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ABSTRACT

China's VAT while seemingly conventional has two major impurities. One is that a separate export rebate system exists where rebate rates are linked from rates paid on creditable inputs. The other is the use of an income base for which there is no crediting of taxes on capital good, rather than the more conventional consumption base with expensing of investment expenditures. Here we argue that in a conventional competitive model both impurities would typically involve a welfare loss, but if we use a numerical calibrated equilibrium model with a monetary structure capturing by these Chinese features in which the trade surplus is endogenously determined and the exchange rate is exogenously set, things are different. These impurities effectively act as added taxes on domestic production (lowed export rebate rates, taxes on a larger VAT base) and tax exporting. Tax exporting reduces exports which lowers the surplus and accumulation of foreign currency. In a static model, a reduced surplus is welfare improving. Using 2002 data, we thus find that China's impure VAT system yields welfare gains in contrast to what a conventional model would show. These results are important since there are arguments being made inside and outside China for changes to be made and move closer to a pure VAT. Our results suggest that unless there are wider changes first in macro-structure, such changes may not be welfare preferred.

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1. Introduction

China since 1994 has had a Value Added Tax (VAT) which seems conventional by international standards, but on closer inspection is nonstandard and impure in some key areas. Export credits are not always given, and are used as a stabilization device on an on/off basis in certain key sectors (textiles and apparel). The tax is administrated on an income basis in most sectors, but on a consumption basis in such areas as light industry. In addition, the tax is effectively restricted to manufacturing level with a lower rate turnover tax on key service sectors.

Here we argue that in a conventional competitive monetary framework such features of the VAT are distortionary and impose welfare costs. However, in a world of fixed exchange rates, non accommodative monetary policy and endogenous trade deficits (as currently in China), this need not be the case. We use a simple single period monetary general equilibrium model with fixed exchange rates and endogenous trade suplus which we calibrate to 2002 Chinese data and show the impure Chinese VAT to be welfare improving compared to the classical neutral tax since it reduces the trade surplus.

Essentially the argument advanced is that in classical public finance analysis of the VAT, departures from a pure destination based consumption form would be regarded as distortionary and imposing welfare costs. However, in a model where the trade surplus is endogenously determined given the exchange rate and non accommodative monetary policy, such policies may instead be welfare improving compared to a pure VAT through these trade effects because they increase production costs for exports and lower the size of the trade surplus. We also show how changes in export rebate rates and exchange rate policy can be substitute instruments in terms of macro impacts on trade flows. There effects can clearly be offset by others excluded from the model. For instance, a labor leisure choice in a static model will change the analysis of an income base versus a consumption base because with a larger base equal yield

rates will be lower under an income tax and distortions of labor supply reduced. We concentrate only on the trade effects of the impure base and their intreaction with the surplus.

We first discuss the Chinese VAT, as well as the two elements of impurities discussed above. We set out how they operate and have evolved over time. Interactions with trade performance and exchange rate policy are also highlighted. We then present a monetized general equilibrium trade model in which the trade surplus is endogenously determined given exchange rate and monetary policies. Production structures in the model capture intermediate production and value added functions for a model calibrated to 2002 Chinese data covering 10 sectors and capturing both China's key items of foreign trade and products/sectors where impurities in tax VAT treatment arise both in export rebates and the use of an income basis. The model is then calibrated to base case data for 2002 and generate a supporting parameterization for trade, consumption, the trade surplus and production in the presence of VAT impurities. We then compute an equilibrium in the absence of these impurities, by moving to a pure VAT eitheringly or jointly. We show that relative to a pure VAT these impurities allow for tax exporting effects which reduce the size of the surplus and yield a welfare gain. We also show how a structure giving no rebates is equivalent to a Renminbi revaluation, suggesting equivalence and interplay between these instruments. The broader theme of the results is that particular features of policy structure in China which may strike those versed in classical theory as odd may make good sense given the overall policy system within which elements reside.

2. China's impure VAT

China introduced the Value Added Tax (VAT) in 1994 as part of a general tax reform. It replaced a preexisting cascading whole sale turnover tax, and was seen both at home and abroad as a major improvement in terms of removing tax distortions and

providing a stable revenue source. The VAT has since emerged as the major and secure revenue source underpinning the finances of the Chinese state. It has a standard tax rate of 17%, which is largely restricted to manufactures and is supplemented by a low rate (3%) turnover tax on key service items. The lower 13% rate applies to a range of products (agriculture, vegetables, heating and natural gas, chemicals, fertilizer, metals and coal, see Table 1).

