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TAX RATES AND TAX EVASION:
EVIDENCE FROM "MISSING IMPORTS" IN CHINA

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ABSTRACT

Tax evasion, by its very nature, is difficult to observe. In this paper, we present a case study of tax evasion in China. The novel feature of our approach is that at a very disaggregated level of individual products, we can measure evasion relatively precisely, by comparing the values that China reports as imports from Hong Kong, with what Hong Kong reports as exports to China. We can match up this 'evasion gap' with the tariff (and VAT tax) schedule at the product level. The result is striking: using the data in 1998, we find that on average, a 1 percent increase in the tax rate results in a 3 percent increase in evasion; these results hold using data from 1998. The result is similar when a first-difference specification is used with data in 1997 and 1998. This relationship is nonlinear: the evasion elasticity is larger at high tax levels. Furthermore, the evasion gap is negatively correlated with the tax rates on closely related products, suggesting that part of the evasion takes place by mis-reporting the type of imports, in addition to under-reporting the value of imports. This effect is even more pronounced when the evasion gap is measured using quantities rather than values.

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1. Introduction

This paper studies the responsiveness of tax evasion to tax rates. Much of the work in the theory and empirics of taxation has taken tax collection as given, and often costlessly executed. This simplification is of course not realistic. Even within the United States, where tax collection is considered to be relatively efficient, about 17 percent of income taxes are estimated unpaid (Slemrod and Yitzhaki, 2000). A number of theoretical models have evolved to incorporate tax evasion, but these models fail to provide a clear prediction regarding the impact of tax rate on evasion. In the pioneering model of Allingham and Sandmo (1972), the relationship between tax rates and evasion is ambiguous, and depends on the third derivative of the utility function. A broader review of the literature reports that, more generally, theoretical predictions of the effect of tax rates on evasion are dependent on modeling assumptions (Slemrod and Yitzhaki, 2000).[1] Furthermore, even if we believe that increased tax rates will encourage greater evasion, there is still a need to assess the magnitude of this effect. Hence, empirically examining the effect of tax rates on evasion would be very useful from the perspectives of both theory and policy. This has proven to be a challenging task due to the difficulties in measuring evasion, which by definition is not directly observed.

A number of indirect approaches have been used to infer the behavior of tax evasion from measurable quantities such as currency demand or the discrepancies between national income and product accounts (e.g., Gutmann, 1977, Feige, 1979, Tanzi, 1980). These approaches have been criticized by Slemrod and Yitzhaki in their survey paper on the subject, since "[n]one of these approaches is likely to be reliable…as their accuracy depends either on unverifiable assumptions or on how well the demand for currency is estimated" (Slemrod and Yitzhaki, 2000). Furthermore, these approaches do not naturally generate an estimate of the responsiveness of evasion to tax rate.

As a more direct approach to examining tax evasion, researchers have used data from the U.S. Taxpayer Compliance Measurement Program (TCMP) conducted by the

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[1] Some models even yield strong predictions that run counter to the conventional wisdom that higher tax rates increase evasion. For example, the model of Yitzhaki (1974) predicts that if the punishment for

U.S. Internal Revenue Service. Based on intensive audits of a random sample of tax returns, the data set gives information on reported taxable income and what auditors later conclude to be true taxable income. Using these data, Clotfelter (1983) estimated that tax evasion is positively associated with tax rates, with the elasticity ranging from 0.5 to 3. Feinstein (1991), using a short panel of two years of TCMP data (1982 and 1985), found that increasing the marginal tax rate has a negative effect on evasion, contradicting Clotfelter's conclusion. However, the main source of variation on tax rates in both of these studies comes from differential marginal tax rates across income levels, so it is not really possible to disentangle tax rate effects from income effects.

In this paper, we take a new approach in measuring the effect of tax rate on tax evasion that is less likely to be contaminated by such problems. Specifically, we examine evasion in China's imports from Hong Kong, at a very disaggregated level (e.g., four-door passenger car), by comparing Hong Kong reported exports and China reported imports of the same products. In the absence of evasion (and measurement error), China and Hong Kong-reported numbers should be the same. So far, the extent to which they differ has generally been taken to be simple measurement error (see, for example, Feenstra and Hanson, 2000). However, when we match these data up with product-specific tax rates in China (tariff plus value-added tax rates), we find that this 'evasion gap' is highly correlated with Chinese tax rates: much more value is 'lost' for products with higher tax rates. Our methodology is related to that of Pritchett and Sethi (1994), who find that tax revenues divided by imports increase at a rate less than the official tax rate, in a sample of four developing countries. Note, however, that our analyses are at a much higher level of disaggregation; furthermore, they are unable to disentangle illegal tax *evasion* from legal tax *avoidance* (e.g., taking advantage of tax loopholes and special exemption). Tax avoidance, as it is legal, is more readily observed than evasion.

Another novel feature of our study is that we are able to differentiate three different aspects of tax evasion: under-reporting of unit value, under-reporting of taxable quantities, and mis-labeling a higher-taxed product as a lower-taxed type. We find strong evidence of mis-labeling, and limited evidence of under-reporting of unit value; on the

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evasion is dependent on the value of taxes evaded (as is the case in China), tax rate increases will reduce evasion.

other hand, once shifting reported imports from a higher- to a lower-taxed category is controlled for, we do not find evidence of under-reporting of overall imported quantities.[2] In looking at the effects of changes in tax rates between 1997 and 1998 on changes in evasion, we obtain similar results. Finally, when we use a flexible functional form, we find that tax evasion occurs mostly at higher tax rates. The rest of the paper is organized as follows: Section 2 describes the data on taxes and imports/exports. Section 3 provides the details of our empirical specification and the results. Finally, Section 4 concludes.

