Tariff evasion, tax incidence, and price disparity in the Japanese market for imported pork parts

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Abstract

The price disparity—a market-based approach for evasion detection—is a tool for understanding the extent of evasion and the incidence of taxes on commodities, but has a number of pitfalls that are often neglected in application. This paper suggests modifications to the price disparity approach and examines its performance in detecting widespread evasion from market price data. In the Japanese market for imported pork parts, I find that the temporary increases in pork tariff hardly had any effects on the prices of imported pork over a period when an alternative method identifies an evasion epidemic in the market. The approach is therefore shown to provide a signal about pervasive non-compliance in the current setting. Auxiliary analyses are, however, needed to rule out alternative explanations, including the possibility that the importers bear the tax burden.

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1 Introduction

Tariffs are important source of government revenue for countries with insufficient infrastructures for collecting taxes. Baunsgaard and Keen (2005) note that sub-Saharan countries in Africa collect on average a quarter of government revenue from levies on international trade, and find that low-income countries have on average recovered only 30% of revenue lost from trade liberalization. Because of the importance of tariff in government revenue, the extent of tariff evasion is of policy interest in developing countries. Tariff evasions, however, are challenging to identify because of the hidden nature,[1] and are subject to renewed research interests recently (Fisman and Wei, 2005; Yang, 2007).

The main aim of this paper is to consider modification to the "price disparity" approach (Pitt, 1981), which infers from the difference between actual market prices and predicted prices, which would have prevailed had there been no tariff evasion, the presence of tariff evasion.[2] The primary advantage of this approach over another popular method is that the price disparity can be used to understand the actual incidence of tariffs. The price gap approach, which was originally suggested by Bhagwati (1964) and popularized by Fisman and Wei (2005), is a powerful method to identify the presence of tariff evasion. The price gap approach is based on the idea that there is an incentive to understate import to evade tariff while there is no such incentives when declaring the amount of export, and compares the declared value of exports and imports, attributing low declared import to evasion. The intuitiveness of price gap has spurred a number of recent applications. The price gap approach however focuses on values declared at the port of entry, rather than prices in marketplaces, so the effects of evasion on market prices are out of scope of the analysis. Moreover, since the price gap approach hinges on the accuracy of the matching of trade statistics across partner countries, a complementary approach would be valuable.[3] Of cause the auditing of company accounts would be the most conclusive method for identifying tariff evasion but the PD approach requires less information and resources, and provides a tool to understand the impact of tariff evasion on the price of imported goods.

While PD approach has a number of considerations that researchers need to be cautious about, there seems insufficient discussion on possible pitfalls since Pitt (1981) suggested the approach. For instance,

[1] For a general review of the studies on tax evasion, see Andreoni, Erard, and Feinstein (1998)
[2] See Thursby, Jensen, and Thursby (1991) for an application.
[3] Hummels and Lugovskyy (2006) examine issues with matched trade partner data.

consider examining a tariff increase. A basic price disparity analysis would attribute the difference between a post-tax-change price with a pre-tax-change price plus tariff as due to evasion. There are at least three ways in which a price disparity arises from innocuous reasons. First, there is a possibility of some confounding influences along with a tariff change. For example, an exogenous reduction in costs may coincide with the timing of a tax hike. Second, while it may be plausible in some setting to assume that the incidence of tariff is fully passed onto buyers, the tariff-rate pass-through may be incomplete in other setting. For example, if exporters have a market power to adjust profit margins, a price disparity can reflect the pricing behaviour of exporters rather than the evasion of custom duties.[4] Third, traders may adjust behaviour to avoid fully bearing tax burden. For example, if an increase in a tax rate is anticipated by traders, trader may hoard stocks to avoid paying higher tax, at least temporally. In sum, various confounding influences render it difficult to predict the impact of a tariff change on prices, and can lead to a biased inference from a price disparity. The goal of this paper is to consider ways to overcome some of the difficulties in a naïve application.

This paper considers the performance of the PD approach in narrowly defined commodities—the Japanese market for imported pork parts. The key advantage in focusing on specific commodities is in the ease of comparison with complementary approaches. This paper implements PD analysis and verifies the result with the PG analysis.[5] The Japanese pork tariff is rather unusual but it offers interesting sources of variations: the tariff scheme creates strong incentives for smuggling low-value pork parts but not for high-value pork parts of pigs due to higher levy on low-value meat. Further, there have been large changes to the threshold price level below which pork parts are taxed heavily. The institutional setting thus creates cross-section as well as time variations that may be exploited empirically. Since I utilize specific institutional features in the analysis, a direct replication in other setting may be difficult but the change in tariff is invoked under the "Safeguard Clause," or the GATT Article XIX, which allows the WTO member countries to increase levy when a surge in import threatens to cause serious injuries to domestic industries. Thus, while the setting in

[4] The extensive literature on the exchange-rate pass through indicates that there are substantial departures from the perfect competition in some of the international markets and that the degree to which the change in exchange rate is passed through to the price in the destination market is affected by the pricing power of the exporter (Feenstra, 1995). The approach would be sensible when the market is approximated by a long-run equilibrium with producers selling at the marginal costs and there is a free entry into the market.

[5] Qualitative evidence from criminal cases also suggests that the presence of evasion.

this study is unique, the approach considered here is applicable in principle to other setting.

This paper also offers a study that would be relevant for a policy discussion in Japan. Although pork tariff collects small fraction of the total government revenue in Japan, there is an on-going political interests on the treatment of the pork import in the backdrop of a rising share of foreign pork in the country.[6] While the opinions in the popular press regard the tariff as convoluted and calls for a simplification,[7] the producer groups seem to be sufficiently influential. In May 2007, a report submitted by the Council on Economic and Fiscal Policy, which is a Japanese-equivalent of the Economic Council of the President in the U.S., argues that the complexity with tariff systems is a cause for tariff evasion, and recommends that the variably levies on pork to be removed. In the reform agenda adopted by the Japanese Cabinet in June, the phrase is substantially toned down, stating that the variable levy is to be "reviewed" (Cabinet Office 2007: 16). Although there are policy interests on the topic, there is a lack of documentation on the impacts of the variable levy on the behaviour of firms.[8] For example, during one Diet Meeting in 2005, a politician demanded to know the effect of evasion on the price levels, and a representative from the Ministry of Agriculture, Forestry and Fishery answered that "it is undeniable that there are some effects (of tariff evasion) on the pork prices in the domestic markets but it is difficult to quantitatively assess the impacts." Of cause it is hard to think that the parties involved in trade are unaware of the impact of evasion, but this study is the first to provide a careful documentation of the effects of tariff evasion on the market prices of imported pork in Japan.

The main conclusion of this paper is that though cautions are required in interpreting price disparities, the PD approach is likely to provide signals for the presence of tariff evasion in other settings. In summary of the analyses, I show that the price disparity approach is a useful tool to pick up the signal of widespread tariff evasion. In the current setting, the price gap approach shows that there is an epidemic of tariff evasion on frozen pork imported from Denmark over 1999-2005. At the peak, the estimated amount of annual evasion

[6] In 1990, the import and domestic production of pork was 342 thousand tons and 1,088 thousand tons respectively. In 2007, the import and domestic production of pork was 879 thousand tons and 869 thousand tons respectively. There are interests in protecting the domestic producers, which manifested in the formation of the Japan Pork Producers Association in 2006. The importers, who have been prosecuted for evading tariffs, have interests in removing the tariff, and a group of importers initiated in 2006 a NPO that pressure for a pork tariff reform.

[7] See, for example, the Editorial in the International Herald Tribune, November 17, 2006.