China's VAT is administered by the State Administration of Taxation (VAT on imports is collected by customs) and VAT tax revenues shared between the central government and local governments who receive roughly 25% of revenue. The VAT coexists at enterprise level with a consumption tax whose rates range from 3-17% on all taxable items, and a business tax at rates of 3-20% on taxable items, as well as enterprise income taxes. These additional taxes apply to domestic sales and imports and cover areas both where the VAT is difficult to collect and luxury oriented consumption items such as cars. Among all Chinese taxes, the VAT is the most important revenue source.

The Chinese VAT, however, has evolved in ways which are quite different from VATs elsewhere, being used both as a stabilization device and an incentive mechanism for policy objectives such as location of firms and area of economic activity (such as high technology products). Specifically, though the tax is formally administered (as in most countries) on a destination basis, rebates of input taxes are variable by sector and commodity, and also used in an on/off manner for stabilization purposes. This is especially the case in the textiles and clothing sector where export tax credits are terminated periodically when export growth rates are seen as too high, and become the source of international pressure. One of China's actions following the termination of the Multi Fiber Arrangement (MFA) in 2005 was to reduce export rebates as a way of slowing the export surge of newly quota free products to the US and other developed country markets. China has announced policy of limited export rebates for VAT which varies by product and which change over time as in 2003, 2005 and more recently in 2006.

Table 1 China's VAT Taxable Items and Rates

Coverage of collection	Rate
Exports of goods(except otherwise reduced by limited export rebates)	0%
Agriculture, forestry, animal husbandry, aquatic products; Edible vegetable and grain products; Tap water, heating, cooling, hot air supply, hot water, gas, liquefied petroleum gas, natural gas, coal/charcoal products for household use; Book, newspapers, magazines Feeds, chemical fertilizers, agricultural chemicals, agricultural machinery and plastic converting film for farming; Selected metal mineral products, Selected non-metal mineral products, coal.	13%
Crude oil, mine salt and goods other than those listed above; Taxable services.	17%

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

The tax is also administered on an income base which does not allow the expensing of purchases of capital goods. This contrasts with the consumption base used in most other countries under which expensing is allowed. Recent tax changes have introduced elements of a consumption basis by region and by sector, and so now a mixture of the two bases operates.

Earlier VAT literature on a switch from destination to origin taxation shows such switch at given tax rates may have no real effects because adjustments of exchange rate and price levels may offset tax effects (Whalley, 1979; Krugman, 1980;

Grossman,1980). Substituting the origin principle (tax on exports, no tax on imports) for the destination principle (tax on import, no tax on export) thus should have no affects on real trade. Since a tax on exports is equivalent to a tax on imports, compensating exchange rate and price level adjustments simply restore the original equilibrium. Generally, full price flexibility in a competitive economy, is taken to imply that a comprehensive uniform-rate VAT and yields this equivalence in practice. Lockwood (Lockwood etal., 1994a, 1994b) extend his analysis to imperfect competitive economy, money economy and when transport cost is taken into account. They find, under assumptions that are different from the earlier literature, that nonequivalence may applies and distortionary policies can influence the economy in various ways.

Besides this equivalence, literature also notes that the administration of the origin principle is difficult. If exports are to be taxed, export values must be verified to ensure that all domestic value added is included in the base. Arm's length pricing rules from the application of separate accounting principles under the corporate income tax would have to be adopted. National tax credits, would have to be attached to imports at amounts equal to the product of the domestic VAT rate and arm's length import values to ensure that they would not be taxed in domestic stages of production or distribution. Thus, in contrast to the assumptions made in earlier literature, the proper treatment of exports and imports under the origin principle seemingly requires the maintenance or re-establishment of border controls.

Equally, tax effects of the VAT are typically analyzed assuming that the trade balance is exogenous if international trade is taken into account. The unrealism of this assumption in the Chinese case is especially troublesome since trade balance is a major element in the structure and reflects exchange rate and monetary policies. Here we start from the classical neutrality literature Whalley (Whalley, 1979) and Lockwood (Lockwood, 1994a, 1994b) and introduce monetary non neutralities in analyzing how under a fixed exchange regime, when the trade surplus is

endogenously determined, features of VAT structure traditionally regarded as impure can nonetheless be welfare preferred.

3 Export Rebates

The first impurity in China's VAT that we discuss are limits placed on the rebate of input tax credits as they relate to exports. Exports are zero rated as in conventional VATs, but export rebates of inputs credits are restricted in various ways and rebate rates differ from statutory rates. There are both general policies by product and sector (which change over time) as to the amount of rebate allowed, and specific responses to trade pressures from importing countries (as in apparel) that temporarily suspend rebates.