2. Data

The trade flow data in this paper are taken from the World Bank's WITS (World Integrated Trade Solution) database, which in turn is derived from the United Nations' Comtrade database. These data are collected by the United Nations Statistical Division from individual countries' trade records, and include information on imports and exports for each country, recorded according to the 6-digit Harmonized Commodity Description and Coding System (HS). The United Nations allows individual countries to have a classification system more detailed than the HS 6 digit levels. In the case of China, an 8-digit classification (a refined version of HS 6-digit classification) is available. However, we choose to use the import data at the 6-digit level in order to be compatible with Hong Kong-reported numbers. The current HS classification system began in 1996, which is also the earliest year for which we have year-end data on tax rates.

For every product that China imports from Hong Kong, we define *Export_Value* as that reported by Hong Kong, and *Import_Value* as that reported by China. The original sample contained 5113 products in 1998 at the 6-digit classifications. However, there were missing observations for 2820 classifications for either imports or exports.[3] Of those remaining, a further 250 did not have consistent tax rates at the 6-digit level, and

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[2] Of course, outright smuggling that evades both Hong Kong and China's customs is not captured in our data set.

[3] These were almost exclusively missing observations on exports; where observations were available for imports and not far exports, it is almost certainly the result of misclassified re-exports (see below). When all regressions were repeated, using all observations on exports and redefining *Gap_Value* = log(1+*Export_Value*) – log(1+*Import_Value*), the sample size increased by about 2 percent, and our results were virtually identical to those reported in Section 3 below.

were also omitted, leaving a final sample of 2043. Some regressions involve fewer observations due to missing observations on other regressors.

Because of Hong Kong's proximity to China and its special status as a former colony, it also does a considerable amount of indirect trade on behalf of other economies (including Taiwan).[4] Hong Kong reports (in the Comtrade database) separate data on indirect as well as direct exports destined for China. China, on the other hand, only reports what it considers to be direct imports from Hong Kong. Indirect imports (say from the U.S. via Hong Kong) are aggregated, in principle, with direct imports from the source country and reported as part of the imports from that source country. Thus, in theory, China-reported imports from Hong Kong should match up to Hong Kong-reported direct exports to China. However, the data suggests that China cannot always successfully separate indirect imports from direct imports. One likely source of confusion is Taiwan's indirect exports to China via Hong Kong. As the government of Taiwan does not allow its firms to have direct trade with China, Taiwan's exports to China often label Hong Kong as the destination. Sometimes shipping labels are modified while the goods are en route to Hong Kong or in a warehouse in Hong Kong. At other times, an intermediary in Hong Kong is used to record the transaction as an import by Hong Kong from Taiwan plus an export from Hong Kong to China. While the Hong Kong customs may understand this as an indirect export to China, China might misclassify at least a portion of such transactions as being direct imports from Hong Kong.[5] It is important to note that, as the tariff and VAT rates are the same for a given product whether it is a direct or indirect import from Hong Kong, there is no tax advantage to mis-reporting between direct and indirect imports. We will return to this issue later.

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[4] Hong Kong's reliance on re-export trade has created the false impression that manufacturing activity is virtually nonexistent in Hong Kong itself. To counter this misconception, we refer to a recent study by the Chinese commercial law firm Johnson, Stokes, and Master (JSM), which described Hong Kong's manufactured exports as including, "a wide range of products including clothing, electronics, watches & clocks, jewelry, textiles and chemicals." Their complete report on Hong Kong may be downloaded from: http://www.hg.org/guide-hongkong.html. Note that if we do limit our sample to the industry categories implied by (JSM), the implied effect of the tax rate on evasion increases somewhat, and the fit of the regressions improves marginally.

[5] We thank Professor SUNG Yung-Wing at the Chinese University in Hong Kong for a helpful discussion on this issue.

Comtrade contains data on both the value and quantity of imports/exports; we will utilize both sets of data. In the case of quantities, we are also required to know the units of measurement (e.g., weight, number; area); in most cases, these values match up between the Chinese (import) and Hong Kong (export) data. Where they do not, it is primarily because China reports the weight of imports, while Hong Kong reports the number of units. These observations are not included in the quantity regressions. We define *Export_Qty* to be the total quantity of exports from Hong Kong destined for China as reported by Hong Kong and *Import_Qty* to be the total quantity of imports (reported by Chinese customs) from Hong Kong into China.

Our basic definition of the evasion gap is given by:

$$Gap\_Value = \log(Export\_Value) - \log(Import\_Value)$$

Thus defined, a larger gap is an indication of greater evasion. We similarly define the gap in quantities reported as:

$$Gap\_Qty = \log(Export\_Qty) - \log(Import\_Qty)$$

The data on Chinese tariffs and taxes were also taken from WITS, derived from the UNCTAD TRAINS (Trade Analysis and Information System) database, which gives tariff rates at the 8-digit HS level. Since our import/export data are at the 6-digit level, we need some way of aggregating up to that level. Fortunately, there is relatively little variation in tax rates at the 6-digit level, so we are able to restrict ourselves to the sample for which there are uniform rates at this level of aggregation.[6] In addition to tariffs, there is a value-added tax levied on most imports, which varies from 13 to 17 percent. Our measure of taxation, Tax_{1998}, is the sum of these.

The earliest year for which we have data on tariffs is 1996, and our data reflect year-end tariff rates. Unfortunately, due to constantly shifting tariff rates in China

[6] We may also utilize the full sample, by using the simple mean or median tariff rate for each 6-digit industry. However, since we do not know the composition of imports, this may had considerable noise to our tariff rate measurement. When we include products for which there is tariff variation at the 6-digit

throughout the years 1992-97, the appropriate tax rate to be utilized is unclear for this period (Lardy, 2000). In our benchmark regressions, we therefore report results utilizing data from 1998, the most recent year for which data were available on both imports and exports. As an extension, we also implement estimation using two years of data (1997 and 1998). We will explain the construction of the 1997 tax rate later in the paper.