[8] To my knowledge, Tanaka and Mori (2001) is the only empirical study on the variable levy, focusing on the tax avoidance through mixing strategy to be discussed below. An interest group has a publication that argues for a reform and shows a simple application of the price disparity analysis (Study Group on Meat Import and Distribution, 2007).

is 8 times as large as the revenue collected on the commodities. Using a finely disaggregated commodity data collected by the wholesale markets in Japan, I show that the invocations of safeguard in 2001-2004, which lead to a 22 % increase in the reported average import value per kilo, virtually had no impact on the market price. The analysis controls for the presence of possible shocks to the costs of production by applying cointegrating regression. The auxiliary examinations show that the lack of response is unlikely to be due to tax avoidance strategies, including stock hoarding and another specific strategy. In the current setting, however, the price disparity approach with an assumption on a tariff-rate pass-through coefficient of 30 % finds that the lack of response is statistically consistent with an explanation that the incidence of the tariff is partially borne by the sellers. This result contrasts with the finding from the price gap analysis, and shows an inherent difficulty in making a conclusive inference from the PD approach alone.

In terms of the broader contribution to the literature, this paper adds to the studies on the evasion on taxes paid by firms, which would be of interest since the evasion literature tend to focus on taxes on individuals. This paper provides a case study in the context of a tax on a commodity. The paper also provides an empirical examination of tax incidence. Alm, Sennoga, and Skidmore (2009) points out that the tax incidence, while theoretically well studied, is not well documented in empirically. The result of this paper illustrates the lack of relationship between the statutory tariff rates and the market prices in presence of evasion, and raises caution about the interpretation of common measures of protectionism that are based on statutory tariff rates.

The rest of the paper is organized as follows. Section 2 describes the market and institution for pork in Japan. Section 3 describes the data used in this study. Section 4 first shows the lack of price response to safeguard, and then considers non-evasion based explanation for the lack of response. Section 5 presents the result of the price gap approach and Section 6 concludes.

2 Background on the Japanese market for imported pork

2.1 Industry characteristics

Japan currently imports about a half of domestic pork consumption from abroad. The major source countries are the Denmark, US, and Canada, which has the import share in 2000 of 32.6%, 29.0%, and 17% respectively (Kaku and Fukase, 2002). About 70% of imports are frozen meat, which are inputs for manufacturing processed meats, such as ham and sausages. The downstream market is dominated by large meat processing companies: the five-firm concentration ratio in 1999 was 56.7%. The meats are imported by trading intermediaries, which are relatively small—there were about 60 companies importing pork in 2000. Some of the trading intermediaries are subsidiaries of the downstream manufacturers.

2.2 Variable levy on pork imports and tax incentives

The European Union used to adopt "variable import levy" on some of its agricultural commodities (Harris, Swinbank, Wilkinson, 1983). The Japanese tariff on pork is a version of the variable import levy (see Obara, Dyck, and Stout, 2003). Figure 1 illustrates the relationship between the imported price (CIF) and after-tax price. The unit is in per kilo of pork parts. There are three segments: If the average price per kilo is beyond the gate price of 524 yen, there is an ad valorem tax of 4.3 percent per kilo; between 524 and 65 yen, the levy is the difference between 546.5 and CIF; below 65 yen, there is unit tax of 482 yen per kilo. Except for dressed carcasses for which the gate price of 393 per kilo applies, any pork parts are taxed under this scheme. In short, the system sets a price floor—officially called a standard import price—on pork parts import.

There are concerns about several types of behavioral responses. First, since low-value pork parts are taxed heavily under the variable levy, there are incentives to smuggle low-value parts disguised as high-value parts. Given that much of the import demand is for low-value frozen pork parts as ingredient for sausages and hams, the incentives for smuggling are relevant. In light of the finding by Fisman and Wei (2005) that suggests higher tariff rates induce more traders to evade tariffs, it is plausible to expect that traders to attempt evading duties. Second, there is de facto permission for mixing different parts shipped from a same origin country by the same storage method. This means that traders can combine frozen tenderloin and

belly from Denmark to increase the weighted average price per invoice. This mixing strategy is thought to be a common practice.[9] Tanaka (2001) shows that high-value meats from the US are traded at discount, and interprets the result as suggesting that the traders import high-value parts for tax purposes despite smaller domestic demand for high-value imported pork parts. Third, one trader mentioned to this author that there are disincentives to claim refund for the commodities that arrive damaged at the destination, since claiming damage reduces the value to be declared to the Japanese custom and thereby increases the amount of tax liability. In sum, the complexity of the Japanese pork tariff creates a variety of incentives.

2.3 Pork safeguard

The variable levy creates strong incentives for smuggling low-value parts, but it is the change in the price floor that makes this institution useful setting to consider the price disparity approach. There are two types of safeguard tariffs on pork that Japan is permitted to invoke under the WTO agreement: gate-price safeguard (SG) and special safeguard (SSG). SG raises the price floor to 681 yen from 546.53 yen and is invoked if import surges beyond a trigger level—the import volume above 119% of the average volume for the past three years. The quantity test is based on the cumulative volume since the beginning of the Japanese Fiscal Year (JFY), which is from April to March. Once invoked, SG lasts till the end of JFY and is removed from the beginning of the following JFY. The focus of this study is the SG invoked in 2001-2004 due to the data availability. SSG increases the tariff rate to 6.5% and was invoked in January-March 1997.

Figure 2 shows the impact of the changes in gate price on the reported import per-kilo price (CIF) from 1988 to 2008. Unlike usual time series data on prices, the pattern is quite unusual in tracing the gate price very closely. The solid line shows the average price for invoices declared above the gate price. The dotted line is the average price below the gate price. The proximity of two lines indicates the distribution of declared price that is dense around the gate price. Two lines trace the reduction in the gate price until 2000 under the WTO agreement, as well as the invocation of SG in JFY 1995, 96, 97 and 2000-2004.

Given that the timing of the safeguard removal is known, there are incentives to change the timing of trade, importing after safeguards are removed at the end of March. Safeguard in 2001 was invoked after

[9] The strategy is permitted according to a Japanese tax official contacted by this author.

there was a surge in import that is intended to beat the import restriction from Europe due to the outbreak of the food and mouth disease. The safeguard in the subsequent years are caused in part due to the surge in import in the period with no SG. Thus, hoarding behaviour is a relevant consideration in the analysis of the price disparity.

2.4 Evidence from court cases

There are chronic cases of tax evasion beginning from the inception of the system in 1971. In my calculation, the tariff revenue on pork was 16.1 billion yen in 2005. In one criminal case in 2007, a meat wholesale company is accused of evading 5.9 billion yen over 23 month (April 2003-Februry 2005), showing that a tip of the iceberg is already substantial relative to the tariff collected. There appears to be a strengthening of enforcement after 2005: the total amount of tax evaded in the five large cases of criminal indictments from 1999 through 2004 is 740 million yen whereas it is roughly 24 billion yen for four cases from 2005 through February 2007; in October 2005, a tax penalty was raised from 10 percent to 35 percent of the correct tax liability; for the first time in the enactment of the custom law, a warehouse company caught with a tariff evasion was revoked its permission to conduct custom clearance services in December 2006. Masahiko Yamada (Democrat, House of Representatives), who stated that he had demanded an increased in the law enforcement in a number of national diet committee meetings, claimed that the stepped-up enforcement caused the prices to increase.

