed in Table 3. All Chinese data except trade data are from the National Bureau of Statistics (NBS) and Chinese Statistic Yearbook. Chinese trade data are from the WTO statistics database. US data except capital are from Bureau of Economic Analysis database, and US capital data are from US census bureau "2010 Capital Spending Report". The foreign exchange rate we use is the average exchange rate for the RMB to US dollar in 2008. Chinese work hours are calculated according to the labor law that each employees work 8 hours per day, and every year has 104 weekend holidays and 11 festival holidays so that each has 250 (=365-104-11) work days. Each Chinese labor is assumed to work 250 multiply 8 equals 2000 hours each year. Annual working hours of per worker for ROW, are taken as the same as average work hour of the world, that is 1764

hours according to OECD report (OECD, 2008). From this working hour data we calculate base case leisure consumption.

The production and utility functions in our model are all of the CES type, and the elasticity specification used in them can affect model results. There are no available estimates of elasticities for China either on the demand or production side (Dong and Whalley, 2009). Many of the estimates of domestic and import good substitution elasticity are around 2 (Betina, 2003), so we set all of these elasticities in our model to 2 (the same as Whalley and Wang (2010)). We change these elasticities later in sensitivity analysis to check their influence on simulation results.

**Table 3 Data Used for Calibration and Simulation (2008 Data)**

| Contents/Country | | China (Million RMB) | | | ROW (Million USD) | | |
|---|---|---|---|---|---|---|---|
| | | **Agriculture** | **Manufacture** | **Services** | **Agriculture** | **Manufacture** | **Services** |
| Trade | Export | 675008.16 | 9234482.76 | 2034164.23 | 393701.00 | 733439.00 | 316008.00 |
| | Import | 2734292.82 | 5093807.20 | 2194707.16 | 97192.00 | 1329640.00 | 292892.00 |
| Factor | Capital | 169414.37 | 3835942.19 | 4449169.60 | 10000.35 | 2113118.22 | 3338582.94 |
| | Labor Number | 306.54 | 211.09 | 257.17 | 5.41 | 93.37 | 400.69 |
| | Labor Hour | 2685290.40 | 1849148.40 | 2252809.20 | 47420.89 | 817936.55 | 3510069.42 |
| | Work Hour | 613080.00 | 422180.00 | 514340.00 | 9549.14 | 164707.77 | 706822.20 |
| | Leisure | 2072210.40 | 1426968.40 | 1738469.20 | 37871.75 | 653228.78 | 2803247.22 |
| Total Production | | 3400000.00 | 14618340.00 | 12048661.00 | 1610802.90 | 31774895.84 | 78651824.10 |
| VAT | | 13% | 17% | 3% | 0 | 0 | 0 |
| Consumption | | 5459284.66 | 10477664.43 | 12209203.93 | 360720.96 | 34288479.26 | 78554367.04 |
| Exchange Rate | | | 6.95 | | | 0.14 | |
| Surplus | | | 1920847.98 | | | -276576.00 | |
| Money Supply | | | 47516660.00 | | | 396554852.00 | |

Source: Chinese data except trade come from National Bureau of Statistics (NBS) and Chinese Statistic Yearbook, Chinese trade data come from "WTO Statistics Database"; ROW data except capital get from BEA database (www.bea.gov ), ROW's capital data get from US census bureau "2010 Capital Spending Report".

Table 4 reports the share and scale parameters generated by calibration.

When used in model solution these regenerate the benchmark data set in Table 3 as an equilibrium for the model.

**Table 4 Parameters Generated by Calibration**

| Country/Content | | China | | | ROW | | |
|---|---|---|---|---|---|---|---|
| | | Agr. | Manu. | Service | Agr. | Manu. | Service |
| Goods Consumption Share | China | 0.1503 | 0.2971 | 0.5526 | 0.2727 | 0.5083 | 0.2190 |
| | ROW | 0.0075 | 0.9710 | 0.0216 | 0.0111 | 0.2807 | 0.7083 |
| Share Parameter in Production | K | 0.2165 | 0.9009 | 0.8964 | 0.5115 | 0.9277 | 0.8253 |
| | L | 0.7835 | 0.0991 | 0.1036 | 0.4885 | 0.0723 | 0.1747 |
| Scale Parameter in Production | | 6.2003 | 4.0125 | 2.8581 | 164.6608 | 15.6083 | 25.8105 |
| Amington Share | Domestic | | 0.6439 | | | 0.9848 | |
| | Import | | 0.3561 | | | 0.0152 | |
| Leisure and Consumption Share | Leisure | | 0.7717 | | | 0.7986 | |
| | Consumption | | 0.2283 | | | 0.2014 | |

Note: Agriculture is abbreviated as Agr. and Manufacture as Manu.

