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Evidence From the U.S.-China Trade Data Discrepancy

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ABSTRACT

Since the late 1990s, reported U.S. imports from China and Hong Kong have regularly and increasingly exceeded reported exports of China and Hong Kong to the United States. This discrepancy, which is not caused by re-exporting through Hong Kong, varies by product categories, and in some cases takes the opposite sign. In this paper, we focus on China's direct exports to the United States, and find strong statistical evidence of underreporting exports at Chinese border to avoid paying value-added tax (VAT). There is also indirect evidence of transfer pricing (i.e. overreporting at U.S. border to avoid higher U.S. corporate income tax for U.S. based multi-nationals) and avoidance of Chinese capital controls (i.e. money-laundering). We also provide evidence that tariff evasion at the U.S. border tends to take the form of underreporting unit values for differentiated products.

Key words: trade data, traders' behavior, tax evasion, money laundering

JEL Classification Numbers: H26, F10, C81

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I. Introduction

The growing trade relationship between the United States and China has drawn increasing attention. This has included attention to the fact that China's reported exports to the United States are routinely smaller than U.S. reported imports from China. Discrepancies between exporters' and importers' trade data are endemic globally, and not peculiar to the U.S.-China relationship (Tsigas, Hertel and Binkley, 1992; Gehlhar, 1996). Accounting for the difference between U.S. and Chinese data has traditionally focused on re-exports through Hong Kong, which follows the normal rule for re-exports: U.S. import data impute the origin as China, while Chinese export data describe the destination as Hong Kong (West, 1995; Fung and Lau, 1998, 2004; Feenstra, Hai, Woo and Yao, 1999; Fung, Lao and Xiong, 2006).

As the role of Hong Kong as an entrepôt for China-U.S. trade has decreased, it has become increasingly apparent that a sizable amount of the discrepancy has other origins. The discrepancy on *direct* Chinese exports to the United States (neither re-exports nor transshipments) increased from approximately $1.7 billion in 1995 to $36.5 billion in 2005 (Ferrantino and Wang, 2008). This suggests that traders may be systematically misstating the value of shipments, either understating them to China's customs authorities, overstating them to U.S. authorities, or both. There are a variety of patterns of tax avoidance, tariff evasion, and avoidance of capital controls that could give rise to such discrepancies. Moreover, depending on the structure of incentives, these types of avoidance behaviors could lead to the opposite result, i.e. overreporting of data to Chinese authorities or underreporting of data to U.S. authorities. For example, the case of tariff avoidance has been studied by several authors (Fisman and Wei, 2004; Fisman, Moustakerski and Wei, 2005; Javorcik and Narciso, 2007). Since tariff evasion involves underreporting of values to the importing country's authority, it cannot be the primary explanation for the U.S.-China trade data discrepancy. Nonetheless, tariff avoidance may still be taking place. There are a number of product categories for which the discrepancy takes the opposite sign, with reported Chinese data being larger.

This paper uses a unique dataset which merges features of finely disaggregated trade data from China Customs and the U.S. Census from 1995-2005 to shed light on the type of trader behaviors which may give rise to the observed discrepancy, and how these behaviors may vary across time and across product categories. We find strong statistical evidence for underreporting of exports at Chinese border to avoid paying VAT. There is also indirect evidence of transfer pricing (i.e. overreporting at the U.S. border to avoid higher U.S. corporate income tax for U.S. based multi-nationals) and avoidance of Chinese capital controls (i.e. money-laundering). However, it is more difficult to obtain conclusive evidence on the responsiveness of traders to Chinese and U.S. corporate income taxes due to data limitations. We also provide evidence that tariff evasion at the U.S. border tends to take the form of underreporting unit values and is more likely to occur for differentiated products.

The rest of the paper is organized as follows. Section 2 presents a partial equilibrium model for misreporting incentives in international trade and discusses the major economic incentives for

firms to misreport export and import transactions in China-U.S. eastbound trade. Section 3 describes data and their sources as well as various proxy variables for misreporting incentives used in our analysis. Section 4 presents our econometric specifications and discusses major findings based on our estimation results. Section 5 concludes with a discussion of possible directions for future research.

II. Economic Incentives for Misreporting: Tax Avoidance, Tariff Evasion, Transfer Pricing and Money Laundering

There are a number of incentives for firms to misstate the invoice price of an export-import transaction, such as tax avoidance, tariff evasion, transfer pricing and avoidance of capital controls. These incentives can give rise to discrepancies in trade data, because there are multiple authorities involved, and there may be an incentive to tell different things to authorities in different countries.[1]

The primary goal of our analysis is to understand why U.S. reported imports are systematically larger than the same exports as reported by China. We argue that avoidance of corporate income taxes in both countries, avoidance of the Chinese VAT, and money laundering are possible factors underlying either the underreporting of exports at Chinese border or the overreporting of imports at the U.S. border. In keeping with the literature on tariff evasion, as discussed above, we find some evidence for tariff evasion at the U.S. border. This explains in part why U.S. reported imports are actually smaller than Chinese reported exports for some product categories. It also suggests that tariff evasion is a universal phenomenon and not restricted to developing or transition economies.

We also draw out some additional implications about firm behaviors from econometric analysis of the observed discrepancy. Narrowing of the discrepancy in recent years is consistent with the possibility that the incentives of avoiding Chinese capital controls have shifted from encouraging unrecorded capital outflow from China to encouraging unrecorded capital inflow into China. This shift is consistent with expected appreciation of the Chinese currency in the most recent period. Also, an apparent greater degree of tariff evasion for related-party transactions may reflect provisions of customs valuation peculiar to the United States (the so-called "First Sale Rule".)

2.1 A model of misreporting incentives

Our basic setup is straightforward and modifies analyses of the transfer pricing problem within multinational firms such as Swenson (2001) for U.S. imports and Bradford, Jensen and Schott (2006) for U.S. exports. These analyses of transfer pricing have derived useful expressions for the optimal transfer price for a firm engaged in intra-firm trade, and liable for corporate income taxes in both countries and tariffs in the importing country. However, the analysis of

[1] Indeed, firms may have incentives to report different values to the customs authorities and tax authorities in the same country, though it may be harder to get away with. For example, understating the value of imports to the customs authorities can reduce tariffs, while overstating the value of the same imports to the general tax authorities in the importing country may reduce corporate profits thus its income tax.

discrepancies in trade data has particular features which bear emphasis. The incentives for misreporting trade values are not the same as those for transfer pricing, though they have many similarities. The relevant features include the following:

First is the fact that different authorities receive different information. This is recognized by Swenson (2001) who assumes separate penalties assigned by the home and foreign authorities, but still derives a single transfer price which presumably is reported to both sets of authorities. Bradford, Jensen and Schott (2006) use a single penalty function, and thus implicitly assume that the same transfer price is reported to both sets of authorities. Empirical evidence that U.S. export prices are sensitive to tariffs and corporate income tax rates in the importing country provides some evidence that this may not be unreasonable.

Second, a large share of U.S. imports from China involves unrelated parties. Thus, one would not expect transfer pricing to be involved in such transactions, but misreporting might well be. China Customs data make it possible to identify the organizational type of firm doing the exporting (e.g. foreign-invested, state-owned, collective, or private enterprise). These enterprise types may differ in the way they are taxed, the type of capital controls they are subject to, and possibly in the relative penalties they face for submitting misleading information. More than 60 percent of China's direct exports to the United States in recent years have originated from foreign-invested enterprises (FIEs), about 20 percent from state-owned enterprises (SOEs), and the rest from private and collective enterprises. By comparison, U.S. data show that about 25 percent of U.S. imports from China consist of related-party trade. This suggests a large share of China's exports to the United States originate from firms with foreign investment in China,[2] but shipping at arms' length to the United States. Non-foreign-invested enterprises are likely to be primarily engaged in arms' length transactions.

Third, Chinese exporters are subject to both a corporate income tax and a value-added tax (VAT). The incidence of these taxes varies both across trade regimes and types of enterprises. In particular, the value-added tax varies across products, and in addition is rebated in whole or in part for firms engaging in exports. Thus, the value-added tax net of the rebate varies substantially across firms and product categories.

Our misreporting model outlined below follows many of the notational conventions of Swenson (2001) but is modified in several ways to incorporate stylized fact discussed above. The most important of these is that there are two statistical agencies, one in the exporting country (i.e. China Customs) and one in the importing country (i.e. U.S. Customs), and the firm has a choice as to what value of trade transactions to report to each country. By contrast, in a standard transfer pricing model there is one transfer price, which differs from the comparable arms' length price, and by assumption is reported identically to both countries' authorities. The model also adds additional policies in the exporting country: there is a VAT as well as a corporate profits tax, and there are capital controls both on money leaving and entering the exporting country. Both the VAT and capital controls provide additional incentives for misreporting to the exporting countries' authorities.

[2] Enterprises from Taiwan, Hong Kong, Macau, Korea and other Asian countries constituted a large portion of FIE operating in China.

The consequence of replacing one transfer pricing decision with two misreporting decisions is to effectively de-link the incentives pertaining to Chinese conditions and U.S. conditions. This, in turn, implies that the misreporting behavior of two arms' length traders is identical to that of an integrated multinational firm. Misreporting is thus a more general phenomenon than transfer pricing, which may contribute to misreporting but is usually conceived of as an actual transfer of resources between the exporting and the importing countries to avoid taxes and tariffs. The standard transfer pricing model can be derived from our model by assuming that the same (misreported) value is reported to both countries' authorities, under a prohibitively high penalty for deviation. We relax this assumption because the large observed discrepancies in the data is consistent with a world in which firms do not place a high weight on the probability of being penalized simply because data reported to the exporting and importing countries' authorities are inconsistent.