3 Data

The data source is the monthly product-level price data on pork parts published by the Japan Meat Trade Center (JMTC), which organizes wholesale markets for domestic as well as imported meats in several locations around Japan. The main advantage of the JMTC data over other information source on pork price is the level of disaggregation; some wholesale markets publicize the prices of domestic dressed carcasses and sometimes the prices by meat parts, but the JMTC is, to my knowledge, the only data that allows us to make a distinction between, for example, the price of chilled tenderloin from the US and frozen belly from Denmark. The main trading results at JMTC are published daily in the press, including the Nikkei, the

Japanese-equivalent of the Wall Street Journal. Transactions of imported pork are, however, typically over-the-counter trades, meaning downstream meat processors deal directly with trading intermediaries rather than making purchases at wholesale markets (Kaku and Fukase 2002). In 2005, the total volume of imported pork traded at the JMTC was 8.2 thousand tons, which is just 0.94% of the total imported volume of frozen and chilled pork parts declared at the custom in the year. An ideal data is the trade information of private parties. Since buyers are likely to have stronger bargaining power over traders owning to the concentration in the downstream industry, it seems plausible to suspect that the benefits of tax saving are passed onto large buyers in over-the-counter trades. The arbitrage would prevent a divergence of JMTC prices from trade conducted elsewhere. In short, as the main publicly-available source of information on pork part trade, the JMTC data provides reference prices for transacting parties that would be useful for researchers.

I use the monthly weighted-average prices from three markets at varying time lengths: Kawasaki, located near Tokyo, (2001:2-2008:7), Osaka (2003:3-2008:7) and Nagoya (2005:3-2008:7). JMTC has provided me with the data in electric format from 2005 onwards, and I obtained photocopies of the trade archives at their business office in Kawasaki for the earlier data. There are six pork parts (back ribs, belly, butt, collar, loin, and tender loin), two storage methods (frozen and chilled), and three countries of origin (Canada, Denmark, and US). I will use in addition information from the markets in. Other sources of data used in this study are in the data appendix. Table 1 shows the summary statistics.

4 Analyses

4.1 Time series analysis

Visual Inspection

As a preliminary examination, Figure 3 plots the weighted average price of Denmark frozen belly traded at the Kawasaki market from 2001:2-2008:7. Frozen meat takes up the largest fraction of pork import into Japan, and Denmark is the main source country. Low-value frozen-pork meats are the key ingredients of sausages. Denmark products were involved in a court case on tariff evasion and their prices are likely to be affected by evasion. Figure 1 also shows the price of Denmark frozen tenderloin, a high-value part, as

comparison.

Since belly and tenderloin are produced at the same location and might be the parts of identical animals, the commodities are subject to the shocks to the costs of production, such as the feed price and wage level in Denmark. Indeed, the two series appear to move fairly closely. The sharp rise in 2001 is due to the effect of the food and mouth disease in Europe that led to a temporary suspension of Denmark import which was lifted in one month. While there are discrepancies, overall, it would be fair to suggest that there is a long-term relationship between the prices of those closely-related commodities.

The dotted lines show the levels of price floors and the SG invocations over August-March in 2001, 2002, 2003, and 2004. The price of belly is well below the price floor during the safeguard, but tenderloin is traded above the price floor, so that under full compliance, we would expect the belly price to be affected by SG but not the tenderloin price, especially since there was an apparent change in the weighted average value of frozen pork parts declared at the custom. However, SG seems to have no effects.

Cointegration model with a structural break

As a statistical test to formalize the visual inspection, I consider a cointegration regression with a known structural break. Standard tests showed that two series are nonstationary and are cointegrated.[10] If SG had its intended effects—to penalize cheap imports—we would expect a break in the cointegrating relationship between belly and tenderloin. In application, I fit a dynamic OLS with a structural break following the application in Hayashi (2000).

$$\begin{aligned} p_{2t} &= \mu + \gamma p_{1t} + \delta_0 D_t + \delta_1 p_{1t} D_t + \\ &\quad \beta_{p,0}\Delta p_{1t} + \beta_{p,-1}\Delta p_{1t+1} + \beta_{p,-2}\Delta p_{1t+2} + \beta_{p,1}\Delta p_{1t-1} + \beta_{p,2}\Delta p_{1t-2} + \upsilon_t \end{aligned} \tag{1}$$

D_t takes the value of 1 while SG is invoked (i.e. August to March, every JFY from 2001 through 2004). This formulation treats all periods of SG as a single regime and is done for modelling convenience. p_{1t} is the

[10] Dicky-Fuller unit root tests on the logarithmic of average price in a specification with time trends reject the unit root hypothesis at the 5 per cent level in only 1 out of 37 instances. I therefore accept the null hypothesis of the log price being nonstationary, but, as in Campa and Goldberg (2005), with caution about the power of the test. The Engle-Granger test rejected the null of no cointegration of the prices of belly and tenderloin, so I take the two series to be cointegrated, once again with caution.

price of belly in log. p_{2t} is for tenderloin. δ_j are the parameter of interest since they capture any changes in the cointegrating relationship. υ_t is a white noise. The lag and lead terms capture the dependence. A structural change is tested with the Wald test. The null hypothesis is the safeguard having no effects on the cointegrating relationship ($\delta_0 = \delta_1 = 0$) and a non rejection of the null is taken to be a pattern consistent with ineffectiveness of safeguard due to reasons that can include tariff evasion, adjustment of profit margin, hoarding, and mixing strategy.

The results are shown in Table 2. The estimate from the baseline model (Column 1) indicates a change in the cointegrating vector in a wrong direction—we would expect that the belly price to become "close" to tenderloin price in the relevant range but the spread widens. This is likely to be due to the increase in the belly price level in 2005, when there was an enforcement strengthening including a heavier penalty for evaders, and it is hard to interpret the result. As a solution, I have excluded the sample period after mid-2005 with a caution that the power of the test is likely to be low due to smaller sample size (Column 2). There are no significant changes in parameters, and Wald test shows that there is no structural break. I have tried a specification with a break point at June 2005 (Column 3). The model appears to fit better and indicates that there was a change in the cointegrating relationship after the mid-2005, and in the expected direction. In sum, a statistical analysis confirms with a caution the visual inspection showing the lack of price response to SG. While the finding of no structural change is consistent with the evasion of tariff, the pattern may be caused by other behavioral response. We examine other possibilities below.

4.2 Is the lack of response due to the adjustment of the profit margin?

Exchange-rate pass-through coefficient as an approximation

One possible explanation for the lack of price response is that the most of tax incidence is borne by traders who adjust profit margin in response to SG. It may be the pricing behaviour of importers that is attenuating the impacts of tariff increase. Here I consider an approach in line with Marion and Muehlegger (2008) and Chatty, Looney, and Kroft (2007). In these studies, different types of behavioral responses are expected to weaken the response of some variables to taxes. To identify the behavioral response, the estimates of the tax effects are compared with some benchmark, where the magnitudes are theoretically equivalent in the

absence of the particular behavioral response. To identify the impact of tax salience, Chatty, Looney, and Kroft (2007) compare the responses of beer demand to exercise tax (salient tax) and sales tax (less salient). To identify the effects of tax evasion, Marion and Muehlegger (2008) compare the elasticity of diesel oil demand to a commodity tax and to whole sale prices.[11]

As a benchmark, I will consider the degree of exchange-rate pass-through (ERPT) which has a theoretical and empirical basis. Feenstra (1989) proposes the symmetry of ERPT and tariff rate pass-through (TRPT) in the following model of an exporting firm whose objective is to maximize an expected profit in the unit of foreign currency.

$$\underset{p}{Max}\left[e/(1-\tau)\right]\left\{px(p,q,I)-c(x,w)\left[(1-\tau)/e\right]\right\} \tag{2}$$

e denotes an expected exchange rate in the unit of foreign currency per unit of home currency. The objective of the firm is to maximize an expected profit, but since the only stochastic variable in the model is the exchange rate, the model is written without the expectation operator. $x(.)$ is an import demand, which is a function of the price of imported product (p), the price of a competing variety (q), and income level (I), all of which is denoted in the unit of domestic currency. $c(.)$ is the cost function, which depends on the foreign factor price and quantity demanded, and is denoted in the unit of foreign currency.