Part of evasion may take place by mislabeling imported products from a higher-taxed to a lower-taxed type. It is reasonable to assume that this type of mis-labeling is easier for "similar" products. Operationally, two products are considered "similar" if they are in the same 4-digit category. We define *Avg(Tax_o)* to be the average level of *Tax* for all other products in a good's 4-digit class, weighted by *Export_Value*. For a full list of variables, definitions, and sources, see the Appendix.

Summary statistics for our variables are contained in Table 1A. One point to note is that the so-called evasion gap actually has a negative mean. This appears to be due to Chinese customs misattributing part of the indirect imports as direct imports. In fact, when we exclude observations for which the ratio of direct to indirect exports (based on Hong Kong's reporting) is very low, the evasion gap quickly rises above zero (see Table 1B). We will further discuss the complications that this may create later. Also note that the evasion gap is higher when measured in values rather than quantities; this is suggestive that some evasion takes the form of under-reporting of per unit values.

3. Empirical Analysis

Benchmark specification

We begin by defining the following: $Export_k$ = Hong Kong reported direct exports of good k to China (which we take as the true import of good k by China from Hong Kong). $Import_k$ = Direct imports of good k by China from HK as reported to the Chinese Customs.

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level, all results are weakened slightly (generally by a few percent), consistent with our measurement error interpretation.

The prediction that we will be examining in the empirical test is that the difference between exports and imports is increasing in the tax rate, due to evasion. That is:

(1) $log(Export_k) - log(Import_k) = \alpha + \beta\ Tax_k + \varepsilon_k$

Tax-induced evasion implies that $\beta > 0$. Unfortunately, because China cannot always accurately separate indirect imports (e.g., U.S. exports to China passing through Hong Kong) from genuine direct imports from Hong Kong, we do not observe $Import_k$ directly.[7] Instead, China's recorded imports from Hong Kong, $Import^*_k$, contains part of indirect imports misclassified as direct imports. In other words, we actually observe the following:

(2) $Import^*_k = Import_k + Misclassified\ Indirect\ Import_k$.

It is crucial to note that the same tax rate is applicable to both direct and indirect imports. Therefore, the magnitude of the misclassified indirect imports for a particular product, say k, should be uncorrelated with the tax rate for that product (since there is no tax advantage from misclassification). Rather, it is plausibly proportional to the magnitude of the import of that product (subject to some random error). We will assume that

(3) $Misclassified\ Indirect\ Import_k = k\ \eta_k\ Import_k$

Where k is a constant, η_k is an independent and identical random variable, and distributional assumptions to be made later. Thus,

[7] There are two types of indirect exports passing through Hong Kong to China. The first one, "transshipments," goes straight from ships docked at Hong Kong to trucks destined for China. The second involves a stopover in Hong Kong before being sent to China. The latter is likely where China gets confused about the true exporter.

(4) $Import^*_k = Import_k + Misclassified\ Indirect\ Import_k$

$= (1 + k\ \eta_k)\ Import_k$

Combining these four equations, we obtain

(5) $\log(Export_k) - \log(Import^*_k) = \alpha^* + \beta\ Tax_k + e_k$

or equivalently:

$$Gap\_Value_k = \alpha^* + \beta\ Tax_k + e_k$$

where α^* is a (new) constant, and e_k a composite error term that is assumed to be iid and normal with a mean of zero and a constant variance. To be more precise, if we denote the mean of $\varepsilon_k - \log(1 + k\ \eta_k)$ by α_0, then,

(6) $\alpha^* \equiv \alpha - \alpha_0$

and

(7) $e_k \equiv \varepsilon_k - \log(1 + k\ \eta_k) - \alpha_0 \sim \text{Normal}(0, \sigma^2_e)$

Equation (5) will be the benchmark for our regression specifications. The results are reported in Table 2. In the first column, we have the basic estimate of the sensitivity of evasion to tax rates, which is 2.82. That is, if the tax rate increases by one percentage point, the gap between reported exports and imports increases by three percent. When observations with the highest and lowest one- percent of values of *Gap_Value* are excluded, the coefficient is virtually unchanged, as seen in the second column. In order to make direct comparisons with other results reported in this paper, we also repeated this basic specification, using the sample of industries with observations on *Avg(Tax_o)*, and also limiting the sample to industries with observations on quantities. Changing the sample in this way once again had very little impact on the reported coefficient.

Unfortunately, because of the noise introduced by misclassified indirect imports, the fit of the regressions might be considered to be fairly poor. A common method of dealing with noisy data is aggregation. We follow this approach, using as the outcome variable the mean value of *Gap_Value* for each tax rate. There are 44 different tax rates, thereby yielding a total of 44 observations. Results for the regression weighted by number of observations per tax rate, as well as the unweighted regression, are listed in Table 3, columns 1 and 2. The coefficient on *Tax*, 3.10, is similar to the baseline regressions from Table 2, and is significant at the one percent level. Moreover, the R2 increases to 0.26. The unweighted regression yields virtually identical results. Taking means is a linear operation, which allows for the same interpretation of these coefficients as in Table 2.

As an alternative way to reduce the noise in the data, we also use the median gap in reported imports, *Gap_Value*, for each tax rate as the outcome variable. This approach has the advantage of further limiting the effect of outliers in the data (though the interpretation of the coefficient on *Tax* is not as straightforward); the results, reported in columns 3 and 4 of Table 3, are the same as those obtained from the mean regressions. Again, while the point estimate on the tax rate is approximately 3, the goodness-of-fit as measured by the adjusted R-squared has increased to 0.3.

So far, we have concentrated our discussion on the statistical properties of the estimation. It may be useful at this point to also consider the economic implication of the point estimation in terms of revenue collection. From (1), we can infer how the percentage-reported imports may be affected by an increase in the tax rate:

$$(11) \qquad \frac{(dImports/dTax)}{Imports} = \frac{(dExports/dTax)}{Exports} - \beta$$

So, the effect of a tax increase could reduce reported imports through two channels: by reducing the true imports (i.e., Hong Kong's exports, the first term in (11)); and by reducing the fraction of true imports that is reported to the Chinese customs (-β, the second term in equation (11)). While we do not have a direct estimate of the first term in Equation (11), it is reasonable to assume that it is negative. Therefore, an estimate of β equal to 3 percent implies that, for any products whose tax rates exceeding 33.3 percent, a one-percentage point increase would lead to more than one-percentage point reduction in reported imports. The average tax rate on imports (tariff plus VAT) in China is 36.1 percent (see Table 1). Therefore, one may infer that the average tax rate is already on the wrong side of the Laffer curve: at the average rate, any increase in the tax rate would actually produce a reduction in tax revenue.