Using the subscripts $_X$ and $_M$ to define information pertaining to the exporting country (China) and the importing country (United States), respectively. Define the deviations in prices reported to the exporters' customs authority and importers' customs authority, respectively, as

$$\delta_X = P_X - P \text{ and } \delta_M = P_M - P \qquad (1)$$

where P represents the true unit value of the traded products. Similarly, let Q represent the quantity of goods traded. Let τ_X and τ_M represent corporate income tax rates in the exporting and importing country, TAR the tariff rate in the importing country, and θ the VAT rate in the exporting country. Let ρ_X and ρ_M represents the basic value of economic return (profit) to the exporter and the importer, in the absence of any avoidance or evasion behavior. Let the share of profits in value-added be represented as $s = \rho/(\rho + w)$, in which w represents the wage bill. Since the base of the VAT is larger than the base of the corporate income tax, the former including both wages and profits and the latter only including profits, the combined tax rate for VAT and corporate income expressed using profits as a base can be written as $(\tau_X + \theta/s)$.

We assume the presence of capital controls in the exporting country only, on both the unlicensed import and export of capital. The shadow price of being able to avoid the capital control in either direction is expressed by λ, and is treated as exogenous but possibly varying across time and types of firms. Since incentives may change over time, sometimes unlicensed import of capital is profitable while at other times unlicensed export of capital is profitable. When incentives are such as to encourage net unrecorded capital inflow into the exporting country, $\lambda > 0$, and when they are such as to encourage net unrecorded capital outflow, $\lambda < 0$. Thus, the incentives for misreporting of trade due to capital controls can be added to the incentives due to tax and tariff evasion. In the absence of other incentives for misreporting, unrecorded capital inflow would be implemented by setting $\lambda > 0$, justifying receipt of funds in excess of those needed to pay for exports, and unrecorded capital outflow would be implemented by setting $\lambda < 0$, and leaving the difference in an account in the importing country.[3] The value of λ may change over time, according to changes in policy or speculation against anticipated exchange rate

[3] The key here is that, in the absence of other incentives for misreporting, λ always has the same sign as δ_X, which guarantees that $\lambda * \delta_X$ enters the objective function as a positive term.

changes, and may also vary across different types of firms as some of them may face tighter capital controls or are more sophisticated in evading them.

The trader's cost function is augmented with a penalty function which represents the costs of being detected in misreporting the value of either exports or imports. Following Swenson (2001), we assume that the cost of detection is proportional to the volume of imports but quadratically increasing in the proportionate amount of the deviation. Following the implicit assumption of Bernard, Jensen, and Schott (2006), we assume that the penalty is added directly to the costs incurred by traders and is not tax-deductible (e.g. there may be jail time or other non-monetary costs incurred as part of the penalty). The variables a_X and a_M, both assumed positive, represent the level of penalty (intensity of enforcement) in the exporting and importing country respectively. The total penalty increases quadratically in the amount of the deviation and linearly in the intensity of enforcement. λ, a_X and a_M may vary in their intensity across time and firm types.

Both the exporter and the importer minimize the costs of taxes, tariffs, and enforcement penalties, adjusted in the exporter's case for the net benefits of avoiding capital controls. Thus, the exporter's cost function is

$$\min_{\delta_X} C_X = (\tau_X + \theta / s)(\rho_X + \delta_X Q) + \frac{a_X}{2}\frac{\delta_X^2 Q}{P} - \lambda \delta_X Q \tag{2}$$

while the importer's cost function is

$$\min_{\delta_M} C_M = \tau_M [\rho_M - \delta_M Q - TAR(P + \delta_M)Q] + TAR(P + \delta_M)Q + \frac{a_M}{2}\frac{\delta_M^2 Q}{P} \tag{3}$$

It is evident that if the exporter and importer are part of the same firm, then the cost function for the combined firm takes the form $C_X(\delta_X) + C_M(\delta_M)$, which is separable in its arguments. Thus, there is no *per se* reason for the parties in an arms' length transaction to behave differently from the parties in an intra firm transaction with respect to misreporting. However, intra-firm transaction may facilitate misreporting through transfer pricing.

Optimization of the exporter's problem yields expressions for the reporting deviation and the reported price as

$$\delta_X = \frac{(\lambda - \tau_X - \theta / s)}{a_X} P \text{ and } P_X = \left(1 + \frac{(\lambda - \tau_X - \theta / s)}{a_X}\right) P \tag{4}$$

while optimization of the importers' problem yields the corresponding expressions

$$\delta_M = \frac{\tau_M - TAR(1 - \tau_M)}{a_M} P \text{ and } P_M = \left(1 + \frac{\tau_M - TAR(1 - \tau_M)}{a_M}\right) P \tag{5}$$

Therefore the percentage difference in observed reporting prices can be written as

$$\frac{\delta_M - \delta_X}{P} = \frac{P_M - P_X}{P} = \frac{\tau_M - TAR(1-\tau_M)}{a_M} - \frac{(\lambda - \tau_X - \theta/s)}{a_X} \qquad (6)^4$$

The economic interpretations of equations (4), (5) and (6), and their implications for econometric analysis of the observed discrepancy, are as follows.

For the exporting country, underreporting implies $\delta_X < 0$. According to equation (4), underreporting is consistent with positive rates of corporate income tax and VAT ($\tau_X > 0$, $\theta > 0$) and with $\lambda < 0$, i.e. a situation in which capital controls work in such a way as to favor net capital outflow. The amount of underreporting is positively associated with the effective tax rates (τ_X and θ/s) and with the degree to which the control on outbound capital is binding (λ). Overreporting can take place if $\lambda > (\tau_X + \theta/s)$, i.e. when the incentives caused by evasion of capital control favor unrecorded capital inflow, and are sufficiently strong to outweigh the incentives caused by tax evasion. In the case of overreporting by the exporter, the degree of overreporting is positively associated with the intensity of capital controls and negatively associated with effective tax rates.

The analysis of misreporting by the importer is simpler since we assume no capital controls. Overreporting implies $\delta_M > 0$, while underreporting implies $\delta_M < 0$. According to equation (5), the sign of δ_M is determined by the sign of the numerator, [$\tau_M - TAR(1-\tau_M)$]. A sufficient condition for overreporting is $\tau_M > TAR(1-\tau_M)$. Underreporting to the importer is only observed when tariff rate after tax deduction is larger than the effective tax rate τ_M.

The observed overall percentage of reporting price discrepancies, according to equation (6), is positively associated with the corporate income tax rate in both the importing and exporting countries (τ_M and τ_X), exporting country's net VAT tax rate θ/s, but negatively associated with importing countries' tariff (TAR) and the degree of enforcement. Thus, differences in the observed discrepancy for different firm types or different categories of transaction may arise from different degrees of enforcement pertaining to those types of firms or transactions. The sign of the observed discrepancies is complicated by the presence of capital control in the exporting country. When importers' data larger than exporters' data, such as the case of China-U.S. eastbound trade, ($P_M - P_X > 0$. and $\delta_M - \delta_X > 0$), the size of the observed discrepancy will be larger when incentives favor unrecorded capital outflow from China, and will be smaller when incentives favor unrecorded capital inflow.

Note that while the misreporting problem we analyze is structurally similar to the traditional transfer pricing problem, it yields some different results. In particular, the size of the discrepancy is positively correlated with tax levels in *both* the exporting and the importing country. When the choice variable is a single transfer price rather than two misreporting margins, the standard result is that a high transfer price is associated with high taxes in the importing country but low taxes in

[4] In our econometric analysis, we will adopt a slightly difference measure for the discrepancy (i.e, log difference of reported imports and exports). We can show easily that the two measures are approximately equivalent to each other.

the exporting country. This does not necessarily mean that the standard result is invalid. For example, multinationals may in fact choose to report a single optimal transfer price to both parties to shift profit from high income tax country to low income tax country, and avoid the cost to keep separate accounting book for the same transaction. This implies the standard transfer pricing model is a special case of misreporting model when related party trade is involved, and this related party price would be correlated with the difference between corporate income tax rates in two countries, not just the levels. However, while the incentives implied by the misreporting model apply to all trade, the incentives implied by the standard transfer pricing problem should apply only to related-party transactions.

Please also note that our theoretical model is based on misreporting price or unit value. In reality, traders may misreport either price or quantity or both. Therefore, in our empirical analysis, we will define the statistical discrepancy in various ways, to reflect discrepancies in trade value, quantity and unit value.

In order to use the general model developed in this section as a guide for empirical analysis, we need to find proper proxies to represent the various kinds of misreporting incentives specified. To do this, and to aid in the interpretation of the results, it is important to understand in more detail how the relevant features of taxation and capital control work, as well as certain institutional features of Chinese exports. These are discussed in the next two sub-sections.

2.2 VAT avoidance and under reporting at Chinese border

China's tax revenue relies primarily on indirect taxes, such as the value-added tax. The VAT accounted for between 36 and 50 percent of China's government revenue in 2006.[5] China's VAT has several peculiar features distinguishing it from the VAT used in other countries. China's VAT is both destination-based (all goods sold in the country are taxed; the VAT is rebated on exports of domestically-produced goods) and production-based (no deduction is allowed for capital goods purchased during the current period).[6] The destination basis of the VAT creates a difference between the tax treatment of domestic sales and trade. Moreover, imports are usually duty-free if they are used for producing exports. The practice of export tax rebates is widespread, and is permitted under the GATT/WTO, as long as the rebate rates are no higher than the actual collection rates.