The origins of this system lie in the 1994 introduction of the VAT when full rebates were planned and the government earmarked a certain amount of revenue for rebates. Due to sharp export growth, and bogus invoices and rebate claims, much of the claimed 1994 rebates had to be deferred. In 1995, the government budget could again not cover requested rebates (which were double the budget), and the government changed the rebate rate. The rebate rate was set at 14% on items taxable at 17%, 10% for items taxable at 13%, and 3% on a small range of items. A year later the government once again could not cover the requested rebates, and rebate rates fell further to 10% from 14% and to 6% from 10%. Table 2 lists refund rates currently used in China.

Table 2 Structure of Current China Export Rebates (2005)

Items	Export Rebate Rate
All non-metal mineral products (except cement and mine salt) include Crude oil, coal, natural gas, wax etc. Selected wood products, paper, leather, wool	0%
Some products using agriculture product as material include wheal, maize, flour	5%
Steel	8%
China, selected leather product and cement, glass	8-11%
Selected metal mineral products	5-11%
Textile, furniture, plastic, few wood product	11%
Important equipment, selected IT products and government preferential export product	17%

Source: Taxation Administration of China.

Between 1991 and 1995, rebates accounted for 7%-10.5% of government expenditures. The growth rate of export rebates in 1996 was 50.5% in part due to rapid export growth from foreign invested enterprises, but also due to fraud and invalid VAT invoices. The share of VAT revenues going to local governments (who did not contribute to rebates before 2003) compounded the problem.

Also, as China's exports grew in the late 1990's, and the share of processing trade

involving imported components also grew, more than half of China's exports came from export processing zones where imports entered both duty free and free of VAT. This created a strong incentive for local firms to convert to processing trade from general trade, since they were still eligible for export rebates. These fiscal problems of processing trade, tax revenue assignment to local governments, and false involves again forced the central government to limit export tax rebates.

Export rebates have thus evolved in ways which are unrelated to input taxes paid on materials as in a conventional credit-invoice VAT, and schedules of allowable rebates are announced which are changed from time to time. These are then supplemented by ad hoc product specific announcements to change or terminate rebates usually as a result of pressure (actual or perceived) to slow export growth to key markets abroad.

These refunds work in the following way. The enterprise first pays VAT to the government ignoring that export products. Each enterprise engaged in export activity calculates its VAT liabilities as

$$T_i = tS_i - tM_i - R_i$$

where T_i are taxes payable, *t* is the VAT rate, S_i are sales of enterprise *i*, M_i are material inputs of firm *i*, and R_i is the refundable VAT on exports sales. Refunds, in turn, are calculated as:

$$R_i = E_i r_i$$

where E_i are export sales, r_i is the refund rate (as per cent in Table 2). $t \geq r_i \geq 0$, and if r_i=0 no refund on all export sales applies. This rebate differs from a credit invoice VAT in applying to the full value of exports, not just the material input component, but if added materials are used to produce export non export VAT is correspondingly reduced.

The net result of this structure is a series of export rebates at varying rates across products and sectors which are little connected to the taxes paid on material inputs, with effects both on trade patterns and trade volumes. And in a model with monetary non neutralities the endogenously determined trade surplus is affected, and changes in rebate rates can be partial substitute instruments for exchange rate realignment. This latter linkage has been much discussed in China.

The second element of impurity in the Chinese VAT relates to the use of an income basis for the tax in contrast to the more conventional consumption base used in most countries, where capital good purchases are expensed under the VAT. Fixed assets for Chinese VAT purposes include machines and transport equipment; effectively all capital equipment used in production regardless of whether the equipment was imported or purchased domestically. This implies input taxes apply to capital goods through the production process.

This treatment is however in transition. In January 2004 a pilot program was launched covering 8 sectors (including oil, chemical and autos) in 3 provinces (Heilongjiang, Jilin and Liaoning) to evaluate the application of VAT on a consumption basis by allowing deductions for capital goods. Also, as part of 11th 5-year-plan in 2005, VAT input credits for capital goods are extended to the production of high technology goods. A mixed income/consumption basis is thus evolving. Both of these impurities represent a considerable departure from a classical pure form of VAT.

4. Modeling the effects

We first discuss the impacts of changes in VAT structure in standard classical models, and then subsequently discuss models which depart from this form by explicitly capturing monetary non-neutralities and allowing for the endogenous determination of the trade surplus. In this latter class of models, tax structures which reduce exports

will tend to reduce the surplus, and this reduces central bank accumulation of foreign currency to support a fixed exchange rate (with inconvertibility). This will be welfare improving in a static model. While simple, this formulation is clearly closer to the contemporary situation in China and in such a model an impure VAT may dominate a pure VAT by generating a smaller trade surplus. Thus, given China's current macro policy posture, an impure VAT may dominate a pure VAT.

4.1 The standard classical case

In a classical world it is relatively easy to demonstrate the neutrality of either a consumption (destination) or origin (production) broadly based VAT levied at a single rate. For simplicity, we can consider 2 countries with 2 producers and 2 factors.