The formulation shows that the change in expected exchange rate or tariff rate can be represented as a cost shifter. i.e. to the extent that the changes in tariff and exchange rate affect the term $(1-\tau)/e$ equivalently, the pricing decision does not depend on the whether the cost shock arises from the exchange rate or tariff rate. Thus, the model predicts a symmetry of ERPT and TRPT.

The symmetry hypothesis however requires assumptions that may not be tenable in various practical settings. If production costs co-vary with exchange rate (Goldberg and Hellerstein, 2008), which can happen when inputs include imported materials, the symmetry prediction does not hold. Similar to the concern discussed by Marion and Muehlegger (2008) in the context of local diesel markets, the transition effects of tariffs and exchange rates are unlikely to be the identical since tariff change may be fully expected while the

[11] To the extent that the profit is affected by SG, the stock price of the trader is likely to be affected by a surprise invocation of SG. A more direct approach to check whether the importers adjust margin may be to see if the response of stock price, but to my knowledge, there is no specialized trader of pork that is publicly listed on the stock market.

exchange rate change can be much uncertain. If the fluctuation of exchange rate is small and the producer do not make adjustment to small changes in exchange rate, the degree of ERPT may underestimate the degree to which the producer respond to a large change in tariff. Nonetheless, previous empirical studies find that the degree of ERPT and TRPT are not different statistically (Feenstra, 1989; Winkleman and Winkleman 1998), suggesting that ERPT provides a first approximation of the expected response of prices in absence of tariff evasion. With qualification, I proceed by considering a ERPT coefficient reported by Campa and Goldberg (2005) of 0.27 for the Japanese food price index, and also by estimating ERPT using the panel data.

Nesting of Hypothesis testing in the cointegration model

The test for a structural change implemented above takes "no change in the relationship between tenderloin and belly" as a null hypothesis. This approach in effect takes evasion as the maintained hypothesis. It would be more conceptually appealing to take no evasion as a null, as done so by Marion and Muehlegger (2008). If there is no evasion, the incidence of SG is bourn by trading parties, some of which would be passed onto buyers. Using as an approximation a 30% pass-through coefficient, which is close to the estimate by Campa and Goldberg (2005), I have nested the hypothesis testing as follows.

The price difference between tenderloin and belly is expected to narrow if the incidence of SG is passed onto buyers. The test is based on a comparison of the change in the tenderloin price implied by the estimate of conintegrting vector with the expected price change. The changes are evaluated at the mean of belly price. The data used in the test are 2001:2-2005:3. The test does not reject the hypothesis that the gap between two prices narrowed in an expected way, showing a result in favour of an explanation that the lack of response is due to incomplete pass through. The power of the test, however, is likely to be low due to the imprecise estimates from a shorter time series. Thus, this result should be viewed with caution.

Panel data analysis

To address the issue with power, I consider utilizing the panel data on pork-parts price series. To begin, Figure 4 presents a 2×2 comparison of the prices of low- and high-value pork parts before and after March 2005, when the last safeguard was removed. I define low-value parts to include all frozen parts except tenderloin (i.e. backribs, belly, butt, collar) and high-value parts to include all the chilled meats (backribs,

belly, butt, loin, tenderloin) and frozen tenderloin. The mean price for the former and latter group is 579 and 793 yen/kilo respectively. Once again, the direct impacts of SG are expected to fall on low-value meats in theory. The figures plot the percentage deviation of average monthly price from the respective group average. The series on the pattern after March 2005 (dotted lines) should capture seasonal trend. If SG has had any effects we would expect to see a deviation from the seasonality in the normal years, especially over August-March. The left panel shows a comparison for low-value parts before and after 2005. Two lines are nearly the same, except for the deviation in January-February and June-July, suggesting that almost no indication that SG had any effects, except perhaps for the beginning of calendar years. The right panel, which shows a comparison of high-value parts, indicates deviations over January-July. High-value parts, which mostly include chilled commodities, generally exhibit higher annual price volatility due to the influence of seasonal factors such as the consumption pattern of table meat and pig biology. One possible explanation for the higher volatility in the first period is the outbreaks of livestock diseases. There were bird flu outbreaks in 2001-2002, and the BSE concerns for domestic as well as U.S. beef.[12] These factors might have increased the price volatility since chilled meats are consumed directly. The possible change in the seasonal pattern for high-value meat raises a question about the appropriateness of using the group as a control in implementing a difference-in-difference (DD) analysis. In application, I will mainly consider a difference estimator, and relegate the DD estimate to the appendix.

The data used in estimation is the unbalanced panel of JMTC pork price series described above. Exchange rates variables are also found to contain unit roots, and I estimate the model in first difference. The following is a baseline difference model estimated in the sample of low-value parts.

$$\Delta \ln p_{it} = \alpha_0 + \sum_{m=1}^{3} \alpha_{km} \Delta \ln e_{k,t-m} + \sum_{j=1}^{12} \lambda_j sg_{jt} + \theta X_{it} + u_{it} \tag{3}$$

p_{it} is the price of i^{th} commodity in log. There are 37 series, containing 3 origin countries, 2 storage types, 6 parts, and 3 locations at the destination country. $e_{k,t-m}$ is the m^{th} lag of the exchange rate between yen and the origin country currency in log. $\alpha_{k,t-m}$ is a currency-specific ERPT coefficient, assumed to be

[12] Another explanation is the inflow of high-value meat through the mixing strategy. While the explanation is consistent with the depressed price in the intermission of SG, it would not account for the rise in January-March. As discussed below, the mixing strategy would not have been prevalent in the sample period.

constant across within commodities from the same origin country. The specification allows for three lags.

To model the impacts of SG invocations and removals with some flexibility, a preferred specification includes dummy variables (sg_{jt}) indicating j^{th} month since the invocation of each SG in '01, '02, '03 and '04. i.e. sg_{1t} is a dummy variable for August '01, '02, '03 and '04. λ is the main coefficient of interest, and is designed to capture the average difference in the price change between the corresponding months in the first and second period. Under the assumption that the seasonal trend remains the same on average for the low value group, the coefficient is interpreted as the impact of the SG. The models are estimated with OLS with standard error clustered by each series.

X_{it} is a vector of control variables: seasonality controls that allow for heterogeneous trend for 6 parts stored in different methods; year-country specific production cost control; dummies for enactment of the strengthened penalty and its two lags.

Results

Table 3 presents the analysis, progressively adding control variables. For the sample of low-value commodities, the coefficients on the SG dummies are generally not significantly different from zero, and are sensitive to the addition of controls for those that have significant coefficients in the baseline specification, which only control for parts-storage specific seasonality (Column 1). A test on joint significance, to be discussed below, confirms the lack of explanatory power of the SG on price. The exchange rates appear to have a weak explanatory power in the sample of frozen commodities. In the full specification (Column4), the individual coefficients are not significant, except for the first lag of Canadian dollar (CAD). The sum of the coefficients are 0.125, 0.076, and 0.097 for CAD, Denmark Kroner (DKK), and U.S. dollar (USD), respectively. Jointly, USD is significant but not CAD and DKK. The timing of the enactment of the tougher penalty law is strongly correlated with the price increase. The first and second lags are significant at the 5 and 10 percent level respectively, and they are jointly significant at the 1 percent level.