The variation in effective VAT rates arises from modifications to the destination and production basis. Unlike the European Union, where the VAT is on a pure destination basis and VAT rebates on exports are fully credited, in China the destination basis of the VAT is frequently modified by reduction or elimination of VAT rebates on exports to pursue a variety of policy goals, including stabilization, reducing trade frictions, and environmental policy.[7] The production basis, which is not common worldwide, was adopted originally in order to maximize tax revenue,

[5] *China Statistical Yearbook 2007* and authors' calculations. The range is due to the category "Consumption Tax and Value-Added Tax on Imports," not broken out separately and accounting for 14 percent of revenues. The category "Value-Added Tax," accounting for 36 percent of revenues, likely refers to VAT on Chinese domestic production.
[6] See USITC (1998) for a contrast of the destination basis with the origin basis, and Lin (2004) for production basis vs. revenue or consumption basis.
[7] See USITC (2007) pp. 148-149.

despite the distortions caused by charging higher taxes to capital-intensive sectors. The tax contains a number of other adjustments and variations which add to its complexity.[8]

As documented by Cui (2003), China implemented the export tax rebate policy in 1985 and established the "full refund" principle in 1988. China implemented a major tax reform in 1994 by replacing the old industrial and commercial standard tax (*gong shang tong yi shui*) with a new value-added tax with base rates at 13 percent and 17 percent and zero rate on exports. The export rebates increased dramatically after 1994 and the central government was forced to reduce the rebate rates twice in 1995 and 1996 due to budget shortfalls. To counter the negative impact of the 1997 Asian financial crisis and promote exports, China increased the export tax rebates for various products nine times from 1998 to 1999. Since 2003, due to rapidly rising exports and increasing pressure for appreciation of the Renminbi, Chinese government has reduced the export VAT refund rates on many products (see Circular No. 222, 2003). For example, rebates on certain scarce natural resources and ores were reduced or completely eliminated. In 2007, a new round of rebates cut on more than one third of the product categories in the customs tariff code was proposed by Chinese government (see Circular No. 90, 2007). Rebates were eliminated on those products that consume high amounts of energy and resources or cause high levels of pollution in production, and lowered for certain products that tend to cause trade frictions such as textiles, toys, paper and furniture. Over 2002-2007, the average statutory VAT rate is about 16 percent, and the rebate rates range from 0 percent to 17 percent with an average around 12 percent and a standard deviation around 4 percent. Thus the net VAT (VAT minus the rebate) has a substantial amount of cross-product and time series variations, which we exploit in our econometric analysis.

The VAT rebate policy on exports in China is complicated and has been changing constantly over time. However, the main method of computing the rebate is rather stable. "Exemption, Credit and Refund" (ECR hereinafter) is the most popular method, especially in the recent years. As specified in Circular No. 7 (2002), almost all manufacturers use the ECR method. Another permissible method, "Refund After Collection," has been rarely used since 2002, applies primarily to trading companies, and upon examination appears to work in a manner very similar to the ECR method. According to Circular No. 7 (2002), the official formula used to calculate VAT payable for general trade and processing exports with imported materials is as follows:

$$\text{VAT Payable} = \text{Output VAT} - (\text{Input VAT} - \text{NCNR}) \tag{7}$$

in which Output VAT = Domestic sales amount * VAT levy rate (there is no output VAT on exports), Input VAT is the VAT paid on domestically acquired inputs, and NCNR (the noncreditable and nonrefundable amount) is defined as

$$\text{NCNR} = (X - BIM)*(t - r) \tag{8}$$

in which X denotes the value of exports, BIM represents bonded (or tax-free) imported materials; t is VAT levy rate, and r is VAT rebate rate. Thus, for the case of exports, the total VAT bill reduces to NCNR – Input VAT.

[8] Liu, Zuo (2006) contains recent detailed descriptions of the VAT in chapter 3 and the business tax in chapter 5.

The above formula implies that exporters may have incentive to underreport export (X) if (t-r) is positive, which is true for the partial rebate regime in China. The higher is (t-r), the stronger the incentive for exporters to underreport to the Chinese customs authorities.[9] Therefore, we predict a positive relationship between the China-U.S. trade discrepancy and (t-r), the net VAT rate.[10] By a similar argument, there should be a positive relationship between the discrepancy and the Chinese corporate income tax rate, since increased export revenues imply increased total revenues and increased profits.

A further complication arises from the fact that not all exporters are eligible for duty-free treatment of imported inputs. Only exports which qualify for the processing trade (either type I or type II) have BIM > 0. Most, but not all, processing exporters are FIEs, and vice versa. "Normal" exporters, which are the most common form of exports for SOEs and non SOE domestic Chinese firms, pay duty on imports; thus BIM often equal or close to zero for these firms. Therefore, for processing traders, there is a limit to which exports can be underreported. In a legally allowable tax filing it must be the case that the value of exports exceeds the value of bonded imported intermediates (X > BIM), otherwise the authorities will detect a problem and the duty exemption for the imports may be revoked. In the case of normal exports, there is no duty exemption for imported intermediates, and thus their value does not create a lower bound for underreporting of exports. We thus expect that underreporting will be greater for "normal" exports than for processing exports.

2.3 Incentives for over-reporting at the U.S. border

As discussed above, there is an incentive to over-report the value of imports at the U.S. border as long as the corporate income tax rate exceeds the tariff rate. Since the average U.S. corporate income tax rate in 2005 was about 35 percent on income subject to tax and about 19 percent on total net income. By contrast, the average tariff rate on U.S. imports was about 1.4 percent. Thus, in almost all cases, incentives favor overreporting at the U.S. border.[11] However, individual firms face different tax situations. As discussed in the data section below, it is challenging to assign an appropriate corporate income tax rate to different U.S. import transactions based on the available information. It is easier to assign a tariff rate. *Ceteris paribus*, one would expect the U.S.-China trade data gap to be smaller for products with high U.S. tariffs.

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[9] Strictly speaking, this is true for both normal exports and exporters in processing trade with imported materials (type II). Processing exports with supplied materials (type I), in which foreign firms own the bonded imports and the exports produced from them, use the "No collection and no refund" method, which means no VAT on the value-added part of type I processing exports so there is no refund on the domestically purchased inputs. Thus, there is no benefit for misreporting exports associated with misreporting type 1 processing exports. However, since type I processing exports only account for about 10 percent of China's total exports in recent years (Table 6a), the VAT formula discussed in the text describes the most relevant case.

[10] Although this may seem counterintuitive at the first glance, underreporting exporting price has been a popular method to save VAT and has been recommended by some accounting firms. One example can be found at http://www.britcham.org/upload/publications/151/VATchangesRussell.pdf (page 10).

[11] Data on corporation returns with net income is available from the Internal Revenue Service at http://www.irs.gov/taxstats/article/0,,id=170693,00.html . The average tariff was calculated as the ratio of calculated duties collected to customs value on all imports for domestic consumption using data available at http://dataweb.usitc.gov.

An additional feature of the U.S. customs valuation system leads us to expect that in the presence of tariffs, the trade data gap will be even smaller for transactions involving related parties. It is often the case that a U.S. importer acquires an imported good by means of a series of transactions between different entities, with each entity re-selling the good to the next one at a higher price. In this case, it is permissible to report the lower sale value on the first of the series of transaction for the purposes of customs valuation. This practice, which is known informally as the First Sale Rule, has received increasing attention recently.[12] The different entities involved in a series of sales may not necessarily be related parties to the ultimate importer; they may simply be middlemen. However, it is more likely that transactions can be structured in such a way as to take advantage of the First Sale Rule in organizations which already consist of multiple legal entities, such as multinational firms. Thus, we expect that the U.S.-China trade data gap will be lower for firms with both high tariffs and engaged in transactions between related parties, in general, for multinational firms.

2.4 Money laundering (evasion of capital controls) and misreporting at Chinese border

Misreporting of trade data is also one of several methods of moving capital into and out of a country. If the true value of exports is higher than that reported to the authorities (i.e. exports are under-invoiced), the difference can be deposited in an overseas account as a method of unreported capital export. Similarly, if the true value of exports is lower than that reported to the authorities (exports are over-invoiced), the difference can be used to provide a paper justification for bringing additional capital into the country. Although there are other methods for concealing capital transactions, such as misstating FDI transactions or the use of underground private banks, a good deal of concealed "hot money" flows into and out of China may take the form of under- and over-invoicing of exports.

Chinese capital controls have taken a variety of forms, varying over time. These include controls on portfolio flows, external debts, banking transactions, and, until recently, outward direct investment. Evidence that the capital controls have been historically binding includes both the fact that the composition of capital inflows into China has been heavily weighted towards less-controlled foreign direct investment inflows (Prasad and Wei, 2005) and the persistence of onshore vs. offshore interest rate spreads, though these have narrowed since the beginning of the current episode of Renminbi appreciation in 2005 (Ma and McCauley, 2007).