The production function for each good in each country can be written as

$$Y_i^j = g_i^j(K_i^j, L_i^j) \qquad i\text{=sector}, \quad j\text{=country} \qquad (1)$$

where Y_i^j is the output, K_i^j and L_i^j are the use of capital and labor input. g_i^j is assumed CRS.

First order conditions imply the following, where factor prices are w_i^j, r_i^j and goods prices are p_i^j:

$$w_j = p_i^j \frac{\partial g_i^j}{\partial L_i^j}$$

$$r_j = p_i^j \frac{\partial g_i^j}{\partial K_i^j}$$

The demand side for each economy reflects utility maximizing behavior for a single representative agent, that is:

$$\max U^j(D_i^j, M_i^j) \qquad (2)$$

$$\text{St.} \quad \sum_i (pd_i{}^j D_i{}^j + pm_i{}^j M_i{}^j) = \sum_i p_i{}^j Y_i{}^j - S^j \qquad j=1,2$$

where $D_i{}^j$ and $M_i{}^j$ are domestic and imported goods *i* in *j* country, and $pd_i{}^j$ and $pm_i{}^j$ are prices of the these goods in country *j*.

Equilibrium in this economy is given by market clearing prices for goods and factors such that

$$D_i{}^i + M_i{}^j = Y_i{}^i \qquad i=1,2 \quad j=1,2 \quad i \neq j \qquad (3)$$

and

$$\sum_{i=1}^{2} L_i{}^j = \overline{L}^j \qquad j=1,2$$

$$\sum_{i=1}^{2} K_i{}^j = \overline{K}^j \qquad j=1,2$$

where $\overline{K}^j$ and $\overline{L}^j$ are endowments of capital and labor in country *j*.

Defining the net trade, import $M_i{}^j$ as the difference between domestic demand and output, and export $E_i{}^j$ as the difference between output and domestic household demand.

$$M_i{}^j = \max((X_i{}^j - Y_i{}^j),0) \qquad (4)$$

$$E_i{}^j = \max((Y_i{}^j - X_i{}^j),0)$$

If follows directly from the budget constraint that balanced trade holds, we have

$$\sum_i p_i{}^j M_i{}^j = \sum_i p_i{}^j E_i{}^j \qquad (5)$$

If we then consider a monetized extension of this model where prices are denominated in terms of domestic currency with an exchange rate e between the two domestic moneys, then cross country arbitrage between the country specific prices with no tax distortion in trade yields:

$$p_i{}^1 = ep_i{}^2 \qquad i=1,2 \qquad (6)$$

If, in turn, we consider only transactions demand for money in each country with unitary velocity and exporters being paid in their own country currency, we have a transactions demand for money in each country. In equilibrium

$$\sum_i (pd_i{}^j D_i{}^j + pm_i{}^j M_i{}^j) = \overline{m}_j \qquad j=1,2 \qquad (7)$$

where $\overline{M}^j$ is the money stock in country *j*.

In this model, money is neutral in the sense that once domestic money stocks are specified, then an equilibrium exchange rate is determined independently of the real side. If instead 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.

The neutrality of movements between a broadly based VAT administered on a destination (consumption) or origin (production) basis, or indeed between no VAT and a VAT for this economy follows directly. If we define $\hat{p}_i{}^j$ as the consumer price of good i in country j and $p_i{}^j$ as the producer price under both a production and a consumption tax, then:

$$\hat{p}_i{}^j = (1+t)\, p_i{}^j \qquad (8)$$

and the household budget constraint changes to

$$\sum_i (\hat{pd}_i{}^j D_i{}^j + pm_i{}^j M_i{}^j) = \sum_i p_i{}^j Y_i{}^j + R^j \qquad (9)$$

where $R_j = \sum_i p_i{}^j t Y_i{}^j$, refers to tax revenue in country *j*.

The differences in tax structure between an origin and destination based tax in country *j* appears in the cross country international arbitrage conditions. Under an origin based tax on production

$$\hat{p}_i^{\,1} = e p_i^{\,2} \qquad \text{import (not taxed)} \qquad (10)$$

$$\hat{p}_i^{\,2} = \frac{(1+t)\,p_i^{\,1}}{e} \qquad \text{export (taxed in country j)}$$

In the origin case, if all $p_i^{\,j}$ fall by $\frac{1}{1+t}$, or if *e* increases by *(1+t)*, the same equilibrium will prevail both in a no tax case, and under an origin or destination basis tax. Taxes and their bases are neutral in effect.

4.2 Non accommodative monetary policy, and fixed exchange rate case

If, however, as in China the monetary regime is non accommodative to the fixed exchange rate chosen and the surplus (and accumulation of reserves) are endogenously determined the neutrality propositions above for broadly based taxes breakdown. In this case, an impure VAT can be welfare preferred to a pure VAT. This can occur, for example, if for a given statutory rate there is a smaller surplus associated with the impure VAT compared to the pure VAT.