For the sample of high-value commodities, the SG dummies have a stronger explanatory power, capturing a large increase in August and the general decline from the beginning of calendar years. Since a SG in theory would not explain this change in the prices of chilled pork, this is likely to reflect other reasons as discussed. The exchange rates appear to have slightly more explanatory power than in the sample of cheaper parts.

More individual coefficients are estimated to have significant coefficients. Jointly, DKK is significant at the 10 percent level. The sum of the first two lags for the USD is significant at the 5 percent level. The contemporaneous penalty dummy is significantly negative but the penalty dummies are jointly not significant.

To interpret these estimates, the SG did not resulted in an average increase of prices of low-value commodities relative to the same set of commodities in the period when there was no SG in place. It would be preferable to use a DD estimate to control for unobserved shocks, but the estimates from the subsample of dearer parts confirms that there is a concern for using the subsample as a control group. The difference estimate does, however, allow for unobserved country-specific cost shocks, and I proceed by using the result from Column 4 in the subsequent tests. The exchange rates in general appear to have a weak explanatory power for pork products in this sample. Kaku and Fukase (2002) suggest that the convention in the pork export to Japan is to invoice in yen due to the variable levy, and states that the fluctuation of exchange rates are fully borne by sellers as a result. While a strong proposition that is supported by the estimates only partially, it is possible that ERPT coefficient estimated here might underestimate the degree of TRPT. To be sure, under the assumption of zero TRPT coefficients, the hypothesis of tariff evasion is not distinguishable from the alternative hypothesis of a full incomplete pass-through of tariff in an empirical strategy solely based on variations in market prices to identify evasion. Here, I proceed by using the estimate by Campa and Goldberg (2005) as the main reference.

Table 4 shows the results of Wald tests that compare the sum of safeguard coefficients to the product of the presumed pass-through coefficient and the change in the average declared price in log [0.22=ln(681.08-546.53)]. The coefficients used in the tests are based on the difference estimate from the full specification on the sample of cheaper commodities. For example, under the assumption that the full burden of tariff increase is passed onto buyers, we should observe a 22% increase in the price level. The test clearly rejects the null of no evasion under the full pass-through assumption. If we assume instead that the benchmark TRPT coefficient of 30%, the sum of the estimates are not distinguishable from a 6.6% increase, leading us to accept the maintained hypothesis that there was no evasion. Finally, if we take as the null hypothesis evasion of tariffs, which is not a preferred position, the test does not find a significant increase in the price level, leading to an acceptance of the null of evasion. Thus, the test results are mixed and are dependent on the

assumption on pass-through coefficient. In conclusion of the current section, the price disparity approach, modified by accounting for partial pass-through, gives some indication of the presence of evasion, but is not able to clearly distinguish between the tax evasion hypothesis and the pricing behaviour hypothesis.

4.3 Was the non-response due to hoarding?

The price may not respond as much if traders were able to stockpile when the tariff is low and sell them off when the tariff rate is high. Figure 5 plots the fraction of frozen pork imported to Japan over August-March from 1988 through 2007 using the Japanese trade statistics. The hoarding behaviour would imply increases in the share of imports in April-July so that we would expect to observe reductions in the August-March import share over JFY2001-2004. The most salient pattern in the figure is the reduction of the share in 1996, which is attributable to the invocation of a SSG that increased the tariff rate on top of the increased price floor over Jan-Mar 1997. It thus appears that a significant shifting had occurred in 1996. Over 2001-2004, in contrast, substantial fractions of pork are imported. Thus, hoarding would not have had a first-order effect on the price level of frozen pork during SG in the 2000s, except perhaps the months immediately following the invocation.

4.4 Was the non-response due to tax avoidance?

Another alternative explanation for the lack of price response to safeguards is the tax avoidance through the mixing of parts. By increasing the average price on invoice through increasing the share of high-value meats, importers can avoid paying penalizing tariff applicable to pork imported at a price below the gate price. While this strategy increases costs to traders due to the purchase of high-value parts that would not have been imported otherwise, the full incidence of the safeguard would not be borne by trading parties because of the adjustment in purchasing mix.

To examine this explanation, Figure 6 plots the per-kilo value of frozen pork exported to Japan declared at the Denmark custom. If there was a change in the composition of pork parts exported from Denmark, the average value should increase, perhaps with a lead. The data is based on frozen swine that would correspond to the category in the Japanese custom data. The dotted line shows the frozen pork parts imported from

Denmark reported to the Japanese custom. In other words, the figure presents a time series examination of the price gap in the context of frozen port import into Japan.

Perhaps the most salient feature of the figure is the price gap over 1999-2006. Two lines are reasonably close in other periods; the 1996 safeguard is associated with a sharp temporary rise in the average value declared at Denmark, indicating that much of the imports for the period employed the tax avoidance strategy—a pattern that is in line with the sharp reduction in the imported volume during SG and SSG. However, from the late 1990s to the mid-2000s, the declared values at Denmark are visibly below those declared at Japan. For 2001-2004, the volatility of the value declared at Denmark appears to increase, perhaps reflecting some adjustments in the timing of trade, but there seem no significant indication that the mixing strategy was in wide use. It is thus unlikely that the mixing strategy explain the lack of price response in the 2000s.

5 Alternative approach: Price-gap estimate of evaded duties

Table 5 shows the price-gap estimate of evaded custom duties on the Japanese import of Denmark frozen pork parts. The "price gap" is defined as the difference between the CIF (per kilo) declared at the Japanese custom and the one-month lag of FOB (per kilo) declared at the Denmark custom. The lag of one month is chosen because shipping from Kobenhavn to Yokohama takes 36 days.[13] The Danish Krone in the Denmark data is converted to Yen using spot exchange rates. The evasion estimate is the product of the price gap and corresponding volume declared at the Japanese custom. The estimate is intended to provide an upper bound estimate only: the sources of discrepancy include the costs of transportation (fright, insurance, other expenses), the difference in the timing of import and export, product category differences in the trade data, actual exchange rate used by trading parties, and commodities damaged during transport. However, since those sources of disparities are unlikely to change abruptly, the price gap estimates would provide a reasonable comparison across time.

Over the decade spanning JFY1998-2007, the upper-bound estimate of total evasion on Denmark frozen swine is 293 billion yen. The amount is 6 times as large as the total tariff revenue on the commodity from

[13] Based on the shipping schedule posted on the Nippon Yusen Kaisha's website (accessed Dec. 1, 2008).

Denmark. The evasion-revenue ratio shows a substantial time variation, peaking at 8.12 in 2002, and falling to 0.31 in 2007. This pattern suggests an "evasion epidemic" over 1999-2005, followed by a period of better compliance. The ratio during the safeguard in JFY2001-04 is higher because of the larger amount of tariff evaded per kilo (due to the higher price floor) and also because of the shifting of timing of legitimate import. A higher evasion-revenue ratio during safeguard suggests that the response of revenue to tariff duties is lowered due to evasion. Overall, this auxiliary evidence supports the interpretation that the price disparity as due to tariff evasion rather than the adjustment of profit margins, and that the break in cointegrating relationship between Denmark frozen belly and tenderloin as due to the better compliance to the variable tariff levy.