Evasion by mis-labeling

In addition to underreporting of the value of imports, evasion can also take the form of mis-labeling -- a higher-taxed good is reported as a lower-taxed variety. To investigate the existence of this type of evasion, we add the average tax rate of similar goods as a regressor. For a particular good k, its "similar products" are defined as all other products in the same 4-digit category.[8] Define Avg(tax_o) to be the average tax rate for product k's similar products, weighted by the value of their Hong Kong-reported exports. We implement a regression of the following form:

(8) $$Gap\_Value_k = \alpha + \beta_1 * Tax_k + \beta_2 * Avg(Tax\_o) + \upsilon_k$$

If there is a significant component of mis-labeling of goods, we expect $\beta_2 < 0$. In other words, holding a product's own tax rate constant, the lower the tax rate on product k's similar varieties, the greater the incentive to mis-report the import of k as other similar products.

Table 4 reports results with *Avg(Tax_o)* included as a regressor. Consistent with the mis-labeling interpretation, we find that the coefficient on *Avg(Tax_o)* is negative and significant at the 5 percent level, taking on values between -2.3 and -4.6. Furthermore, the inclusion of the average tax rate of similar goods as a regressor results in a substantial increase in the coefficient on *Tax*, which takes on values of 4.9 to 7.7.

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[8] We cannot look at the 5-digit level, because we have only a single observation in each 5-digit class for about 75 percent of the sample. We obtain very similar results to those reported in the main text if aggregation is at the 3-digit level.

[9] One additional control that we might include is the proportion of imports into China that are exempt from tariffs, because they are to be re-exported. This could potentially be correlated with tax rates, since there would be less incentive to lobby for exemptions if tax rates are low. Unfortunately, we have exemption

Quantity versus unit value

So far, we have not separated under-reporting unit values versus under-reporting quantities; both will show up as a positive coefficient on *Tax*. We now turn to regressions that use the gap in imported quantity as the dependent variable. Specifically, we examine the following regression:

(9) $Gap\_Qty_k = \alpha + \beta_1 * Tax_k + \upsilon_k$

(10) $Gap\_Qty_k = \alpha + \beta_1 * Tax_k + \beta_2 * Avg(Tax\_o) + \upsilon_k$

If under-reporting of quantities is prevalent, we expect to also find a positive coefficient on Tax_i in the quantity regression (10), $\beta_1 > 0$. If there is mis-labeling of the imports from a higher-taxed category to a lower-taxed one, we expect to find $\beta_1 > 0$ and $\beta_2 < 0$.

Results paralleling those of Table 2 and 4, using *Gap_Qty* as the dependent variable, are listed in Table 5. Interestingly, when *Avg(Tax_o)* is excluded from the regression, the coefficient on *Tax* is insignificantly different from zero. However, when *Avg(Tax_o)* is included, we find that the coefficient on *Tax* becomes significant, positive, and approximately equal to the coefficient on *Avg(Tax_o)* in absolute value. Thus, the data suggests the following: under-reporting total value of imports and mis-labeling type of goods are widespread, while the total quantities imported across all tax brackets are not significantly under-reported.

Tariff exemptions

Large proportions of Hong Kong's imports into China are exempt from import tariffs. These exemptions presumably impact incentives for evasion, and could potentially be correlated with tariff rates, since high tax rates may increase incentives for

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rate data for only about half of the sample, and only at the 2-digit HS level. When we do include this coarse proxy as a regressor, it is of the 'correct' sign (i.e., greater exemption implies less evasion), but not at all significant. Moreover, the coefficient on *Tax* increases by about 80 percent relative to the figures reported in Table 2, though this change is entirely due to the difference in sample.

exemption seeking.[10] More precisely, for products where exemptions are common, evasion may be less sensitive to tax rates than for products where exemptions are rare, since exemptions provide a legal means of avoiding tax payments.

We now describe how the fraction of imports that is exempted from tax is calculated for each of the 6-digit product. First, we obtained data at the 8-digit level on the exemption status of imports from the *Chinese Customs Statistics 1998*. These data also included the value of China-reported imports from Hong Kong at the 8-digit level, which were used to calculate a weighted average of the proportion of imports exempt from tariffs for each 6-digit product, i.e.,

$$Exemption_{HS6} = \frac{\sum_{HS8 \in HS6} Import\_Value_{HS8} * Exempt_{HS8}}{\sum_{HS8 \in HS6} Import\_Value_{HS8}}$$

where Exempt is an indicator variable denoting whether a product is exempt from import tariffs, HS6 denotes products at the 6-digit level of aggregation, and HS8 denotes products at the 8-digit level of aggregation. Aggregating in this way is necessary in order to match the Hong Kong-reported export data.

Table 6 shows the results of the following regression:

$$(11) \quad Gap\_Value_k = \alpha + \beta_1 * Tax_k + \beta_2 * Exemption_k + \beta_3 * Tax_k * Exemption_k$$
$$\beta_4 * Avg(Tax\_o) + \beta_5 * Avg(Tax\_o) * Exemption_k + \upsilon_k$$

Consistent with higher exemption rates lowering the incentives for evasion, the coefficient on *Exemption* is consistently negative and significant (See columns (1) to (4)). When interacted with *Tax*, the coefficient is negative, highly significant, and approximately the same size as the coefficient on *Tax*. This implies that, for a product with complete exemption in 1998 (i.e., *Exemption*=1), there is no effect on evasion from tax increases. By contrast, for industries with no exemptions, the implied elasticity is

[10] In fact, there is very low correlation between *Tax* and *Exemption*.

about 26 percent.[11] In looking at the effect of exemptions on incentives to relabel goods, we find that the coefficient on *Avg(Tax_o)*Exemption* is positive, though not significant at conventional levels (t-statistic of 1.4), implying less relabeling for goods with high exemption levels. In columns (5) to (8), we report the results of the same regressions, using *Gap_Qty* as the outcome variable, and obtain qualitatively very similar results.