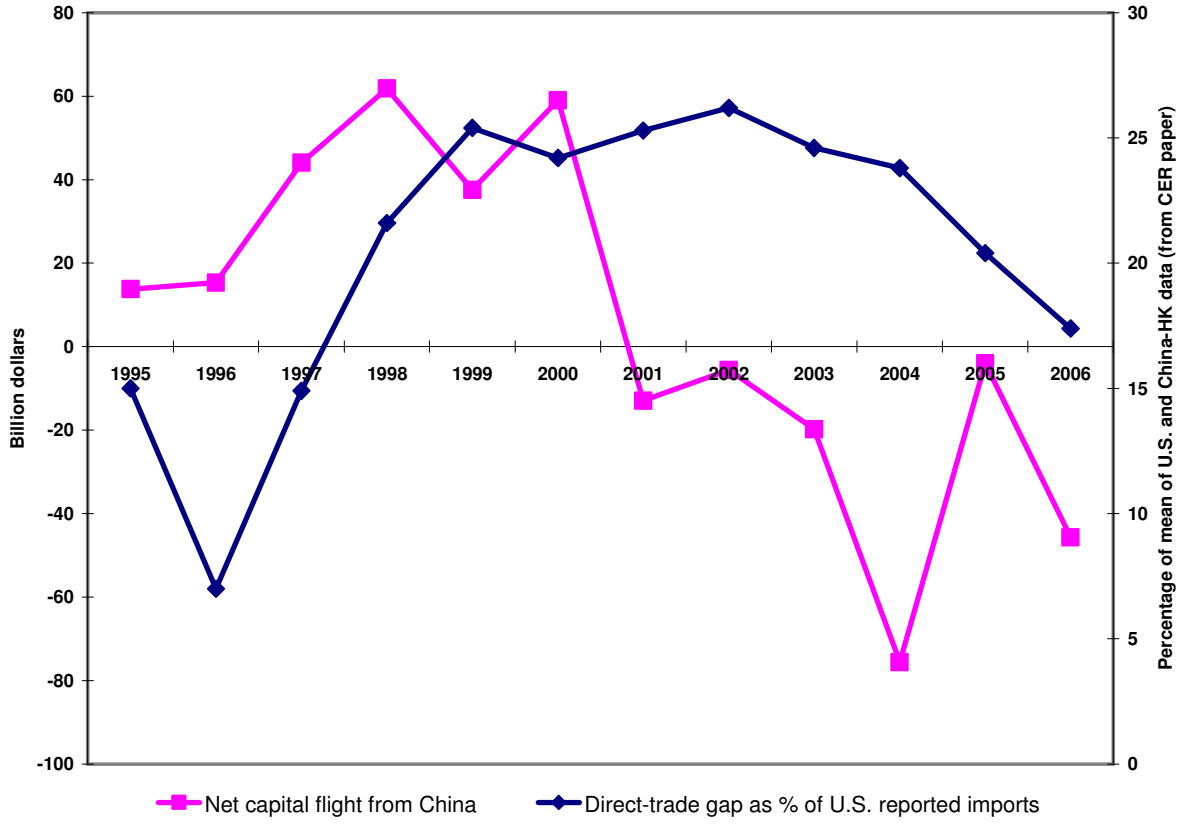
Lyungwall and Wall (2007), studying capital flight from China, examine several alternative measures of capital flight, using different measures generated from the balance of payments. These measures are in broad agreement that China has experienced net capital flight since at least 1986, which peaked in approximately 1998 and declined to near zero by 2001-2002. The peak of capital flight coincides with the period of extensive bankruptcies and restructuring of state-owned enterprises. We extended the three methods for the period from 2003-2006, using IMF balance of payments data. The results for the period prior to 2003 broadly replicate those of Lyungwall and Wall, who use some data from the China State Administration of Foreign Exchange. Beginning in 2001, we find evidence for net capital inflow into China. This is

[12] In January 2008, the Bureau of Customs and Border Protection proposed eliminating the First Sale Rule. This proposal was temporarily postponed by Congress by a provision of the Food, Conservation and Energy Act of 2008 in May. Further background on the First Sale Rule may be found in *Federal Register* (2008).

consistent with anecdotal reports and with a motivation for net inflow due to anticipated appreciation of the Renminbi, which in fact began a process of managed appreciation in July 2005. By some estimates, the value of "hot money" inflows into China accelerated markedly in 2007 and 2008 (*The Economist*, 2008).

Figure 1 below shows the net capital flight from China calculated according to the "World Bank Residual Method" (World Bank, 1985),[13] graphed on the left axis, and showing the reversal from net "hot money" inflow through 2000 to net outflow from 2001 onwards. On the right axis is shown the difference between the reported values of China direct exports as reported to U.S. and Chinese authorities, expressed as a percentage of the U.S.-reported value. The size of the discrepancy measured in this way peaked in 2002 at 26.2 percent but declined to 20.4 percent in 2005.

Figure 1 Net Capital Flight from China and Discrepancy in U.S.-China Direct Trade



Since the incentive for avoiding capital control pertains to all traders, and does not observably vary by the type of goods traded, it is not able to enter into the econometric specification presented later in the paper directly. However, the pattern presented here is broadly suggestive of a situation in which under-invoicing of exports from China prior to 2001-2002 may have contributed to an expansion of the observed data discrepancy, while over-invoicing of exports

[13] This is defined as (change in external debts + net foreign direct investment + current account balance – change in foreign exchange reserves). Data generated using the other two methods are broadly similar.

from 2003 onward may have contributed to a narrowing of the discrepancy, therefore a year dummy variable using 2002 as benchmark in the econometric model may be indicative for whether such general pattern exists when we control all other possible misreporting incentive variables. If, as is widely believed, the amount of "hot money" inflows into China accelerated rapidly in 2007 and 2008, a careful examination of more recent data should show a further narrowing of the trade statistical discrepancy.

III. Data Sources and Descriptive Statistics

Our strategy is to make use of variation across disaggregated trade data at the Harmonized System subheading level (HS-6), the finest level at which consistent international comparisons can be made. The goal is to identify statistically significant and economically important correlations between the observed discrepancies and the incentives for misreporting, as well as any potential differences in enforcement associated with different firm types and trade policies. Our measure of the trade discrepancy excludes re-exports and transshipment through Hong Kong and other third countries. Thus, we concentrate our analysis on discrepancies between China's reported direct exports to the United States and U.S. reported direct imports from China. Our variables capturing the economic incentives for misreporting include, tariff imposed at the U.S. border, the difference between the Chinese VAT collection rate and rebate rate, the difference between corporate income tax rate in the United States and the income tax rate of foreign-invested enterprises (FIEs) in China, the shares of different enterprise types and trade regimes in China, and the share of related-party trade in U.S. reported imports from China.

3.1 Trade Data

U.S. reported direct imports from China are taken from unpublished records obtained from the U.S. Census Bureau, which identify goods shipped directly from ports within China (direct shipment) and whether the goods entered into commerce (cleared customs) in a third country en route to the United States (re-exports) or otherwise transited through a third-country port (transshipment). The data cover all U.S. direct imports from China (direct shipment) during 1995-2005 at the HS-6 level. China's reported direct exports to the United States are taken from official China Customs trade statistics at HS-6 level.[14] In order to match data reported from U.S. side, all re-exports through Hong Kong or other third countries have been eliminated. Details on the unpublished U.S. shipping records, the data sources and adjustments made to official China Customs statistics are described in Ferrantino and Wang (2008). Our measure of statistical discrepancies between U.S. reported direct imports from China and China's reported direct exports to the U.S. is computed as :

[14] In Chinese export statistics, China Customs ask traders to declare both a "country of destination", which refers to the next stop exported goods arrive at after they depart a Chinese port (not necessarily the final destination country), and "countries of consumption", which refers to the final destination country where goods will be consumed. If the United States is both "country of destination" and "country of consumption" in a transaction, it is clear that this is direct export from China to the United States, e.g. shipments which travel non-stop from Shanghai to San Francisco. However, when "country of destination" is Hong Kong or other third counties and "country of consumption" is the United States, we only know that this is a shipment from China to the United States via Hong Kong or other third countries, but are not sure whether this reflects re-exports through Hong Kong (goods passing through Hong Kong Customs) or transshipment (goods passing through Hong Kong ports but not through Customs). See Ferrantino and Wang (2008).

$$GAP_{it} = Ln(M_{it}^{US}) - Ln(X_{it}^{CH}) \quad (9)$$

where M is U.S. reported direct imports from China; X is China reported direct exports to the U.S.; i represents product; and t represents year.

Summary statistics for our measure of U.S.-China trade data discrepancy are reported in Table 1. There are three notable features in the data. First, the mean of *GAP* is near zero before 1997, implying that the data match fairly well once Hong Kong is taken into account. From 1997 onward, the mean discrepancy is positive, reaching its peak in 2004 (2001-2002 in the trade weighted case), then starts to decline. Second, the size of the discrepancies varies significantly across HS-6 subheadings, as reflected by the large size of the coefficient of variation (standard error/mean). Finally, despite of the overall positive discrepancy, over 40 percent of the discrepancies at the HS-6 level are actually negative, demonstrating that the factors influencing the discrepancies are very complex and may operate in opposite direction.

Table 1: China-U.S. trade data Discrepancies, 1995-2005

Year	*Trade-weighted Gap*	*Whole Sample*					*Gap>=0*			*Gap<0*		
		N	Mean	Std. Err.	Min	Max	N	mean	Share of lines	N	mean	Share of lines
1995	0.22	2,427	0.00	1.92	-10.89	10.13	1,152	1.38	47.5	1,275	-1.24	52.5
1996	0.12	2,545	-0.06	1.81	-7.47	11.77	1,231	1.21	48.4	1,314	-1.25	51.6
1997	0.21	2,778	0.05	1.91	-8.56	13.42	1,438	1.30	51.8	1,340	-1.28	48.2
1998	0.29	2,918	0.09	1.91	-8.86	10.76	1,540	1.30	52.8	1,378	-1.26	47.2
1999	0.33	3,057	0.17	2.01	-8.71	11.64	1,657	1.37	54.2	1,400	-1.26	45.8
2000	0.32	3,203	0.22	1.95	-6.89	12.79	1,790	1.36	55.9	1,413	-1.24	44.1
2001	0.33	3,271	0.30	1.89	-7.95	12.04	1,872	1.37	57.2	1,399	-1.12	42.8
2002	0.33	3,481	0.30	1.84	-7.82	13.04	2,028	1.32	58.3	1,453	-1.11	41.7
2003	0.31	3,579	0.32	1.84	-8.94	14.48	2,104	1.32	58.8	1,475	-1.09	41.2
2004	0.30	3,725	0.36	1.85	-7.43	12.63	2,188	1.36	58.7	1,537	-1.05	41.3
2005	0.26	3,857	0.29	1.83	-8.75	11.87	2,245	1.27	58.2	1,612	-1.06	41.8
2002-2005	0.29	14,642	0.32	1.84	-8.94	14.48	8,565	1.31	58.5	6,077	-1.08	41.5

Notes: Only 53 products have exactly zero discrepancies over 1995-2002 and they are included in the "GAP>=0" category.