6 Concluding remarks

In the context of the Japanese safeguard tariffs on pork, this paper evaluated the effectiveness of the price disparity approach in uncovering tariff evasion. A cointegration analysis focused on two narrowly-defined commodities from Denmark showed that the safeguard did not have statistically significant effects on prices, suggesting that tariff evasion, along with other behavioral responses, attenuated the effects of statutory tariffs on the price of imported porks. Alternative explanations, including stock hoarding and mixing strategy, were considered in auxiliary analyses, but they are not likely to explain the price disparity. I found however that it is difficult to quantitatively make a distinction between the tariff evasion hypothesis and the adjustment of profit margins hypothesis in a modified price disparity analysis. The price gap approach corroborated the finding by indicating that there was a pervasive evasion on Denmark produce over 1999-2005. The total amount of evasion on Denmark frozen swine is 293 billion yen over 1998-2007, which is 6 time as much as the revenue collected from the commodities.

Overall, the results of this paper indicate that, while cautions are required, a casual examination of price disparity gives sufficient indication of pervasive tax evasion. This implies that the popular press, which has limited stuff time to produce a story, can supplement anecdotal comments of "anonymous industry insiders" by using published commodity prices in raising public awareness about the possibility of widespread non-compliance in markets. Particularly, a comparison of two similar commodities that are reasonably thought

of as differentially affected by non-compliance would make a stronger case in news article. This paper also raises questions about the safeguard as a public policy tool. Safeguard tariffs affect the margins of incentives that are neglected in the partial equilibrium analysis of a commodity tax. I find results consistent with the hypothesis that the safeguard is rendered ineffective when the evasion is widespread. This implies that safeguard tariffs should be accompanied by a closer monitoring to achieve its protectionist goal, but policy makers should be aware that such effort would require drawing resource away from the monitoring of other commodities or even border protection when the custom resource is fixed.

There are several possible extensions to this paper. First, it would be of interest to examine price disparities in countries that rely more heavily on tariff as a revenue source. Particularly, it seem a useful exercise to see whether there exists price disparities for commodities that are found to have price gaps. Conversely, there have been studies in which the results suggest the presence of price disparity for the U.S. steel safeguard (Liebman, 2006). Given that the Wall Street Journal reports a widespread smuggling in the US steel import,[14] an obvious question would be: Is there price gaps for the steel import into the U.S? Last, given the goal of protecting Japanese pork producers, a further study might ask whether the Japanese pork safeguard was successful in maintaining the prices of domestic varieties.

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Data Appendix

Trade Statistics of Japan

The monthly information for the declared pork parts imports are obtained from the Trade Statistics of Japan published by the Ministry of Finance (http://www.customs.go.jp/toukei/info/index.htm). The Harmonized System codes for the frozen meat of swine are 020329021 and 020329022 and correspond to "other pork meats," which exclude dressed carcasses and "hams, shoulders and cuts thereof, with bone in."

Denmark custom data

The monthly Denmark custom data is obtained from the StatBank of the Statistics Denmark.

(http://www.statbank.dk/statbank5a/default.asp?w=1024).

I combined 11 categories of swine meats that begin with "Frozen." In practice, nearly all of frozen meat is reported under the category "Frozen boneless meat of domestic swine (excluding bellies streaky and cuts thereof)."

Exchange rates

Monthly exchange rates are obtained from International Financial Statistics published by the IMF.