## 4. Simulation Results

We report model results for a series of model experiments in which the Chinese VAT is switched from a destination to an origin basis. All of the results are reported as per percentage changes compared to the base case equilibrium with a VAT destination basis; that is the origin principle model equilibrium minus the destination principle model equilibrium. We then divide by destination principle values to give percentage changes. We are interested in trade imbalance effects, trade effects, tax revenue effects, production effects and welfare effects, but also report Hicksian equivalent variations (EV) for the changes. Additionally, we report sensitivity analyses for elasticity parameters on simulation results.

### 4.1 Simulation Results

When the Chinese VAT regime is switched from a destination principle to an origin basis, Chinese export prices, which now include the tax increase, and import prices decrease. Chinese imports increase and exports (plus the trade surplus) decrease. Additionally, this change increases Chinese VAT revenues.

We use two different methods to calculate the VAT rates and VAT revenues from regime switching. The first is the traditional equal yield tax reform as in the literature (Shoven and Whalley, 1977; Feldstein, 1974; Pereira, 1995; Hamilton, 1999), which keeps tax revenues constant and has tax rates endogenously determined. The second keeps tax rates constant and has tax revenues endogenously determined. We analyze these two cases separately.

### 4.1.1 Equal Yield Tax Basis Switching

Since we have three different products in our model, their VAT rates are different. Table 5 reports results for trade, production and welfare for equal yield VAT regime switching. In the equal yield tax analyses reported here, we assume these three rates change by the same proportion in a basis switch so as to preserve tax revenues.

**Table 5 Simulation Results For Chinese Equal Yield VAT Basis Switching (2008 Data)**

| Country | Item | Import | Export | Trade Imbalance | Production | EV | Equal Yield VAT Rate for Origin Basis |
|---|---|---|---|---|---|---|---|
| China | Total | 6.24% | -4.39% | -59.84% | -1.73% | 0.26% | — |
| | Agriculture | 11.44% | -9.99% | — | -1.69% | — | 9.88% |
| | Manufacture | 6.08% | -4.89% | — | -9.50% | — | 12.92% |
| | Service | 0.12% | -0.26% | — | 7.68% | — | 2.28% |
| ROW | Total | -4.39% | 6.24% | -59.84% | 0.45% | 0.69% | — |
| | Agriculture | -9.99% | 11.44% | — | 1.10% | — | — |
| | Manufacture | -4.89% | 6.08% | — | 1.96% | — | — |
| | Service | -0.26% | 0.12% | — | -0.17% | — | — |

These results suggest that the trade surplus in China could decrease by 59.84% of its former size under VAT regime switching. This could be a major contribution to global rebalancing, and would be accompanied by a welfare gain for both China and the rest of the world. Under the basis switch Chinese exports of agriculture, manufactures and service separately decrease by 9.99%, 4.89% and 0.26%, and imports of these three kinds of products separately increase by 11.44%, 6.08% and 0.12%. Agricultural output changes the most, then manufactures and lastly services. Because manufacturing account for most of the

Chinese trade surplus, its changes determines most of the trade imbalance changes. Although exports and imports do not change a lot, their different signed effects decrease the trade surplus substantially. In our two country model, Chinese imports equal ROW's exports and Chinese exports equal ROW's imports. These import and export changes are the same as in Table 5, and the Chinese trade surplus equals ROW's trade deficit.

Total production in China decreases by 1.73% which reflects decreased exports and increased imports. The production change is less in percentage terms than in trade which means that Chinese domestic demand increases after VAT regime switching. Production of ROW increases by 0.45% reflecting the Chinese trade imbalance adjustment.

The Hicksian equivalent variation gain for China for the change is 0.26% of GDP and for the ROW 0.69%. This suggests VAT regime switching can improve both countries' welfare. Chinese domestic products have prices lowered and improved consumer welfare follows, and the ROW's production increases and improves its welfare.

In order to keep total VAT revenues unchanged, Chinese VAT rates decrease because of the trade surplus status. These simulation results indicate that the VAT rate can be reduced by 23.99%, and VAT rates for agriculture, manufacture and service are 9.88%, 12.92% and 2.28% respectively.

#### 4.1.2 Equal Tax Rate Basis Switching

Table 6 also reports equal tax rate basis switching simulation results in

which tax rates remain unchanged but tax revenues rise. Total Chinese imports increase by 6.77% and agriculture, manufacture and service imports separately increase by 11.63%, 7.02% and 0.13%. Total exports decrease by 4.63% and agriculture, manufacture and service products by 10.38%, 5.17% and 0.27%. These changes jointly decrease the trade imbalance by 64.11%, a little more than in the equal yield case. Trade effects are more severe than equal yield tax switching.