3.2 U.S. Import Tariff Data

U.S. tariffs on merchandise imported from China are computed using USITC internal data, as the ratio of calculated duties collected to customs value of U.S. imports from China for consumption at the HS-6 level. Summary statistics and average discrepancies by year are reported in Table 2, which distinguishes products with tariff rates below the mean from those with tariffs above the mean. The data show that in general, U.S. tariff rates on imports from China are about 5 percent for the average HS-6 subheading, with peaks at around 60 percent. The average discrepancies for products with low tariff rates are higher than the discrepancies for products with high tariff rates. This implies a negative association between the discrepancies and U.S. tariff rates, consistent with the predictions of our model.

Table 2: U.S. tariff on imports from China, simple average, 1995-2005

Year	*U.S. tariff on imports from China*					*GAP of Low tariff Products*			*GAP of High tariff Products*		
	N	Mean	Std. Err.	Min	Max	N	Mean (GAP)	Share of lines	N	Mean (GAP)	Share of lines
1995	2,421	5.44	5.50	0	37.50	1,621	0.04	66.8	806	-0.06	33.2
1996	2,539	5.19	5.43	0	39.15	1,686	0.02	66.2	859	-0.22	33.8
1997	2,773	4.84	5.28	0	37.50	1,823	0.14	65.6	955	-0.10	34.4
1998	2,914	4.52	5.37	0	37.98	1,910	0.19	65.5	1,008	-0.10	34.5
1999	3,055	4.30	5.31	0	37.92	1,991	0.29	65.1	1,066	-0.06	34.9
2000	3,195	4.17	5.19	0	37.50	2,056	0.36	64.2	1,147	-0.04	35.8
2001	3,268	4.04	5.23	0	39.68	2,134	0.42	65.2	1,137	0.08	34.8
2002	3,475	4.03	5.14	0	37.50	2,242	0.42	64.4	1,239	0.10	35.6
2003	3,576	3.98	5.27	0	80.42	2,298	0.48	64.2	1,281	0.05	35.8
2004	3,722	3.75	5.12	0	79.90	2,361	0.46	63.4	1,364	0.18	36.6
2005	3,854	3.81	5.00	0	55.83	2,448	0.46	63.5	1,409	-0.01	36.5
2002 -2005	14,627	3.89	5.13	0	80.42	9,349	0.46	63.9	5,278	0.08	36.1

Notes: "Low tariff " panel shows the average discrepancies by year for the products with tariffs lower than the average tariff in that year; "High tariff" panel shows the average discrepancies by year for the products with tariffs higher than or equal to average tariff in that year.

3.3 Chinese VAT and VAT Rebate Data

China VAT rebate rate data are obtained from the Department of Taxation Policy, Ministry of Finance, and the State Administration of Taxation. These include statutory collection rates and refund rates for each product at HS-8 or higher levels from 2002 to 2005. When VAT statutory or rebate rates change in the middle of a year, we use the weighted average, weighted by the numbers of days in each period for a given year. Data at HS-8 level are aggregated to HS-6 using simple averages. Summary statistics of the net VAT collection rate for Chinese exports are presented in Table 3a. Although only four year data are available, the data show clearly that the average discrepancies for products with lower net VAT collection rate are significantly lower than the discrepancies for products with a higher net VAT collection rate, consistent with the prediction made in the previous section.

Table 3b reports the variation of the average net VAT collection rates across enterprise types and trade regimes. The data show that normal exports are generally subject to higher net VAT collect rates than processing trade, regardless of firm type. There is relatively little difference between type I and type II processing exports, and processing exports by FIEs appear to enjoy the lowest net VAT collection rate. If VAT avoidance is an economic incentive for firms to underreport their exports at Chinese border, we should expect a positive association between the trade data discrepancy (GAP) and the share of normal exports from all types of enterprises. We will test these hypotheses in our econometric work.

Table 3a: VAT collection rate net of rebate, simple average, 2002-2005

Year	*VAT rate net of rebate*					*Low net VAT rate*			*High net VAT rate*		
	N	Mean	Std. Err.	Min	Max	N	Mean (GAP)	Share of lines	N	Mean (GAP)	Share of lines
2002	3,456	2.06	2.03	0	17.00	2,449	0.22	70.4	1,032	0.49	29.6
2003	3,553	2.09	2.03	0	8.00	2,438	0.22	68.1	1,141	0.54	31.9
2004	3,708	4.35	2.31	0	17.00	3,359	0.31	90.2	366	0.81	9.80
2005	3,841	4.48	2.62	0	17.00	3,389	0.22	87.9	468	0.83	12.1
2002 -2005	14,558	3.29	2.56	0	17.00	11,635	0.25	79.9	2,923	0.59	20.1

Notes: "Low" panel shows the average discrepancies by year for the products with lower than the average net VAT rate in that year; "High" panel shows the average discrepancies by year for the products with higher than or equal to average net VAT rate in that year.

Table 3b: VAT collection rate net of rebate, by firm type and trade regime, exports weighted, 2002-2005

Year	*2002*	*2003*	*2004*	*2005*	*2002-2005*
SOE normal exports	1.66	1.59	4.11	4.14	3.04
FIE normal exports	2.13	2.09	4.08	4.23	3.49
Collective & private normal exports	1.74	1.74	3.99	4.03	3.43
SOE type I Processing exports	1.02	1.12	3.77	3.68	2.61
FIE type I Processing exports	1.34	0.99	3.97	3.32	2.71
Collective & private type I Processing exports	1.94	0.88	4.03	4.08	3.17
SOE type II Processing exports	1.05	0.98	4.01	4.27	2.56
FIE type II Processing exports	0.98	0.84	3.36	3.11	2.47
Collective & private type II Processing exports	0.89	1.00	4.01	4.34	2.98
All others[a]	1.47	1.51	4.24	4.36	3.38
Total	1.33	1.22	3.71	3.60	2.83

3.4 Corporate Income Tax Data

The income tax rate data of China's FIEs are obtained from the survey of industrial enterprises above designated size, and computed as income tax payable divided by firms' total profit. The original data is on China's 4-digit classification of economic activities (GB/T4754-2002). This is concorded first into 4-digit International Standard Industrial Classification (ISIC rev. 3) classification, then into HS-6 using a concordance from the United Nations Statistical Division. In principle we would like to use the income tax rates for all categories of Chinese enterprises because FIE rates are in most cases substantially lower than those charged on Chinese domestic enterprises. As discussed earlier, the transfer pricing model is a special case of our misreporting model when trade transactions occur among related parties, we only test the hypothesis based on the transfer-pricing model (i.e., the gap is positively correlated with the difference between tax rates) using the corporate income tax data currently available to us. We will further test the hypothesis implied by the misreporting model (the gap is positively correlated with each country's tax rate) when our corporate income tax data get improved.

U.S. corporate income tax data are obtained from the Internal Revenue Service (IRS) website[15] at 3 digit NAICS. They are computed using income taxes paid by firms divided by their total income before credits (i.e., the actual payable tax rates). One problem is that the taxes are paid by the importing industries, rather than the industries producing the products. For example, U.S. retailers may import apparel and U.S. auto manufactures may import some electronics, and so on. In order to address this issue, we need to generate the average tax rate of all industries which may import the goods in question, weighted by their shares in the demand for that product. This is done using the import use matrix from U.S. annual input-output tables published by BEA. We first concord the IRS tax data from 3-digit NAICS to the classification used in the annual input-output tables, then use another concordance published by BEA to concord the input-output classifications to HS-6. We realize that this transformation may not fully capture the effective rates we are looking for; and the relevant importers for tax purposes may be middlemen other than the demanding industries identified in the input-output table. Hopefully the procedure we follow represents at least some improvement over naively choosing the tax rate of the producing industry.

Table 4 reports the summary statistics of the differences in corporate income tax rates between U.S. and FIEs in China. It is clear that the corporate income tax rates in the U.S. is significantly higher than those for FIEs operating in China. As others have shown both theoretically and empirically, such a difference in corporate income tax rates provides an incentive for multinational firms to charge transfer prices higher than costs in order to shift profits. However, there is no obvious relationship between the transfer price and the statistical discrepancy. An alternative good proxy variable for transfer pricing incentive is the share of related party trade in U.S. imports from China at detailed product level, which will be discussed in the next sub-section.

Table 4: The difference in corporate income tax rates between U.S. and China, 2002-2005

Year	*Tax Difference (U.S.-China)*					*Low Tax Difference*			*High Tax Difference*		
	N	Mean	Std Err	Min	Max	N	Mean (GAP)	Share of lines	N	Mean (GAP)	Share of lines
2002	2,542	15.08	8.51	-56.21	26.78	905	0.24	26.0	2,576	0.32	74.0
2003	3,206	16.04	4.46	-17.30	28.17	1,122	0.33	31.3	2,457	0.32	68.7
2004	3,327	17.06	5.05	-34.52	27.53	1,508	0.39	40.5	2,217	0.34	59.5
2005	3,479	16.67	3.35	-4.68	26.87	1,539	0.35	39.9	2,318	0.25	60.1
2002 -2005	12,554	16.29	5.5	-56.21	28.17	5,074	0.34	40.4	7,480	0.22	59.6

Notes: "Low" panel shows the average discrepancies by year for the products with lower tax difference than its mean in that year; "High" panel shows the average discrepancies by year for the products with higher than or equal to average tax difference in that year.