First differences in tax rates

Our primary results suggest a strong effect of taxes on evasion, acting through both under-pricing and product mis-labeling to lower-taxed categories. There may be concerns, however, that certain features of the different products that are not directly measured and not included in the regressions may have driven the results. We do not have specific factors in mind that may bias our result. However, to be on the safe side, we now use two years of data and adopt a first-difference specification that can net out all such time-invariant and product-specific determinants of the tax evasion. More precisely, we estimate the following:

$$(12) \quad DGap\_Value_k = \alpha + \beta_1 * DTax_k + \beta_2 * DAvg(Tax\_o) + \upsilon_k$$

where a prefix *D*- denotes the change between 1997 and 1998.

To determine the tax rate for 1997 turns out to be a little challenging. While there was virtually no change in the tariff structure during 1998, there was a fairly large-scale tariff reform on October 1, 1997. Since our import data for 1997 was cumulated for the year, we have to use the weighted average of tax rates that prevailed before and after the tariff reform. However, the knowledge of a tariff reform in the near future could affect the timing of the imports. We do not have a good way to correct for this. Instead, we assume that the effective tax rate for 1997 is given by:

[11] This figure seems unreasonably large; if we omit outliers of Gap_Value, the implied elasticity of evasion with respect to taxes drops to 16 percent, while the significance of all coefficients in this regression are more or less unchanged. Also, there may be concerns that, because most of the exemption ratios are relatively high (the 25th percentile of *Exemption* is 0.68), making inferences about the effects of evasion at *Exemption* = 0 is too far out of sample. However, when we run regressions comparable to those reported in

Tax_{1997} = 0.75*(Year-end tax rate for 1996) + 0.25*(Year-end tax rate for 1997)

We then define $DTax = Tax_{1998} - Tax_{1997}$. We will similarly denote changes in other variables using the *D-* prefix.

Table 7 shows the estimation results. We note that the R-squared values are very low in these regressions; this is not surprising, as we have differenced out much of the information in the data. In columns (1) and (2), with the change in *Gap_Value* as the dependent variable, the coefficient on *DTax* is significant, though marginally smaller than that obtained in our level regressions. The coefficient on *Davg(Tax_o)* is no longer significant at conventional levels (t-statistic of approximately one), but is of the same sign as in the level regressions. We obtain similar results with the change in *Gap_Value* as the dependent variable (see columns (3) and (4)).

Flexible functional form

We now allow the marginal effect of a tax increase on evasion to differ across different tax rates. Following, for example, Chamberlain (1997), we allow for the slope to differ across quartiles, with knots at tax rates of 29, 34, and 42 percent. The results, in Table 8, suggest that there is relatively little effect on evasion at relatively low tax rates. However, as tax rates rise above the median level of 34 percent, the extent of evasion rises dramatically. The marginal effect then tapers off again at higher levels. As before, the effect of tax rate increases is larger, when we control for average tax levels by 4-digit HS.

This pattern of non-linearity is consistent with the existence of a fixed cost in undertaking evasion activity. For example, if there is some fixity in the punishment for evasion, there may be a threshold tax level above which evasion becomes worthwhile.[12] Alternatively, it is also consistent with a probability of detection that is relatively

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Table 6, limiting the sample to observations with *Exemption* < 0.5, we obtain a coefficient on *Tax* of 22. This suggests that functional form is *not* driving our results on the interaction of *Tax* and *Exemption*.

[12] Unfortunately, the punishment code for customs evasion in China is sufficiently vague as to give relatively little guidance on this question. While the punishment includes the confiscation of the goods involved, it also may incorporate a fine of an unspecified amount. Furthermore, in recent years, some traders have been executed for tariff evasion, thereby highlighting the full extent of autonomy that the authorities have in determining punishments.

invariant to the tax rate, so that the benefit of evasion increases more rapidly than the cost as tax rates increase.

<u>Robustness to Alternative Specifications of Indirect exports</u>

As noted in the data section of this paper, the Chinese customs-reported import figures are likely to include part of the indirect imports that are mis-classified as direct imports. We have argued that the amount of such mis-classified imports should not be correlated with the tax rate on the product since the same tax rate is applied to both direct and indirect imports. We can make a more direct assessment of this assumption by restricting our sample to those products that Hong Kong does relatively few indirect exports to China.

We repeated the basic regressions from Tables 2 and 3, excluding observations with relatively low values of *Direct Export Ratio = (Direct Export)/(Indirect Export + Direct Export)*. We use cut-off values of 0.01,0.05, and 0.1;the results using export values are reported in Table 9. In the case of the simple binary regression, the coefficient on *Tax* increases slightly with the cut-off. The qualitative inference, however, remains the same. The results with *Avg(Tax_o)* included as a regressor are somewhat mixed, possibly owing to the colinearity of *Tax* and *Avg(Tax_o)* once the sample size has been reduced. When we look at the results from the quantity regressions, the coefficients are uniformly suggestive of a stronger effect of tax rates on evasion, when products with relatively low ratios of direct exports are excluded (See Table 10).[13]

4. Conclusions

In this paper, we take a new approach in measuring the effect of tax rates on tax evasion, by looking at the reporting gap between China and Hong Kong on China's imports from Hong Kong, as a function of the Chinese tax rates (tariff plus VAT rates). We find that this 'evasion gap' is highly correlated with tax rates: much more value is 'lost' for products with higher tax rates. The point estimates suggest that the Chinese average tax rate on its imports is already on the wrong side of the Laffer curve: any increase in tax rate is likely to produce a reduction rather than an increase in tax revenue.