To analyze this case, we assume a fixed exchange rate $\bar{e}$ chosen by country 1 who is willing to support the rate with reserve accumulation which implies trade surpluses. We thus assume that monetary policy in countries 1 and 2 as represented by $\bar{m}_1 / \bar{m}_2$ is non-accomodative of $\bar{e}$, and a trade surplus (deficit) results in country 1 (2).

In this case, the budget constraints for each country in the no tax case are given by

$$\sum_i p_i^{\,1} X_i^{\,1} = \sum_i p_i^{\,1} Y_i^{\,1} - S^1 \qquad (11)$$

$$\sum_i p_i^{\,2} X_i^{\,2} = \sum_i p_i^{\,2} Y_i^{\,2} + D^2$$

where S^1 represents the endogenously determined trade surplus in 1 in the currency

of j. S^1, in turn, is

$$S^1 = \sum_i p_i^1 E_i^1 - \sum_i p_i^1 M_i^1 \qquad (12)$$

And the corresponding trade deficit D^2 in country 2 is:

$$D^2 = \sum_i p_i^2 M_i^2 - \sum_i p_i^2 E_i^2 \qquad (13)$$

In equilibrium, $S^1 = D^2$, and in this case, money demand functions change to reflect the surplus and become

$$\sum_i p_i^1 X_i^1 = \overline{m}^1$$

$$\sum_i p_i^2 X_i^2 + S^j = \overline{m}^2$$

The surplus thus is accommodated in the model by the central bank in country *i* accumulating currency of *i* equal to S^i $(= eS^j)$.

In this world, a consumption based VAT will be similar to the classical case in that arbitrage across countries will still imply that

$$\hat{p}_i^1 = e(1+t)p_i^2 \qquad \text{(imports taxed)} \qquad (15)$$

$$\hat{p}_i^2 = \frac{p_i^1}{e} \qquad \text{(export not taxed)}$$

and so no adjustment is needed in either p_i^j or e to achieve the same equilibrium. However, a tax structure that reduces S will typically be welfare preferred for country j, and so an impure VAT in these cases can yield welfare benefits.

The case of a production (origin) based VAT will also no longer be equivalent to a destination basis VAT on consumption. In these cases, the international arbitrage conditions are as before, that is:

$$\hat{p}_i^1 = ep_i^2 \qquad \text{import (not taxed)} \qquad (16)$$

$$\hat{p}_i^{\,2} = \frac{(1+t)\,p_i^{\,1}}{e} \qquad \text{export (taxed in country j)}$$

Here equivalence can no longer be obtained by adjustments only in either $p_i^{\,j}$ or in e. If all $p_i^{\,1}$ were to change by $\frac{1}{1+t}$, then S would have to change which would change all $Y_i^{\,j}$ and $X_i^{\,j}$, or e increase by (1+t). Equally changing $p_i^{\,j}$ by *(1+t)*, would require a change in S^j (D^2).

The impure VAT can be modeled directly using a fixed coefficient technology $\beta_{a_i}^{\;\;j}$ which represents the use of good *a* in the production of good *i* in country *j*.

In this case, the zero profit conditions for good *i* in country *j* become

$$p_i^{\,j} = wl_i^{\,j} + (r_i^{\,j} - \delta_i^{\,j})k_i^{\,j} + \sum_e \beta_{a_i}^{\;\;j}\, p_a^{\,j}$$

where $\delta_i^{\,j}$ is depreciation rate on capital in *j* in sector *i*. $r_i^{\,j}$ is depreciation rate of return on capital in sector *i* in *j* and $r = r_i^{\,j} - \delta_i^{\,j}$ is the common net of depreciation rate of return on capital across sectors in country *i* (capital is assumed immobile across countries).

Taxes on value added of consumption type with full input credit yield zero profit conditions

$$\hat{p}_i^{\,j} = (1+t)(wl_i^{\,j} + (r_i^{\,j} - \delta_i^{\,j})k_i^{\,j}) + \sum_e \beta_{a_i}^{\;\;j}\, p_a^{\,j}$$

If we treat the lack of input credits on capital pure purchases as equivalent to allowing no deduction for depreciation from the gross return on capital, taxes on value added of the income type with full input credit yield

$$\hat{p}_i^{\,j} = (1+t)wl_i^{\,j} + (r_i^{\,j}(1+t) - \delta_i^{\,j})k_i^{\,j} + \sum_e \beta_{a_i}^{\;\;j}\, p_a^{\,j}$$

which allows income and consumption type VATs to be compared. If the income type VAT results in a smaller value of S it will typically be welfare preferred.