3.5 Data on U.S. Related-Party Imports from China

The transfer pricing model should, strictly speaking, apply only to the transactions with intrafirm trade. The incentives under this model would imply larger values for imports, since

[15] http://www.irs.gov/taxstats/article/0,,id=170693,00.html

U.S. corporate income taxes are generally higher than Chinese taxes as applied to FIEs. In a misreporting model, the presence of either corporate income tax gives rise to a positive gap. The incentives for overreporting imports are greater than the incentives for underreporting exports, though, because of the differences in the tax rates. It may also be the case that multinational firms are more sensitive to the relative incentives than firms making arms' length comparisons, and more sophisticated in avoiding enforcement. Any of these considerations, or all of them taken together, would lead us to predict that the statistical discrepancy is higher for related-part trade.

U.S. data on imports from China distinguishing intra-firm (related party) trade from arms' length trade were generated using confidential Census data.[16] The share of intra firm transactions in U.S. total imports from China is computed using the value of related party imports divided by U.S. general imports at HS-6. Summary statistics are reported in Table 5.[17] In general, the statistical discrepancy is higher for products with a high share of intra-firm trade as expected.

Table 5: Relative party share in U.S. imports from China and average discrepancies for products with high or low related party trade share

Year	*Related party trade Share*					*Low Share*			*High Share*		
	N	Mean	Std. Err.	Min	Max	N	Mean (GAP)	Share of lines	N	Mean (GAP)	Share of lines
1999	3,048	9.53	19.55	0	100	2,345	0.10	76.7	712	0.38	23.3
2000	3,197	9.36	18.65	0	100	2,434	0.15	76.0	769	0.43	24.0
2001	3,266	9.57	19.09	0	100	2,490	0.26	76.1	781	0.45	23.9
2002	3,476	9.81	19.23	0	100	2,640	0.29	75.8	841	0.34	24.2
2003	3,575	10.22	19.20	0	100	2,670	0.31	74.6	909	0.35	25.4
2004	3,721	10.76	19.50	0	100	2,781	0.36	74.7	944	0.38	25.3
2005	3,854	10.49	18.9	0	100	2,862	0.28	74.2	995	0.33	25.8
2002 -2005	14,626	10.33	19.20	0	100	10,953	0.31	74.9	3,673	0.33	25.1

Notes: "Low" panel shows the average discrepancies by year for the products with lower than the average related party trade share in that year; "High" panel shows the average discrepancies by year for the products with higher than average related party trade share in that year.

3.6 Share of different trade and enterprise types in China's direct exports to the United States

China's share of direct exports to the United States by different types of enterprises and trade regimes are computed from official China Customs trade statistics at HS-6 level, and reported in Table 6a.

A number of features are worth noting. First, there has been a steady decline in the share of SOEs and steady increase in the share of FIEs in China's exports. At the end of 2006, FIEs are responsible for more than 65 percent of China's direct shipments to the United States, while the

[16] Comparable publicly available data are available at http://sasweb.ssd.census.gov/relatedparty/.
[17] The mean for a typical observation is lower than the aggregate because of the large number of products have no related-party trade. For example, the overall share of related party imports among U.S. imports from China in 2005 is 25.8 percent. Intra-firm imports from China highly concentrate in certain categories of electronic equipment and precision instruments.

share of SOEs has declined to only about 15 percent. Second, FIEs' direct exports to the U.S. are dominated by processing exports (about 80 percent), while the share of processing exports is much smaller in Chinese domestic firms' exports, whether state-owned or private. Third, Type II processing exports, in which Chinese parties own the exports and corresponding imports, are the major format of China's direct exports to the U.S. and are mostly engaged by FIEs. However, the value of FIEs' normal exports to the United States is also significant. The role of Chinese non-state-owned domestic firms in overall Chinese exports to the United States has increased over time and is dominated by normal exports. (Firms registered as collective enterprises are often *de facto* private enterprises).

Table 6a Export share by firm types and trade regimes, 2001-2006

Share of total exports	2001	2002	2003	2004	2005	2006
SOE normal exports	24.0	20.1	16.0	13.2	11.1	9.9
SOE type I Processing exports	8.4	7.5	5.6	5.3	4.2	3.3
SOE type II Processing exports	4.3	4.5	3.3	2.0	1.9	1.7
FIE normal exports	10.2	11.1	11.2	11.6	12.4	13.2
FIE type I Processing exports	5.1	4.9	5.3	4.4	5.6	6.2
FIE type II Processing exports	37.5	40.2	44.2	47.5	46.4	45.6
Collective & private normal exports	4.8	6.4	8.3	10.2	12.6	14.3
Collective & private type I Processing exports	0.6	0.3	1.4	1.4	1.1	0.9
Collective & private type II Processing exports	1.8	2.0	2.0	1.6	1.8	2.0
All others [(a)]	3.3	2.9	2.6	2.7	3.0	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: [(a)] Include re-export, exports other than normal and processing exports, and exports conducted by other firms, e.g. customs broking enterprise, foreign embassy, and foreign company's office in China.

Table 6b lists summary statistics for the exports shares at the HS-6 level. Again, there is a difference between the aggregate data and the data for a typical HS-6 subheading. There are many HS-6 lines with small trade flows dominated by SOE normal exports, and larger trade flows in the lines dominated by FIE processing exports.

Table 6b: Simple statistics for firm type and trade regime share at HS-6 level.

Share of total exports	Obs	Mean	Std. Dev.	Min	Max
SOE normal exports	14,213	36.6	33.2	0	100
SOE type I Processing exports	14,213	2.7	9.7	0	100
SOE type II Processing exports	14,213	2.4	10.2	0	100
FIE normal exports	14,213	17.9	24.4	0	100
FIE type I Processing exports	14,213	2.1	9.3	0	100
FIE type II Processing exports	14,213	14.7	25.3	0	100
Collective & private normal exports	14,213	18.8	24.1	0	100
Collective & private type I Processing exports	14,213	0.5	3.8	0	100
Collective & private type II Processing exports	14,213	1.4	7.1	0	100
All other	14,213	3.0	11.6	0	100

IV. Econometric Analysis

We relate China-U.S. trade statistics discrepancies to the economic incentives of misreporting and other possible determinants. The formal econometric specification is given in following equation (or by variation to be noted in discussion).

$$GAP_{it} = \beta_{ot} D_t + \beta_1 \text{tariff}_{\text{it}} + \beta_2 VATrate_{\text{it}} + \beta_3 itaxrate_{\text{it}} + \beta_4 related\_share_{it} + \sum_k \beta_k C\exp\_shares_{it}^k + HS6fixed_i + \mu_{it} \quad (10)$$

where β_k's are coefficients to be estimated, *tariff* is U.S. tariff rate on imports from China, *VATrate* is the difference between VAT collect and refund rate (Net VAT rate) on China's exports, *itaxrate* is the difference between U.S. corporate income tax rate and income tax rate of Foreign Invested Enterprises (FIEs) in China, *related_share* is the share of related party trade in total U.S. import from China, *Cexp_share* are China's export share by various trade regimes and firm types, D_t is year dummy variables, $HS6fixed_{\text{i}}$ is fixed effect of 6 digit HS product categories, and μ is the error term.

The dependent variable is always GAP as defined in Equation (9). We assume that net VAT rates, Chinese trade regime and firm type variables only affect the magnitude of export data reported at Chinese border, while the corporate income tax difference, U.S. import tariffs and related party trade share only affect the magnitude of import data reported at the U.S. border. We combine the shares of type I and type II processing exports to reduce the numbers of explanatory variables used in each regression.[18] All share and rate variables are divided by 100 so that each has a domain of [0, 1]. We run both OLS and fixed effects panel regressions at HS-6 level, but rely primarily on our fixed-effect results which can control for unobserved heterogeneity at product level. In most of our regressions, only years 2002-2005 are covered due to unavailability of VAT data in earlier years. All regressions include year dummies.

4.1. Basic results

Major regression results are reported in Table 7. All the regressions, except the first one, use HS 6-digit product fixed effects. The first four regressions use data for years 2002-2005, while the last one covers longer time period (1999-2005).

The results generally support our misreporting incentive model outlined in section II, especially our VAT avoidance hypothesis. All variables have the signs as predicted by theory. The coefficients of China's net VAT rate are positive and statistically significant across different specifications. This clearly indicates a positive correlation between China's net VAT rates and China-U.S. trade data discrepancy. It indicates that avoiding VAT tax may be one of the primary economic incentives for firms operating in China to underreport their exports to Chinese Customs

[18] In an alternative specification, not reported, we disaggregate type I and type II processing exports. For FIEs, which account for most of the processing exports, we reject the hypothesis that the coefficients are different at a 99 percent confidence level. For SOEs and other domestic firms, however, we can reject the hypothesis of same coefficients for the two types of processing trade at a 90 percent confidence level.

authorities. For example, the results in Column (2) imply that one percentage increase in China's net VAT rate (due to reduction of VAT rebate rate) on exports will cause about a 5.26 percent increase in the U.S.-China trade data discrepancy or 5.4 percent ($\exp^{(5.26/100)}$ -1= -0.054) decrease in Chinese reported export if we keep U.S. reported import data fixed. This impact is economically very large.

In considering the results by firm type and trade regimes, the omitted category is FIE processing exports, the largest category in terms of trade volume. Our results imply that the statistical discrepancy is larger for normal exports than for processing exports, and for SOEs than for FIEs or collective and private firms. As discussed above, normal exports cannot rely on bonded imported materials (BIM) to reduce VAT liability. This implies two things. First, processing traders can reduce VAT liability through either understating exports or overstating BIM, while normal traders can only understate exports. For this reason, normal traders may understate exports more heavily. Second, BIM imposes a lower bound for processing traders to report the value of exports (X > BIM), while normal traders do not have such a constraint when underreporting.