By comparing the evasion gap in quantities and in values, we conclude that there are widespread practices of under-reporting the unit values of the imports, and mis-labeling higher-taxed products as lower-taxed varieties.

As a broader contribution to the literature, we believe that our approach can be applied to other countries as well. In addition to providing more information on the behavior response of tax evasion to tax rates, the generalized multiple-country study could provide a more objective measure of the laxity of rule of law across countries – in contrast to the subjective perception based measures of corruption and rule of law now popular in empirical studies. We leave this, and other extensions, for future work.

[13] An alternative approach, since we are estimating a very reduced form of the evasion equation, is to simply include the value of indirect exports as a regressor. The results from this approach are virtually identical to those previously reported.

Table 1A – Summary Statistics, Full Sample

	Mean	Std. Dev.	Min.	Max	Obs.
log(Value_Export)	4.68	2.81	-6.21	12.72	2043
log(Value_Import)	5.29	2.53	-5.52	12.20	2043
Gap_Value	-0.62	2.43	-13.79	9.64	2043
log(Qty_Export)	5.98	4.49	-2.30	20.17	1478
log(Qty_Import)	6.14	4.05	-2.30	21.99	1972
Gap_Qty	-1.06	2.56	-13.35	11.74	1368
Tax Rate (Tariff+VAT) (at the 6-digit level)	36.09	10.34	13	134.6	2043
Avg(Tax_o) (at the 4-digit level)	36.09	9.20	13	88	1760
Exemption	0.78	0.31	0	1	1918
Direct Export Ratio	0.17	0.23	0.00	0.99	2024
Change in Tax Rate, 1997 – 1998	-5.56	5.98	-30	9	1808

Table 1B – Summary Statistics, Restricted to Products with Direct Export Ratio above the Median

	Mean	Std. Dev.	Min.	Max	Obs.
log(Value_Export)	5.95	2.42	-4.51	12.72	1031
log(Value_Import)	5.55	2.62	-5.12	12.20	1031
Gap_Value	0.40	1.96	-7.92	9.64	1031
log(Qty_Export)	8.03	4.52	-2.30	20.17	725
log(Qty_Import)	6.93	4.40	-2.30	21.99	984
Gap_Qty	-0.13	2.31	-8.63	11.74	656
Tax Rate (Tariff+VAT) (at the 6-digit level)	37.00	10.23	13.00	104.20	1031
Exemption ratio	0.82	0.28	0	1	969
Avg(Tax_o) (at the 4-digit level)	37.01	9.18	13.00	88.00	919
Change in Tax Rate, 1997 – 1998	-6.23	6.07	-30	9	957

Table 2: The Effect Of Tax Rates on Evasion (Measured in Value)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tax Rate	2.82	2.59	3.08	2.85	2.76	2.78	3.44
	(0.78)	(0.66)	(0.10)	(0.88)	(0.84)	(0.78)	(1.02)
Constant	-1.63	-1.38	-1.69	-1.65	-1.45	-1.53	-1.73
	(0.27)	(0.23)	(0.34)	(0.30)	(0.29)	(0.27)	(0.36)
Excluding Outliers?	No	Yes	No	No	Yes	Yes	Yes
Excluding products lacking tax on similar products?	No	No	Yes	No	No	Yes	Yes
Excluding products lacking Obs. on Quantities?	No	No	No	Yes	Yes	No	Yes
No of Observations	2043	1974	1760	1368	1710	1337	1165
R^2	0.015	0.017	0.015	0.018	0.016	0.020	0.025

Note: Dependent Variable: log(Value of Exports from HK to China) – log(Value Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 3: Aggregating the Evasion Gap by Tax Brackets

	(1)	(2)	(3)	(4)
Tax Rate	3.10 (0.99)	3.11 (0.88)	3.47 (0.98)	2.95 (0.94)
Constant	-1.73 (0.31)	-1.74 (0.38)	-1.73 (0.31)	-1.58 (0.39)
Method of Aggregation	Mean	Mean	Median	Median
Weighting of Data by Number of Observations per Tax Rate?	Yes	No	Yes	No
No of Observations	44	44	44	44
R^2	0.26	0.32	0.34	0.31

Note: For columns 1 and 2, the dependent Variable is Mean[log(Value of Exports from HK to China) – log(Value Imports to China from HK], with means taken for each level of tax rate. For columns 3 and 4, the dependent variable is Median[log(Value of Exports from HK to China) – log(Value Imports to China from HK]. Robust standard errors in parentheses.

Table 4: Incorporating the Average Tax on Similar Products

	(1)	(2)	(3)	(4)	(5)
Tax Rate		6.32 (1.77)	4.89 (1.22)	7.69 (1.77)	7.20 (1.39)
Tax on Similar Products	2.40 (1.00)	-3.57 (1.70)	-2.34 (1.25)	-4.62 (1.72)	-4.09 (1.47)
Constant	-1.45 (0.034)	-1.58 (0.35)	-1.38 (0.30)	-1.76 (0.41)	-1.68 (0.37)
Excluding Outliers?	No	No	Yes	No	Yes
Excluding products lacking Obs. on Quantities?	No	No	No	Yes	Yes
No of Observations	1760	1760	1710	1191	1165
R^2	0.016	0.018	0.017	0.026	0.029

Note: Dependent Variable: log(Value of Exports from HK to China) – log(Value Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 5: Evasion in Physical Quantities