Figure 1: Variable import levy on pork

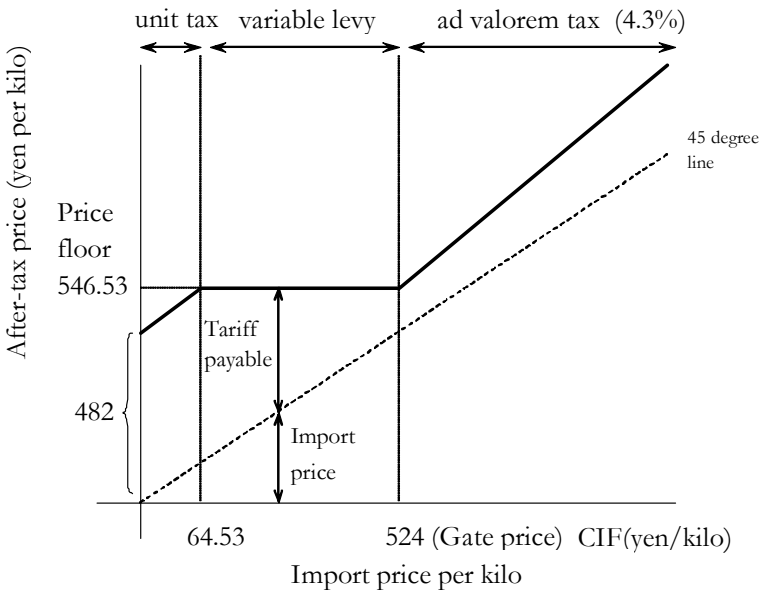

Figure 2: Average declared price of frozen pork import

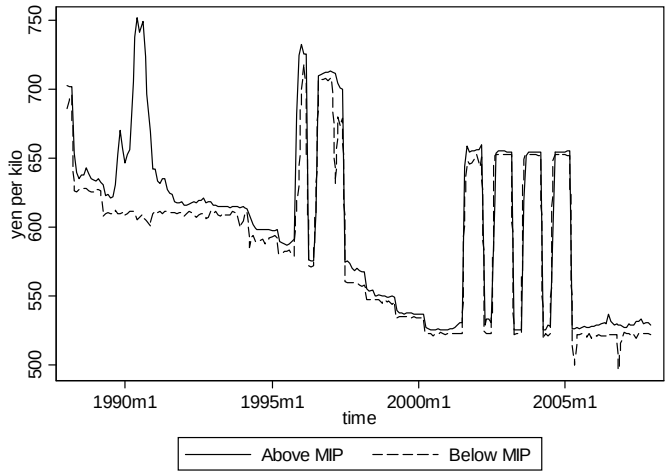

Figure 3

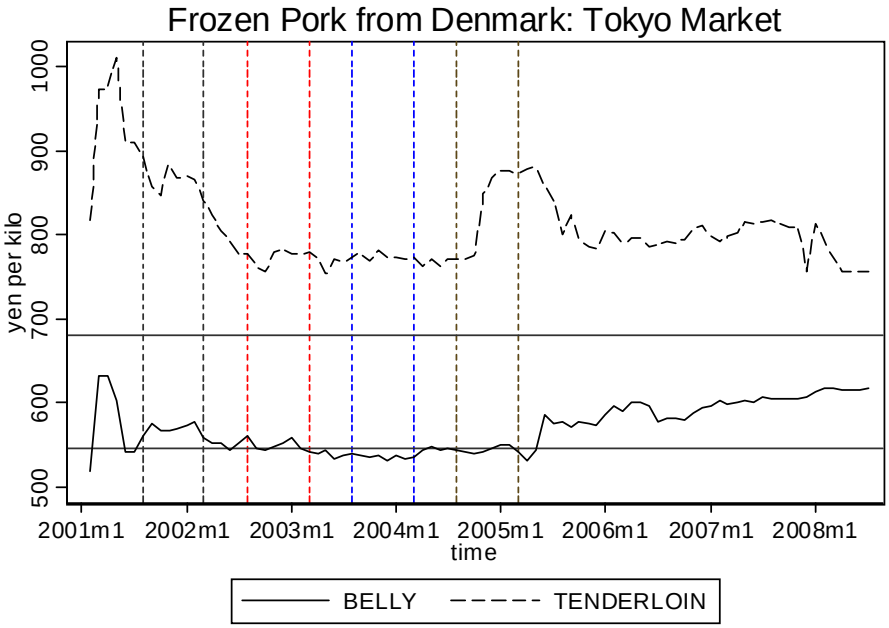

Figure 4: Seasonality of pork price by the value of meat

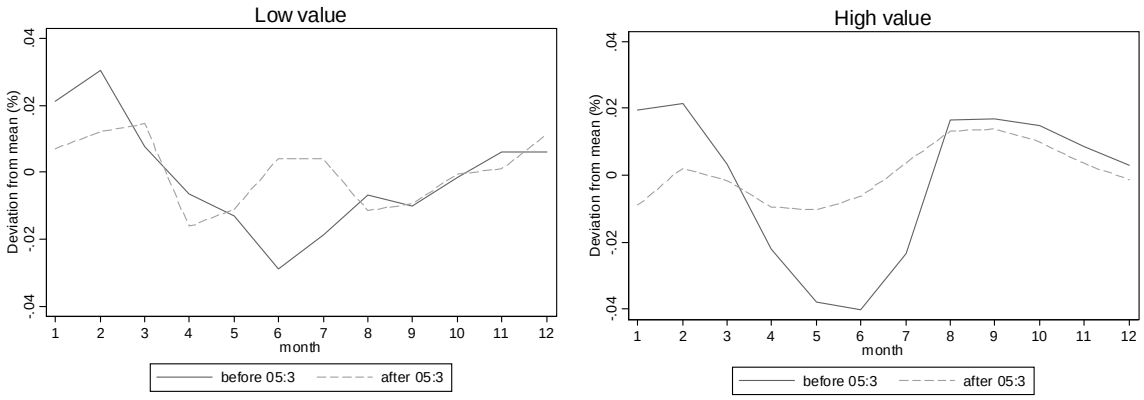

Figure 5: The share of imports over August-March

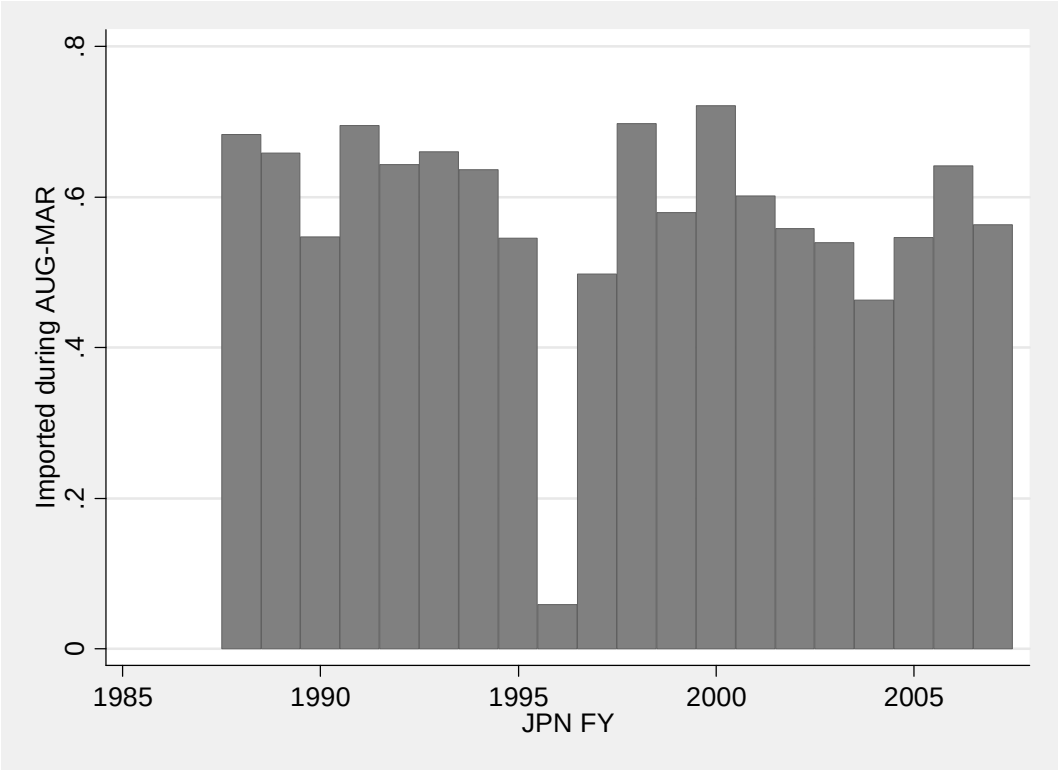

Figure 5: The price gap analysis

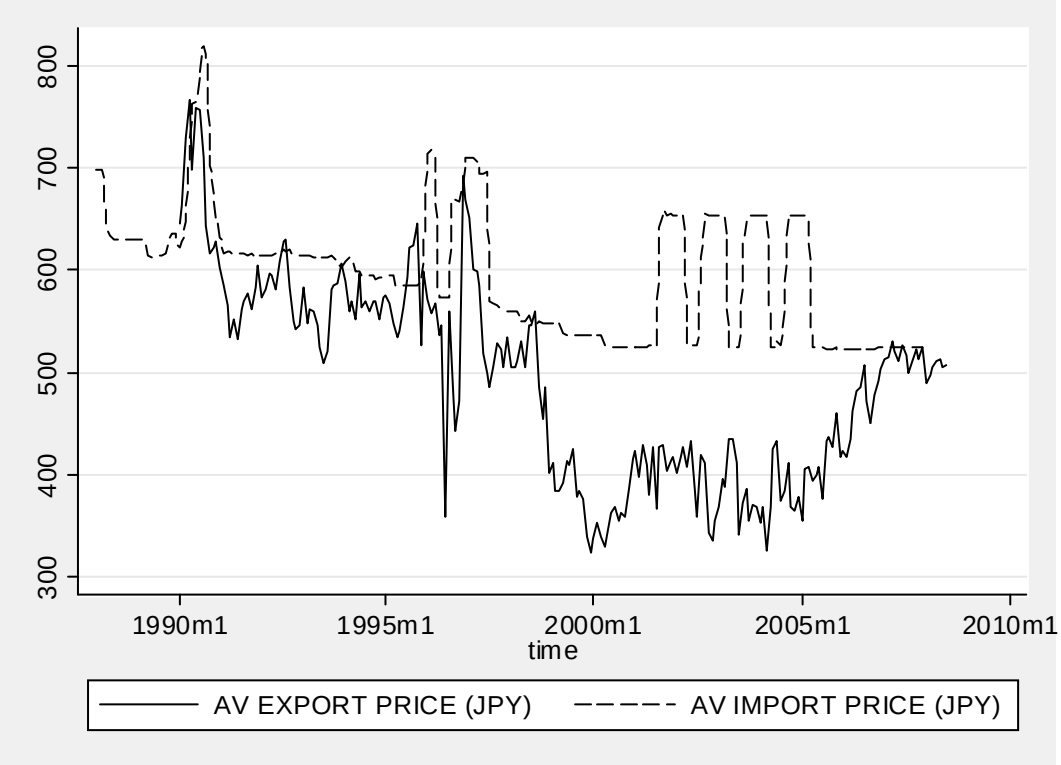

Table 1: Summary Statistics

	Mean	S.D.	N
Frozen			
Backribs	580.6	37.7	196
Belly	589.8	39.9	544
Butt	577.8	43.5	90
Collar	548.0	82.5	196
Tender Loin	811.5	54.3	344
Chilled			
Backribs	721.6	40.2	196
Belly	749.8	27.3	252
Butt	704.9	33.3	155
Loin	698.4	39.0	196
Tender Loin	936.1	73.6	351
Exchange rates			
JPY/CAD	91.3	12.4	90
JPY/DKK	18.4	2.4	90
JPY?USD	115.6	7.3	90

Table 2

DOLS Estimates

Dependent variable: LOGTLOIN, DENMARK FROZEN

Variables	Break point				
	Safeguard		Safeguard	2005.6	
BELLY	0.064		3.025	2.135	**
	(0.390)		(3.989)	(0.813)	
REGIME	-11.116	+	6.327	14.516	+
	(5.916)		(26.502)	(7.546)	
BELLY×REGIME	1.764	+	-1.000	-2.301	+
	(0.937)		(4.204)	(1.188)	
WALD TEST	4.193		0.142	7.049	*
	[0.123]		[0.931]	[0.029]	
Sample period	01:4-08:5		01:4-05:3	01:4-08:5	

Note: Rescaled standard errors are in round brackets. P-values for the Wald tests are in square brackets.