Further inferences may be drawn by comparing the estimated coefficients for processing traders of different firm types. The statistical discrepancy is larger for SOE processing exporters than for either FIE processing exporters or domestic collective and private processing exporters, who behave in a manner statistically indistinguishable from FIEs. Our theoretical framework gives us two possible interpretations of this result. First, since SOEs are subject to more strict capital controls, the incentive to underreport exports in order to engage in unrecorded capital export (money laundering) may be greater from them. Second, SOE processing traders may be more sophisticated about exploiting loopholes in the VAT rebate procedure, or may have closer relationships with Chinese Customs which may reduce the severity of penalties they receive if their misreporting is detected.

In column (3) of Table 7, we add two interaction terms. One is between China's net VAT rate and share of processing exports. Another one is between U.S. import tariffs and related party share, which will be discussed later. The estimated coefficient of net VAT and processing export share interaction implies that the statistical discrepancy caused by the incentive to avoid VAT is smaller for goods heavily dominated by processing exports. Disaggregated, each 1 percent increase in the net VAT implies a 6.1 percent increase in the statistical discrepancy for a product traded as normal exports, and a 2.55 percent decrease (=6.148-8.693) for a product traded as processing exports. Part of the explanation for this may be that, as noted above, processing traders have two instruments for avoiding VAT, and they may prefer to over-report the value of bonded imported materials rather than under-report the value of exports. It also appears to be the case that processing traders are subject to more strict surveillance by Customs. All processing trade transactions are tracked for at least a five-year period, increasing the probability of detecting a misreported discrepancy. Thus processing traders have lower incentives to avoid VAT by underreporting exports, and may face higher penalties if caught.

Table 7. Major Regression results

	(1)	(2)	(3)	(4)	(5)
	OLS	FE	FE	FE	FE
Net VAT rate	6.151***	5.263***	6.148***	6.202***	
	(1.037)	(0.904)	(1.010)	(1.011)	
U.S. Import Tariffs	-2.916***	-2.718*	-1.962	-1.976	-2.091**
	(0.429)	(1.501)	(1.510)	(1.508)	(0.943)
Related party share	0.218*	-0.118	0.150	0.151	0.505***
	(0.128)	(0.137)	(0.164)	(0.164)	(0.122)
Net VAT rate*Share of processing exports			-8.693***	-8.702***	-7.945***
			(3.256)	(3.255)	(2.693)
U.S. Import Tariffs*Related party share			-4.003**	-4.007**	
			(1.946)	(1.944)	
Difference in corporate income tax				0.450	
				(0.425)	
Share of FIE normal exports	0.433***	1.018***	0.874***	0.874***	1.052***
	(0.111)	(0.131)	(0.141)	(0.141)	(0.092)
Share of SOE normal exports	0.715***	1.387***	1.257***	1.257***	1.379***
	(0.087)	(0.120)	(0.127)	(0.127)	(0.079)
Share of SOE processing exports	0.356**	0.739***	0.710***	0.711***	0.516***
	(0.165)	(0.170)	(0.170)	(0.169)	(0.114)
Share of Collective & private normal exports	0.502***	1.137***	0.993***	0.993***	1.070***
	(0.108)	(0.129)	(0.142)	(0.142)	(0.096)
Share of Collective & private processing exports	0.143	0.215	0.217	0.215	0.063
	(0.200)	(0.227)	(0.226)	(0.226)	(0.170)
Share of all other exports	2.154***	1.593***	1.454***	1.455***	1.468***
	(0.249)	(0.247)	(0.252)	(0.252)	(0.188)
Year Dummy 1999					-0.094***
					(0.033)
Year Dummy 2000					-0.076**
					(0.030)
Year Dummy 2001					-0.005
					(0.028)
Year Dummy 2003	0.022	0.049*	0.050*	0.049*	0.051*
	(0.030)	(0.026)	(0.026)	(0.026)	(0.027)
Year Dummy 2004	-0.088**	-0.052	-0.047	-0.054	0.077***
	(0.041)	(0.034)	(0.034)	(0.034)	(0.028)
Year Dummy 2005	-0.139***	-0.070*	-0.065*	-0.069*	0.061**
	(0.045)	(0.038)	(0.038)	(0.038)	(0.031)
HS 6 digit product fixed effects (FE)		Yes	Yes	Yes	Yes
Observations	14535	14134	14134	14134	23723
R-squared	0.0353				

Notes: Robust standard errors in parentheses, clustered by HS 6 digit products in pooled data regression; * significant at 10percent; ** significant at 5percent; *** significant at 1percent; Columns (5) and (6) covers 1999-2005 while other columns cover 2002-2005 due to availability of China's VAT data.

The regression results also suggest there may be tariff evasion at the U.S. border, indicated by the negative coefficients of U.S. import tariff rate, which varies in statistical significance depending on the specification. The estimate in column (2) implies that if we hold export data fixed, one percentage increase in U.S. import tariffs will lead to a 2.8 percent decrease in U.S. reported imports from China. When we include an interaction term between U.S. tariff rate and share of related party trade in total U.S imports from China, the coefficient estimates of the U.S. import tariff become insignificant (Columns (3) and (4)). The action moves to the interaction

between the tariff and related-party share, suggesting that for related parties the reduction in U.S. reported imports is more on the order of 4 percent for each one percent increase in the import duty. This is consistent with the possibility that U.S. multinational firms are able to more conveniently, even legally, undervalue imports to avoid tariffs using the First Sale Rule mechanism exploited in section II.

The transfer pricing literature suggests that there are incentives to under-price U.S. intra-firm exports to low tax countries and overprice U.S. intra-firm imports from such countries. Most of these studies exploit the cross-country variation in tax rates. In one estimate, Bernard, Jensen and Schott (2006) estimate that the United States over-reported its imports from China by about $1.72 billion in 2004. Our econometric analysis primarily relies on the data at HS-6 digit product level. Although there is no cross-product variation *per se* in the statutory corporate income tax rates, there is variation in the effective rates. We use two proxies for the data we wish to observe. The first proxy is the related-party trade share in U.S. imports from China at HS-6 product level. We have already discussed above the interaction of this variable with U.S. import tariffs. The second proxy is the difference in the applied U.S. corporate income tax rate and the Chinese rate applied to FIEs, calculated as described in section III. Neither of these variables produces significant or robust results. This may well be due to the weaknesses of the available data, and is not necessarily conclusive in rejecting the hypothesis that corporate income tax rates matter. The observed variation in U.S. corporate income taxes is at a higher degree of aggregation than that for other variables in the model. Moreover, we have data on the related-party share from 1999-2005, but the net VAT rate data are available only for 2002-2005. Using both variables together limits the degrees of freedom available to test the hypothesis on the related-party share. When we drop the net VAT rate, thus expanding the number of observations, the coefficient on the related-party share becomes strongly significant, and economically important. It is relevant to compare the cases for which the related-party share is 0 or 100 percent, since most HS-6 subheadings approach one of these two extremes. Compared on this basis, related-party transactions have a data discrepancy 50.5 percent greater than arms' length transactions. This result is at least broadly consistent with the transfer pricing literature. Because omitting the net VAT rate biases the results, it would be useful to re-confirm this result once a longer time period VAT data become available.

The estimated coefficients of year dummy variables could be used to examine the impact of capital control on trades' reporting behavior at Chinese border. As discussed earlier, the under-invoicing of exports from China prior to 2002 to avoid capital control may have contributed to an expansion of the observed data discrepancy, while over-invoicing of exports after 2003 to facilitate "hot money" into China because Renminbi appreciation expectation may have contributed to a narrowing of the discrepancy. If capital controls are very important, we might expect the pattern of the time dummies to be similar to the behavior of the aggregate discrepancy as reflected in Figure 1. Specifications (1)-(4), in which 2002 is the omitted variable, seem consistent with such a hypothesis. The negative coefficient in 2004, increasing in absolute value in 2005, is consistent with a pattern of unrecorded capital inflow induced by expected Renminbi appreciation. The pattern is not replicated in column (5), which, if the time dummy is interpreted as referring to capital controls, suggests that unrecorded capital outflow persisted through 2005. However, as noted in the previous paragraph, omitting the net VAT rate causes a specification error. This error is likely to be particularly severe in the case of capital flows, since reducing VAT rebate and allowing the exchange rate to appreciate were employed simultaneously in an

attempt to reduce trade frictions. Thus, causing the time dummy to bear the weight of both polices, as in column (5), impairs the ability to give it a proper interpretation.

4.2. Underreporting quantity, unit value or misclassification

We have found strong evidence for underreporting export statistics at Chinese border and some evidence of underreporting imports statistics at the U.S. border. A natural question to ask is whether the underreporting is due to underreporting product quantity, price or unit value, or misclassification from products with high tax rates to products with low tax rates (see also Fisman and Wei, 2004).

To test the hypothesis of whether underreporting arises from underreporting quantities or underreporting unit values, we create the following two new dependent variables from our trade data, which allow us to distinguish quantities and unit values for many products:

GAP_Q = ln(U.S. reported quantity of imports) - ln(China reported quantity of exports)
GAP_{uv}= ln(U.S. reported unit value of imports) - ln(China reported unit value of exports)
where unit value = value/quantity at 6 digit HS lines.

To be consistent in the unit of measurement, we select a subsample using only goods measured in kilograms into our sample. Such transactions account for about half of all the observations, but less than half of the trade, and produce a sample which is more heavily weighted toward primary products than the full sample.

The first two columns in Table 8 report the OLS and fixed effects regression results for the gap in reported quantities. The U.S. tariff is insignificant in the fixed effect regression, while the net VAT rate variable is significant. Columns (3) and (4) of Table 8 present results which test the possibility of misreporting unit values. U.S. Tariff is significant in such a case, while VAT variable turns insignificant. Therefore, the testing results indicate VAT avoidance at Chinese border may be primarily through underreporting quantity, while tariff evasion at the U.S. border may be primarily though underreporting unit values.