Export rebates at rates which differ from statutory rates used for taxes on input and apply to the total value of product rather than just value added used directly can then be incorporated. In this case, under a destination based VAT the cross country arbitrage conditions become

$$\hat{p}_i^{\,j} = e(1+t)\,p_i^{\,h} \qquad \text{import (not taxed)}$$

$$\hat{p}_i^{\,h} = \frac{(1+t-r)\,p_i^{\,j}}{e} \qquad \text{export (only partially taxed in country j)}$$

where r refers to the export rebate rate as in the Chinese structure described earlier. In this case given the rebates applies to the value of all production, the zero profit conditions for exporting sectors become

$$\hat{p}_i^{\,j} = (1+t-r)(wl_i^{\,j} + (r_i^{\,j} - \delta_i^{\,j})k_i^{\,j}) + \sum_e \beta_{a_i}^{\,j}\, p_a^{\,j}$$

The issue then becomes the impacts of these impurities in the VAT system on trade patterns, S and hence on welfare. As emphasized in the introduction, we put all of the non trade effects connected to VATs structure (such as labor/leisure distortions) on one side and only evaluate trade effects.

5. Model based analyses of the experience with China's VAT reform

5.1 Data and parameterization

Our VAT model of China with monetary non neutralities incorporates 2 countries and 10 traded goods (agriculture and energy, manufactures, and other sectors). Applied export rebate rates are from Development Research Centre, State Council. China. Value-added tax rates are from Taxation Administration of China (See Table 3). We construct a model compatible benchmark equilibrium data set for calibration (see

Dawkins, Srinivasan and Whalley 2001). Due to the multi-country character of the data set, ensuring model consistency of data is a problem in building the benchmark data. We first use total output, sectoral output, domestic consumption, total import and export for China and the rest of the world from GTAP 5 database for 1997 to get the share parameter. Then we use data from China's 2002 input-output table yielding China's gross output, and totals for imports and exports. Using share data from GTAP and China's data from the input-output table, we generate China's sectoral gross output, import and export data for 2002. China's exports are taken as imports by the rest of the world from China. All the above data are recorded in Table 4.

Table 3 Rates of VAT and export rebate rate by commodity used in the model simulation

Commodity Classification	Rate of VAT	Export Rebate Rate[2]
1. Agriculture	13%	0%
2. Energy product[3]	17%	6.31%
3. Textile	17%	6.31%
4. Other light manufacturing	17%	6.31%
5. Manufacture intermediate	17%	6.31%
6. Motor vehicle	17%	6.31%
7. Other transportation equipment	17%	6.31%
8. Electronic equipment	17%	6.31%
9. Other manufacturing goods	17%	6.31%
10. Service	3%	0%

[2] The rebate rate in this column are sourced from GTAP, see Zhi Wang (2003).
[3] Actually crude oil is levied at 17% for VAT.

Table 4 2 Country Base Case Data in 2002 for China and ROW (the Rest of the World) used to calibrate the model

China *(in billion RMB*[4])*	*Value of Production*	*Value of Consumption*	*Exports to ROW*	*Import from ROW*	*Net trade*
1. Agriculture	757.05	728.07	28.29	28.98	-0.69
2. Energy product[5]	295.41	272.65	17.40	22.76	-5.36
3. Textile	220.43	183.01	107.13	37.43	69.71
4. Other light manufacturing	55.78	52.12	34.91	3.66	31.26
5. Manufacture intermediate	649.51	566.36	49.38	83.15	-33.77
6. Motor vehicle	62.02	55.48	2.05	6.53	-4.49
7. Other transportation equipment	25.21	18.75	5.23	6.46	-1.23
8. Electronic equipment	83.80	41.04	48.99	42.76	6.24
9. Other manufacturing goods	351.98	288.69	48.44	63.29	-14.85
10. Service	1285.58	1255.08	32.03	30.51	1.53

ROW *(in million US$)*	*Value of Production*	*Value of Consumption*	*Exports to China*	*Import from China*	*Net trade*
1. Agriculture	5788.21	5759.92	28.98	28.29	0.69
2. Energy product[6]	1995.92	1978.52	22.76	17.40	5.36
3. Textile	1319.77	1212.64	37.43	107.13	-69.71
4. Other light manufacturing	495.55	460.63	3.66	34.91	-31.26
5. Manufacture intermediate	5710.10	5660.73	83.15	49.38	33.77
6. Motor vehicle	1440.07	1438.02	6.53	2.05	4.49
7. Other transportation equipment	488.57	483.34	6.46	5.23	1.23
8. Electronic equipment	1354.54	1305.55	42.76	48.99	-6.24
9. Other manufacturing goods	1701.03	1652.59	63.29	48.44	14.85
10. Service	34029.13	33997.10	30.51	32.03	-1.53

[4] The currency unit used here for Chinese domestic currency is artificial in that we set it to 8.277RMB which is the exchange rate of the US dollar to Renminbi in 2002, this implies that 1 unit RMB* equals 1 US dollar before we scale all the data for 2005. This convention is adapted so that in calibration all equilibrium prices will be unity.