**Table 6 Simulation Results of Equal Tax Rate VAT Basis Switching in China (2008 data)**

| Country | Item | Import | Export | Trade Imbalance | Production | EV | Revenue |
|---|---|---|---|---|---|---|---|
| China | Total | 6.77% | -4.63% | -64.11% | -1.87% | 0.23% | 7.42% |
| | Agriculture | 11.63% | -10.38% | — | -1.72% | — | -38.79% |
| | Manufacture | 7.02% | -5.17% | — | -9.61% | — | 26.11% |
| | Service | 0.13% | -0.27% | — | 7.49% | — | 6.08% |
| ROW | Total | -4.63% | 6.77% | -64.11% | 0.53% | 0.74% | — |
| | Agriculture | -10.38% | 11.63% | — | 1.34% | — | — |
| | Manufacture | -5.17% | 7.02% | — | 2.16% | — | — |
| | Service | -0.27% | 0.13% | — | -0.15% | — | — |

On the production side, China's output decreases 1.87% in total. Production of agriculture and manufacture separately decrease by 1.72% and 9.61% and services increase by 7.49%. Production of the ROW increases by 0.53% and its agriculture and manufacture output increases by 1.34% and 2.16%, while services decrease by 0.15%. In welfare terms, China and the ROW both benefit from the switching; China's EV is 0.23% of GDP and the ROW 0.74%.

China's total VAT revenue increases if we use equal tax rate switching. These results show that total revenues increase by 7.42%; in detail, agriculture decreases by 38.79%, and manufacture and service separately increase by 26.11% and 6.08%.

In general, equal tax rate VAT regime switching decreases China's exports a little more and also increases imports by more, and the two effects jointly decrease the trade surplus more. Although China experiences a negative production effect, its welfare and tax revenue increase.

**4.2 Sensitivity Analysis**

In our model, the elasticity parameter values we use reflect available literature. But changing these parameters value can change results, and so we provide sensitivity analyze for different elasticity parameters. We change elasticity parameters to different values and compare results of VAT basis switching on trade, production, VAT revenues and welfare. In order to simplify our sensitivity analyze, we assume all of the elasticity parameters are equal and do not change each elasticity value one by one. We choose elasticity values equal to 0.5, 0.8, 1.2, 1.6, 2.1 and 2.4. In our sensitivity analyze, we focus on the equal tax yield case.

Table 7 reports sensitivity analysis results for Chinese VAT basis switching. In general, all of these elasticity variations do not change results that much. The export impacts change from -4.29% to -4.89%, import impacts change from 6.21% to 6.92%, trade surplus impacts change from -59.63% to -66.51%, Chinese

production impacts change from -1.39% to -1.83%, and EVs change from 0.20% to 0.31%. All of these changes are within 30% of their central case values.

**Table 7 Sensitivity of Results For Equal Yield VAT Basis Changes in China (2008 data)**

| **Elasticity Values** | **0.5** | **0.8** | **1.2** | **1.6** | **2.0** | **2.4** |
|---|---|---|---|---|---|---|
| Export Impacts | -4.29% | -4.50% | -4.89% | -4.78% | -4.39% | -4.37% |
| Import Impacts | 6.85% | 6.62% | 6.92% | 6.21% | 6.24% | 6.22% |
| Trade Surplus Changes | -62.42% | -62.52% | -66.51% | -62.13% | -59.84% | -59.63% |
| Production Changes | -1.67% | -1.39% | -1.83% | -1.78% | -1.73% | -1.47% |
| EV | 0.28% | 0.31% | 0.20% | 0.21% | 0.26% | 0.23% |

## 5. Conclusions and Policy Implications

Trade rebalancing has become a major focus of discussion in the G20, and is now taken as a task for the entire world after the 2008 financial crisis. Present G20 summit discussions focus on members adjusting exchange rates. Here, we argue that for China with a large trade surplus, VAT basis switching from a destination to an origin basis may also be a significant accompanying measure yielding reductions in China's trade imbalance of over 50% and also welfare gains both for China and the world.

We use a two country, three sector and two factor global trade equilibrium model with a fixed exchange rate and non-accommodative monetary policy in a structure which accommodates an endogenous trade imbalance to simulate the possible effects of Chinese VAT regime switching from a destination basis to an origin basis. We use data for 2008 as our base year. Our results suggest that the Chinese trade surplus and total production would both decrease under such a change and there will be a positive welfare benefit for China. Production in ROW will also increase.

These results thus suggest that Chinese VAT regime switching can not only reduce the Chinese trade imbalance, and also benefit both China and the ROW, and that G20 discussion of rebalancing could usefully focus not only on exchange rate reassignments, but also on other possible instruments. Using the origin principle in the Chinese VAT may also have other advantages, including lower administrative costs, and can alleviate the export rebate burden on the Chinese government budget.

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