We also test the hypothesis of misclassification. We created two new explanatory variables: average U.S. tariffs and China's net VAT rate for similar products, i.e., other HS 6 digit products within an HS4 category. These variables yielded weak results, thus we do not report the results, and conclude that by this test at least we do not find significant evidence of misclassification.

Table 8: Underreporting quantity, unit value

	(1)	(2)	(3)	(4)
	Q_OLS	Q_FE	UV_OLS	UV_FE
Net VAT rate	8.543***	4.283***	0.826	0.171
	(1.746)	(1.538)	(0.648)	(0.723)
U.S. Import Tariffs	-2.971***	1.527	-0.941***	-2.066***
	(0.939)	(1.566)	(0.355)	(0.630)
Related party share	0.187	0.084	0.083	0.207
	(0.290)	(0.345)	(0.152)	(0.186)
Difference in corporate income tax	-0.079	1.356*	0.121	-0.262
	(0.963)	(0.710)	(0.432)	(0.368)
Share of FIE normal exports	0.647***	1.088***	-0.167*	-0.015
	(0.227)	(0.267)	(0.101)	(0.127)
Share of SOE normal exports	0.726***	1.313***	0.026	0.087
	(0.189)	(0.238)	(0.086)	(0.116)
Share of SOE processing exports	-0.256	0.417	0.106	0.101
	(0.352)	(0.342)	(0.162)	(0.173)
Share of Collective & private normal exports	0.465**	1.202***	0.036	0.096
	(0.218)	(0.256)	(0.093)	(0.125)
Share of Collective & private processing exports	-0.379	0.013	0.142	-0.004
	(0.340)	(0.405)	(0.169)	(0.180)
Share of all other exports	1.502***	1.075***	0.022	-0.103
	(0.404)	(0.373)	(0.176)	(0.183)
Year Dummy 2003	0.015	0.019	-0.018	-0.029
	(0.058)	(0.050)	(0.030)	(0.028)
Year Dummy 2004	-0.049	-0.022	-0.077**	-0.083**
	(0.073)	(0.061)	(0.036)	(0.033)
Year Dummy 2005	-0.063	0.034	-0.102***	-0.110***
	(0.077)	(0.064)	(0.039)	(0.034)
HS-6 digit product fixed effects		Yes		Yes
Observations	5,861	5,861	5,861	5,861
R-squared	0.0305		0.0075	

Notes: Robust standard errors in parentheses ; * significant at 10percent; ** significant at 5percent; *** significant at 1percent.

4.3 Robustness of the results in sub-samples

In this section, we check the robustness of our results reported in previous subsections to some sub-samples.

First, we divide the positive and negative discrepancies (GAP) into sub-samples. As shown in Table 1, about 41.5 percent of the HS 6-digit products have negative discrepancies over 2002-2005 despite of positive aggregate discrepancy. We may expect that tariff evasion is more likely in the sub-sample with negative discrepancies (i.e., M<X), while VAT avoidance is more likely in the sub-sample of positive discrepancies.[19] The first two columns in Table 9 report the fixed effect results using the GAP sub-samples. We do find that VAT avoidance receives stronger support in positive GAP sub-sample, but no evidence of stronger tariff evasion in negative GAP sample. Tariff variable is highly insignificant in both sub-samples possibly due to reduced variation in the data.

[19] But this is not always true because the regressions reply on variations of GAP rather than the mean of the GAP.

Second, we divide the regression data set into three sub-samples based on Rauch's product classification. According to Rauch (1999), the products at 4-digit SITC level are grouped into three different categories: homogenous, reference-priced and differentiated goods. Homogenous goods (e.g., un-milled wheat and basic metals) are well-defined products listed on organized exchanges. Reference-priced goods (e.g., Polyoxyethylene) are not listed on organized exchanges, but their prices can be quoted in trade publications as "reference prices" without mentioning the names of the producers. Differentiated goods (e.g., clothing and electronics) are usually "branded" with varying quality and features even within very detailed product categories. We expect that the differentiated products are more likely to be used for tax evasion purpose. For example, due to large variations in quality and features, it will be easier to underreport unit values of differentiated products and avoid detection than underreporting unit values of homogenous products. This point has been made by Javorcic and Narciso (2007) in the case of tariff evasion at the borders of some East European countries. To test for this hypothesis, we concord our HS 6-digit products into 4-digit SITC classification and then use Rauch's method to group the products into the three categories. We then run fixed effect regressions with each sub-sample. The results as reported in the last three columns of Table 9. They show that if there is tariff evasion at the U.S. border, it would very likely occur to differentiated products, not to homogeneous or referenced products. This result is consistent to our previous finding that tariff evasion usually happens through underreporting unit values and is more likely for differentiated products. The coefficients of net VAT rate in all three subsamples are significant, implying VAT avoidance existing across different product categories. Interestingly, corporate tax difference variable turns significant for the first time although only marginally. One possible explanation is that transfer pricing behavior is also more likely to occur for differentiated products because it is difficult to be detected by tax authorities.

Table 9: Subsamples

	Positive & negative GAP		Rauch classification		
	(1)	(2)	(3)	(4)	(5)
	M>=X	M<X	Hom.	Ref.	Diff.
Net VAT rate	4.868***	2.429**	6.140**	4.927***	5.788***
	(1.222)	(1.199)	(2.785)	(1.608)	(1.303)
U.S. Import Tariffs	-0.782	-0.029	-0.773	-1.079	-5.874**
	(1.730)	(1.574)	(2.091)	(2.583)	(2.943)
Related party share	-0.167	-0.024	-1.217	0.118	-0.207
	(0.180)	(0.159)	(1.035)	(0.224)	(0.192)
Difference in corporate income tax	0.000	-0.278	-0.083	-1.289	0.915*
	(0.563)	(0.549)	(1.748)	(0.982)	(0.535)
Share of FIE normal exports	0.869***	0.062	0.667	0.874***	0.990***
	(0.163)	(0.177)	(0.553)	(0.280)	(0.165)
Share of SOE normal exports	1.257***	0.473***	1.211**	1.178***	1.368***
	(0.147)	(0.160)	(0.602)	(0.258)	(0.150)
Share of SOE processing exports	0.583***	0.433	1.717	0.452	0.841***
	(0.221)	(0.270)	(1.487)	(0.395)	(0.195)
Share of Collective & private normal exports	0.984***	0.453***	0.926	0.970***	1.087***
	(0.165)	(0.172)	(0.658)	(0.276)	(0.159)
Share of Collective & private processing exports	-0.071	0.338	1.511*	0.051	-0.051
	(0.293)	(0.271)	(0.787)	(0.479)	(0.286)
Share of all other exports	1.526***	0.070	2.609*	1.330***	1.930***
	(0.260)	(0.370)	(1.577)	(0.515)	(0.313)
Year Dummy 2003	0.007	0.098***	0.185	-0.014	0.053*
	(0.032)	(0.033)	(0.137)	(0.064)	(0.030)
Year Dummy 2004	-0.140***	0.110**	-0.137	-0.087	-0.061
	(0.045)	(0.045)	(0.175)	(0.074)	(0.044)
Year Dummy 2005	-0.200***	0.143***	-0.303	-0.142*	-0.062
	(0.050)	(0.048)	(0.188)	(0.082)	(0.048)
HS 6 digit product fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	8,487	6,048	586	3,718	8,879

Notes: Robust standard errors in parentheses; * significant at 10percent; ** significant at 5percent; *** significant at 1percent; All regressions use HS 6-digit product fixed effects and year dummies.

V. Concluding Remarks

We believe that the discrepancies in international trade data are more than simply an inconvenience for empirical researchers. They may, in fact, reveal a significant amount of information about the incentives of exporters and importers who are confronted with taxes, tariffs, and capital controls, and have incentives to evade them. In order to highlight these incentives, we develop a model to explain the behaviors of trading firms facing two decisions; how much to misreport to exporting countries, and how much to misreport to importing countries. The model, though similar to those in the transfer pricing literature which considers the single decision of the level of the transfer price, has some additional implications for trader behavior and can accommodate both arms' length traders and related-party traders. The incentives for misreporting are similar for both types of traders. The model indicates that an exporter has an incentive to underreport the value of exports in the presence of either a corporate income tax or a value-added tax, which is increasing in the level of the actual collect rate of these

taxes. The model also predicts that importer has an incentive to overstate the value of imports when corporate income tax is higher than import tariff rate. These incentives are decreasing in the intensity of enforcement.

We then test the model using the discrepancies between China reported direct exports to the U.S. and U.S. reported direct imports from China, China's net VAT rates on exports, U.S. import tariff and related party trade share in U.S. imports from China at 6 digit HS from 2002 to 2005. Our empirical results are generally consistent with the predictions of our theoretical model. There is strong statistical evidence for underreporting of exports at Chinese border to avoid paying VAT. Exports by SOEs are more likely to have understated values than exports by FIEs or other Chinese domestic firms. Normal exports, conducted by all types of enterprises, include FIEs, are also more likely to have understated values than processing exports. These patterns have reasonable explanations in terms of the incentives facing different kinds of firms. Processing exporters may be subject to more intense enforcement, and can avoid VAT by the alternative method of over-reporting bonded imported materials. SOEs may be subject to both weaker customs enforcement and more stringent capital controls than other firms. We also provide evidence that tariff evasion at the U.S. border tends to take the form of underreporting unit values and most likely occurs to differentiated products. There is also indirect evidence of overreporting at U.S. border to avoid higher U.S. corporate income tax for U.S. based multi-nationals and avoidance of Chinese capital controls. However, it is more difficult to obtain conclusive evidence on the responsiveness of traders to Chinese and U.S. corporate income taxes due to data limitation. We will further improve our analysis when more VAT and corporate income tax data become available, and expect to provide better understanding on the incentives facing U.S. and Chinese traders and their misreporting behaviors.

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