[5] Actually crude oil is levied at 17% for VAT.

[6] Actually crude oil is levied at 17% for VAT.

We use a Leontief technology to present total output; and Cobb-Douglas production with constant returns to scale as value-added function in the 2 countries. On the demand side, we use CES composites and initially set substitution elasticities to equal to 2 in both countries. We use this as the central case although the literature provides different estimates of this key elasticity. Many of the estimates of domestic and import good substitution are around 2 or greater than 2 (See Betina (2003)). Table 5 and 6 report parameter values in production and preferences generated by calibration, as well as shares of intermediate imports in China's imports that are used in counterfactual analysis.

Our benchmark case is a VAT with the impurities we analyze present. We then simulate counterfactuals. One is taxes on value-added of the consumption type and full export rebating (scenario 1); another is only VAT on value-added on a consumption base(scenario2); and a third is with full rebating of export taxes at statutory rate. We are also able to analyze cases where there is a substitute change in exchange rates and export rebates.

The rates of export rebates are clearly important. Statutory rates according to Chinese Law are listed in Table 3. Using these rates directly in our simulation procedure potentially overestimates the effect of export rebates on export and import for a number reasons. One is that the rates listed in table 3 are just for selected goods that belongs to our model commodity classification rather than all goods that are classified into these groups of commodities. Secondly, according to statistical data from China official documents, export rebates divided by the exports yield an average actual rebate rate across all goods of around 5%. However, given a lack of information on export rebate by good, even though actual export rebate rates differ from the legal rates, to implement a full rebate simulation we simply use the rebate rates according to the law as our base case.

Table 5 shares in Cobb-Douglas production functions[7]

	China			*Rest of the world*		
	Share of capital	Share of labor	Share of intermediates	Share of capital	Share of labor	Share of intermediates
1. Agriculture	0.1241	0.5289	0.3470	0.2794	0.3280	0.3927
2. Energy product	0.3954	0.1947	0.4099	0.3631	0.2322	0.4047
3. Textile	0.2873	0.2258	0.4869	0.2171	0.3257	0.4572
4. Other light manufacturing	0.3090	0.2428	0.4481	0.2440	0.3106	0.4454
5. Intermediate manufacturing	0.3640	0.1635	0.4724	0.2383	0.3430	0.4187
6. Motor vehicle	0.4014	0.1338	0.4648	0.1680	0.3570	0.4750
7. Other transportation equipment	0.2922	0.1716	0.5362	0.1561	0.4221	0.4218
8. Electronic equipment	0.2277	0.1121	0.6602	0.1903	0.3241	0.4856
9. Other manufacturing goods	0.3095	0.1979	0.4926	0.1792	0.3639	0.4569
10. Service	0.3557	0.2795	0.3647	0.3010	0.4156	0.2834

[7] Original data used in calibration for production functions are from the GTAP version-5 database. We aggregate skilled and un-skilled labor and generate a labor endowment for China and the rest of the world. Land and sector specific resources are not taken into account in production.

Table 6 Share parameters for imports and domestic goods in nested CES utility functions

	China		*Rest of the World*	
	imports demand	domestic produced demand	imports demand	domestic produced demand
1. Agriculture	0.19	0.81	0.06	0.94
2. Energy product	0.25	0.75	0.08	0.92
3. Textile	0.35	0.65	0.21	0.79
4. Other light manufacturing	0.24	0.76	0.19	0.81
5. Manufacture intermediate	0.31	0.69	0.08	0.92
6. Motor vehicle	0.29	0.71	0.03	0.97
9. Other transportation equipment	0.41	0.59	0.08	0.92
8. Electronic equipment	0.54	0.46	0.14	0.86
9. Other manufacturing goods	0.35	0.65	0.13	0.87
10. Service	0.15	0.85	0.03	0.97

5.2 Simulation results

We have used our calibrated model to simulate changes in tax arrangements on both China's trade flows and welfare. We firstly compare an elimination of China's export rebate and an appreciation of the RMB by 5% with a fixed money stock in both China and the rest of the world. Then we keep the export rebates unchanged into our model, but shift from an income based VAT to a consumption basis. Finally, we assess the impacts of joint elimination of export rebates and using a consumption basis VAT on trade and welfare.