	(1)	(2)	(3)	(4)	(5)	(6)
Tax Rate	0.92 (0.84)	0.82 (1.11)	0.76 (0.73)		7.59 (2.08)	8.11 (1.62)
Tax on Similar Products				0.16 (1.14)	-7.40 (2.07)	-8.13 (3.50)
Constant	-1.39 (0.30)	-1.37 (0.41)	-1.15 (0.26)	-1.01 (0.40)	-1.17 (0.41)	-0.89 (0.35)
Excluding products lacking Obs. on Avg(Tax_o)?	No	Yes	No	Yes	Yes	Yes
Excluding Outliers?	No	No	Yes	No	No	Yes
No of Observations	1368	1191	1317	1191	1191	1145
R^2	0.002	0.001	0.002	0.000	0.011	0.017

Note: Dependent Variable: log(Quantity of Exports from HK to China) – log(Quantity of Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 6: Controlling for the Effect of Tariff Exemptions

	Dependent Variable: Gap_Value				Dependent Variable: Gap_Qty			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tax Rate		2.94	6.03	25.77		0.97	6.97	21.11
		(0.79)	(1.84)	(7.08)		(0.81)	(2.06)	(5.42)
Tax on Similar Products			-3.04	-16.29			-6.57	-12.58
			(1.77)	(0.70)			(2.09)	(5.44)
Exemption	-0.49	-0.47	-0.72	2.59	-0.92	-0.89	-1.02	3.16
	(0.23)	(0.24)	(0.26)	(0.94)	(0.29)	(0.29)	(0.32)	(1.24)
Exemption*(Tax Rate)				-26.82				-19.51
				(8.53)				(6.99)
Exemption*(Tax on Similar Products)	No	No	No	18.26				9.39
				(8.34)				(6.92)
Constant	-0.25	-1.34	-1.13	-3.66	-0.36	-0.75	-0.47	-3.86
	(0.21)	(0.34)	(0.43)	(0.78)	(0.26)	(0.38)	(0.48)	(1.10)
No of Observations	1918	1918	1639	1639	1278	1278	1104	1104
R^2	0.004	0.020	0.028	0.054	0.012	0.014	0.026	0.044

Note: Dependent Variable: Columns (1) – (4): log(Value of Exports from HK to China) – log(Value Imports to China from HK). Columns (5) – (8): log(Quantity of Exports from HK to China) – log(Quantity of Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 7: Tax and Evasion in First Differences, 1997-98

	Dependent Variable: Change in Gap_Value		Dependent Variable: Change in Gap_Qty	
	(1)	(2)	(3)	(4)
Change in Tax Rate	1.87 (0.73)	3.90 (1.92)	2.53 (1.16)	5.43 (2.77)
Change in Tax on Similar Products		-1.89 (2.01)		3.12 (3.08)
Constant	0.063 (0.060)	0.049 (0.064)	0.18 (0.08)	0.14 (0.08)
No of Observations	1808	1574	1177	1045
R^2	0.004	0.006	0.003	0.004

Note: Dependent Variable: Columns (1) and (2): Change in Gap_Value between 1997 and 1998. Columns (3) and (4): Change in Gap_Qty between 1997 and 1998. Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 8: The Effect of Tax Rates on Evasion – Flexible Functional Form

	(1)	(2)
Tax rate in 1st quartile ($0 \leq$ Tax Rate < 29)	-0.97	-0.10
	(3.56)	(4.96)
Tax rate in 2nd quartile $29 \leq$ Tax Rate < 34	0.77	-5.26
	(4.47)	(4.72)
Tax rate in 3rd quartile ($34 \leq$ Tax Rate < 42)	7.41	10.50
	(3.04)	(3.98)
Tax rate in 4th quartile ($42 \leq$ Tax Rate)	1.59	5.51
	(1.20)	(2.65)
Avg Tax on Similar Products		-3.69
		(1.79)
Constant	-0.62	-0.18
	(0.94)	(1.07)
No of Observations	2043	1760
R^2	0.017	0.022

Note: Dependent Variable: log(Value of Exports from HK to China) – log(Value Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Table 9: Excluding Products with Extensive Indirect Exports

(Evasion in Values)

	(1)	(2)	(3)	(5)	(6)	(7)
Tax Rate	2.93 (0.75)	3.10 (0.75)	4.03 (0.83)	6.19 (1.35)	5.27 (1.65)	5.11 (1.88)
Avg Tax on Similar Products				-3.33 (1.38)	-2.16 (1.71)	-1.31 (2.06)
Constant	-1.18 (0.26)	-0.86 (0.26)	-0.96 (0.30)	-1.19 (0.31)	-0.87 (0.30)	-0.86 (0.36)
Cutoff for (Direct Exports/(Total Exports)	0.01	0.05	0.10	0.01	0.05	0.10
No of Observations	1663	1157	863	1464	1028	764
R^2	0.020	0.026	0.041	0.025	0.029	0.037

Note: Dependent Variable: log(Value of Exports from HK to China) – log(Value Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

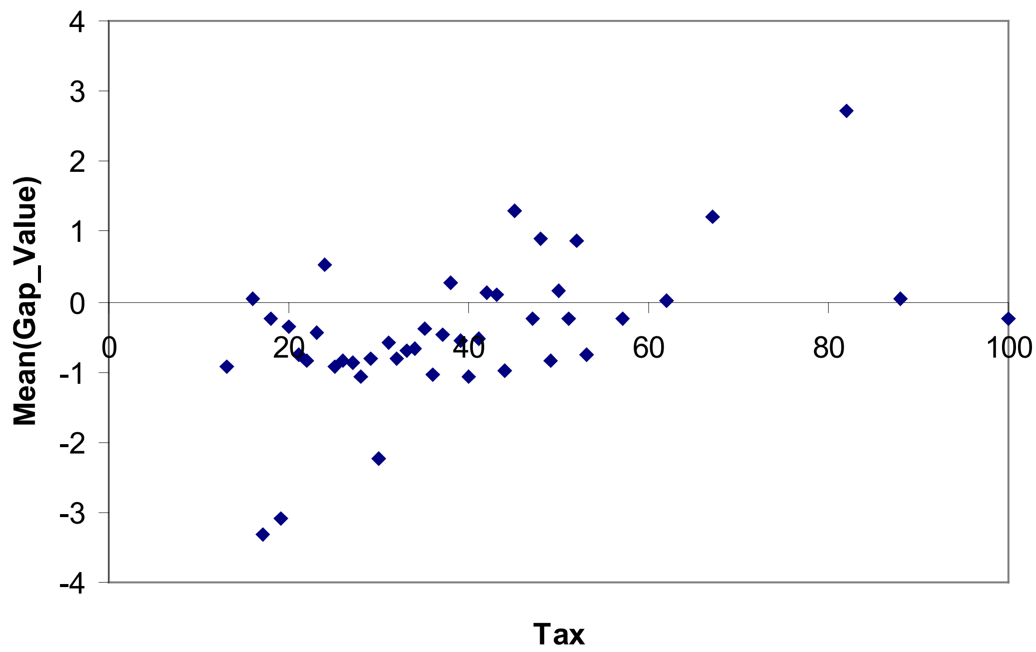
Table 10: Excluding the Products with Extensive Indirect Exports

(Quantity Regressions)

	(1)	(2)	(3)	(5)	(6)	(7)
Tax Rate	1.19 (0.93)	1.58 (0.99)	2.21 (0.83)	9.00 (2.09)	9.54 (2.72)	8.14 (2.79)
Avg Tax on Similar Products				-8.52 (2.18)	-9.14 (2.78)	-7.17 (2.91)
Constant	-1.05 (0.33)	-0.76 (0.37)	-0.76 (0.43)	-0.84 (0.39)	-0.38 (0.44)	-0.35 (0.50)
Cutoff for Direct Export Ratio	0.01	0.05	0.10	0.01	0.05	0.10
No of Observations	1098	770	592	975	692	534
R^2	0.003	0.006	0.011	0.019	0.024	0.017

Note: Dependent Variable: log(Quantity of Exports from HK to China) – log(Quantity of Imports to China from HK). Robust standard errors in parentheses, accounting for clustering of standard errors by 4-digit HSC.

Figure 1 - Relationship Between Mean(Gap_Value) and Tax Rates, 1998



References

Allingham, Michael G. and Agnar Sandmo. "Income Tax Evasion: A Theoretical Analysis." *Journal of Public Economics*, Vol. 1, No. 3-4 (1972), pp. 323-338.

Andreoni, James, Brian Erard, and Jonathan Feinstein. "Tax Compliance." *Journal of Economic Literature,* Vol. 36, No. 2 (June, 1998), pp. 818-860.

Chamberlain, Gary. *Econometrics*, unpublished manuscript, 1997.

Economic Information Agency, *Chinese Customs Statistics 1998 (CCS)*, 2001.

Clotfelter, Charles T. "Tax Evasion and Tax Rates: An Analysis of Individual Returns." *Review of Economics and Statistics*, Vol. 65, No. 3 (August, 1983), pp. 363-373.

Feenstra, Robert, and Gordon Hanson. "Aggregation Bias in the Factor Content of Trade: Evidence from U.S. Manufacturing." *American Economic Review*, vol. 90, no. 2, May 2000, pp. 155-60.

Feige, Edgar L. "How Big is the Irregular Economy?" *Challenge*, Vol. 22, No. 5 (November-December, 1979), pp. 5-13.

Feinstein, Jonathan. "An Econometric Analysis of Income Tariff Evasion and its Detection." *RAND Journal of Economics*, Vol. 22, No. 1 (Spring, 1991), pp. 14-35.

Gutmann, Peter M. "The Subterranean Economy." *Financial Analysts Journal*, Vol. 33, No. 6 (November-December, 1977), pp. 26-34.

Slemrod, Joel and Shlomo Yitzhaki. " Tax Avoidance, Evasion, and Administration." NBER Working Paper No. W7473, January 2000.

Tanzi, Vito. "The Underground Economy in the United States: Estimates and

Implications." *Banco Nazionale del Lavoro Quarterly Revie*w, No. 135 (December, 1980), pp. 427-53.

World Bank, *World Integrated Trade Solution (WITS)*, 2000.

Yitzhaki, Shlomo, "A Note on 'Income Tax Evasion: A Theoretical Analysis'". *Journal of Public Economic*s, Vol. 3, No. 2 (May, 1974), pp. 201-202.

Appendix A: Variable Definitions

Import_Value: Value of imports from Hong Kong into China, as reported by the Chinese customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: World Bank's World Integrated Trade Solutions (WITS), derived from the United Nations' Comtrade Database.

Export_Value: Value of exports by Hong Kong destined for China, as reported by Hong Kong customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: WITS

Indirect Export_Value: Value of Indirect Exports from Hong Kong to China, originating from third-party countries. Reported by the Hong Kong customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: WITS

Gap_Value – log(*Import_Value*) – log(*Export_Value*)

Import_Qty: Quantity of imports from Hong Kong into China, as reported by the Chinese customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: WITS

Export_Qty: Quantity of exports from Hong Kong destined for China, as reported by Hong Kong customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: WITS

Indirect Export_Quantity: Quantity of indirect exports, originating from third-party countries. Reported by the Hong Kong customs, for 1998, at the 6-digit HS level. Measured in U.S. dollars. Source: WITS

Gap_Qty – log(*Import_Qty*) – log(*Export_Qty*)

Tax – Total taxes rate levied on incoming goods by the Chinese Authorities, equal to the sum of tariffs and commercial taxes, for 1998. Source: WITS

DTax – Difference in tax rate for imports in1998 (Tax) and estimated average tax rate for 1997. See the text for details.

Exemption – At the 6-digit level, the proportion of goods exempt from import tariffs. Source: China Customs Statistics, purchased from the EIA CCS Information Service Center in Hong Kong.

Avg(Tax_o) **–**Average of the level of *Tax* for all other goods in a product's 4-digit HS class, weighted by *Export_Value*.

Direct Export Ratio **–** Ratio of Direct Exports to Direct Exports + Indirect Exports