Results are presented in Tables 7 and 8. Table 7 shows that with a complete elimination of VAT export rebates, all sectors in China increase their imports in quantity terms which range from 0~16.9%, with the biggest changes in textiles, other light industries and electronic equipment. All sectors decrease their exports, by an average of 11%. However, decreasing exports causes an increase in the final use of domestically produced goods and welfare increases by 1.45%. To compare currency revaluation and changed tax arrangements, we also let China's RMB revalue by 5%, and find that the 2 instruments are substitutes.

We then compare the income basis VAT and a consumption basis VAT. Table 8 shows if we tax imports rather than exports, imports decrease sharply by around 20%. Exports changes very little compare to imports. Welfare in this case decreases by 2.3%.

Finally, we calibrate the opposite case to China's currently impure VAT, which is the case of no export rebate with consumption basis VAT. We find both exports and imports of China decrease substantially, with export decrease around 11% and imports decrease around 20%. Welfare thus lose 0.9%.

Table 7 Impacts of eliminating export rebate and a 5% appreciation of the RMB on welfare, import and exports of China

	Elimination export rebate		*RMB revaluation 5%*	
	% change in exports	% change in imports	% change in exports	% change in imports
1. Agriculture	0.00	0.00	-9.57	10.99
2. Energy product	-11.64	0.87	-9.62	11.28
3. Textile	-11.83	8.13	-9.89	17.58
4. Other light manufacturing	-11.69	9.19	-9.63	18.38
5. Manufacture intermediate	-11.65	1.19	-9.64	11.56
6. Motor vehicle	-11.64	0.50	-9.56	10.96
7. Other transportation equipment	-11.67	3.82	-9.65	13.81
8. Electronic equipment	-12.07	16.92	-10.07	25.16
9. Other manufacturing goods	-11.70	2.31	-9.85	12.55
10. Service	-11.64	0.34	-9.54	10.83

	Elimination export rebate	*RMB revaluation 5%*
% change in Hicksian EV	1.45	2.15

Table 8 Impacts of moving to a consumption VAT and the joint elimination of export rebates and a consumption VAT on trade flows and welfare

	Move to full export rebates		*Move to Consumption tax arrangement*		*Move to both*	
	% change in export	% change in import	% change in export	% change in import	% change in export	% change in import
1. Agriculture	32.12	-1.46	0.09	-20.63	32.24	-21.80
2. Energy product	28.28	-2.11	0.23	-23.47	28.58	-25.09
3. Textile	28.95	-19.90	0.66	-24.38	29.63	-39.51
4. Other light manufacturing	28.46	-22.38	0.16	-24.14	28.63	-41.14
5. Manufacture intermediate	28.31	-2.89	0.30	-23.35	28.68	-25.58
6. Motor vehicle	28.26	-1.22	0.09	-23.04	28.38	-23.99
7. Other transportation equipment	28.40	-9.30	0.27	-23.75	28.72	-30.86
8. Electronic equipment	29.80	-41.77	0.69	-24.19	30.32	-55.98
9. Other manufacturing goods	28.50	-5.61	0.80	-23.92	29.48	-28.22
10. Service	28.26	-0.84	0.02	-24.05	28.28	-24.69

	Move to full export rebates	*Move to Consumption tax arrangement*	*Move to both*
% change in Hicksian EV	-7.37	-2.30	-9.69

Table 9 Sensitivity of elasticity parameters in demand

	Varying the elasticity of substitution between domestic and foreign products only in China				
Value of elasticity used	0.5	0.75	1.0[8]	1.5	2.0
% change in imports					
Full export rebates	-10.42	-10.42	-10.42	-10.42	-10.42
Impure export rebates	0.00	0.00	0.00	0.00	0.00
Zero export rebates	10.88	10.88	10.88	10.88	10.88
% change in exports					
Full export rebates	29.01	29.01	29.01	29.01	29.01
Impure export rebates	0.00	0.00	0.00	0.00	0.00
Zero export rebates	4.13	4.13	4.13	4.13	4.13
% change in Hicksian EV	0.00	0.00	0.00	0.00	0.00

[8] Because we use a CES form in the code, we use 0.999 rather than 1 here in execution.

6. Conclusion

We discuss two significant impurities in China's VAT. One is incomplete rebating of taxes on inputs used for exports through a separate rebate system to the statutory rate. The other is the use of an income rather than a consumption basis. We argue that in classical public finance models these would both be treated as distortionary and the source of a welfare cost. In a monetary trade model in which there is a fixed exchange rate, non accommodative monetary policy, inconvertibility and endogenous reserve accumulation things are different. Both of them departures from price can raise export prices and reduce the surplus and yield a welfare gain. We show this using a calibrated monetary trade general equilibrium model of China based on 2002 data. This is suggestion of a broader theme that elements of China's policy structure that might strike outsiders as odd, makes more sense once the wider policy environment within which policies operate is understood.

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