Table 3 Difference Estimators

	Low-value Sample				High-value Sample			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
sg_aug	-0.0088	-0.0084	0.0028	-0.0113	0.0267**	0.0287**	0.0271**	0.0278**
	(0.0110)	(0.0109)	(0.0159)	(0.0174)	(0.0060)	(0.0057)	(0.0056)	(0.0057)
sg_sep	-0.0037	-0.0039	0.0075	-0.0043	0.0014	0.0002	-0.0054	-0.0039
	(0.0066)	(0.0075)	(0.0081)	(0.0088)	(0.0053)	(0.0054)	(0.0063)	(0.0071)
sg_oct	0.0006	0.0010	0.0126	0.0014	0.0026	0.0059	-0.0000	0.0012
	(0.0072)	(0.0081)	(0.0147)	(0.0167)	(0.0049)	(0.0052)	(0.0058)	(0.0060)
sg_nov	0.0078	0.0078	0.0197*	0.0076	-0.0003	-0.0001	-0.0057	-0.0046
	(0.0052)	(0.0053)	(0.0074)	(0.0084)	(0.0056)	(0.0061)	(0.0086)	(0.0085)
sg_dec	-0.0112*	-0.0115*	-0.0002	-0.0128	-0.0013	0.0001	-0.0051	-0.0045
	(0.0041)	(0.0046)	(0.0085)	(0.0114)	(0.0037)	(0.0040)	(0.0065)	(0.0065)
sg_jan	0.0020	0.0025	0.0131	0.0083	-0.0101*	-0.0083+	-0.0162*	-0.0157*
	(0.0081)	(0.0083)	(0.0098)	(0.0094)	(0.0045)	(0.0044)	(0.0070)	(0.0068)
sg_feb	-0.0338**	-0.0212*	-0.0101	-0.0166	-0.0167**	-0.0139*	-0.0219**	-0.0218**
	(0.0074)	(0.0076)	(0.0133)	(0.0142)	(0.0057)	(0.0054)	(0.0062)	(0.0063)
sg_mar	-0.0179**	-0.0106*	-0.0002	-0.0134	-0.0356**	-0.0301**	-0.0378**	-0.0254**
	(0.0054)	(0.0042)	(0.0094)	(0.0142)	(0.0076)	(0.0072)	(0.0092)	(0.0075)
sg_apr	0.0073	-0.0013	0.0097	-0.0061	-0.0168**	-0.0136**	-0.0218**	-0.0241**
	(0.0056)	(0.0047)	(0.0088)	(0.0126)	(0.0042)	(0.0042)	(0.0065)	(0.0065)
sg_may	0.0219**	0.0238*	0.0331*	0.0036	0.0017	0.0048	-0.0042	-0.0082
	(0.0072)	(0.0086)	(0.0134)	(0.0136)	(0.0037)	(0.0042)	(0.0060)	(0.0079)
sg_jun	0.0071	0.0059	0.0154	0.0115	0.0028	0.0017	-0.0077	-0.0070
	(0.0056)	(0.0058)	(0.0108)	(0.0115)	(0.0047)	(0.0049)	(0.0061)	(0.0060)
sg_jul	0.0062	0.0059	0.0070	0.0100	-0.0035	-0.0032	-0.0109*	-0.0113*
	(0.0084)	(0.0083)	(0.0081)	(0.0082)	(0.0039)	(0.0037)	(0.0042)	(0.0042)
L1(CAD)		0.0186	0.0353+	0.0639*		0.0274	0.0114	0.0312
		(0.0154)	(0.0200)	(0.0237)		(0.0236)	(0.0264)	(0.0310)
L2(CAD)		0.0304	0.0611	0.0915		0.0226	-0.0046	-0.0042
		(0.0593)	(0.0703)	(0.0717)		(0.0253)	(0.0299)	(0.0293)
L3(CAD)		-0.0288	-0.0045	-0.0301		-0.0617*	-0.0793**	-0.0841**
		(0.0306)	(0.0369)	(0.0351)		(0.0230)	(0.0219)	(0.0218)
L1(DKK)		-0.0532	-0.0384	0.0390		0.1078	0.0931	0.1309
		(0.0678)	(0.0758)	(0.0901)		(0.0831)	(0.1009)	(0.0932)
L2(DKK)		-0.0044	0.0078	0.0379		0.1218+	0.0970*	0.1109*
		(0.0702)	(0.0781)	(0.0940)		(0.0683)	(0.0351)	(0.0396)
L3(DKK)		0.0274	0.0238	-0.0005		-0.0026	-0.0118	-0.0320
		(0.0511)	(0.0535)	(0.0595)		(0.0361)	(0.0476)	(0.0520)
L1(USD)		-0.0414	-0.0518	-0.0411		-0.0080	-0.0010	0.0215
		(0.0873)	(0.1120)	(0.0990)		(0.0352)	(0.0448)	(0.0423)
L2(USD)		-0.0122	0.0129	0.0443		0.1733**	0.1779**	0.1727**
		(0.1338)	(0.1275)	(0.1396)		(0.0544)	(0.0602)	(0.0604)
L3(USD)		0.1215*	0.1547*	0.0941		-0.0201	-0.0124	-0.0204
		(0.0513)	(0.0593)	(0.0666)		(0.0436)	(0.0498)	(0.0516)
Penalty Law				0.0224				-0.0355*
				(0.0192)				(0.0142)
L1(Penalty Law)				0.0365*				0.0111
				(0.0147)				(0.0104)
L2(Penalty Law)				0.0802**				0.0135
				(0.0199)				(0.0097)
SEASONALITY	YES	YES	YES	YES	YES	YES	YES	YES
ORIGIN SPECIFIC COSTS	NO	NO	YES	YES	NO	NO	YES	YES
Constant	0.0114**	-0.0031	-0.0015	0.0032	0.0025	0.0032	-0.0009	-0.0013
	(0.0000)	(0.0101)	(0.0079)	(0.0081)	(0.0034)	(0.0034)	(0.0028)	(0.0028)
Observations	1008	963	963	963	1469	1403	1403	1403
Adjusted R-squared	0.03	0.02	0.04	0.08	0.17	0.17	0.18	0.19

Notes: Robust standard errors in parentheses. + significant at 10%; * significant at 5%; ** significant at 1%.
Variables except dummies are differenced.

Table 4 The test for the null of no evasion

Tariff-rate pass-through coefficients (%)	F-statistics	
100	9.462	**
80	6.542	*
50	3.169	+
30	1.600	
0 (Null of no evasion)	0.234	

Notes: The results from the Wald tests. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 5

Revenue and Evasion: Denmark Frozen Swine

	Evasion Estimate		Revenue		Evasion-Revenue Ratio	
JFY	All year Apr.-Mar.	Safeguard Aug.-Mar.	All year Apr.-Mar.	Safeguard Aug.-Mar.	All year Apr.-Mar.	Safeguard Aug.-Mar.
1998	9,006.0		3,598.4		2.50	
1999	34,134.5		4,946.0		6.90	
2000	29,849.1		4,417.1		6.76	
2001	40,668.1	31,357.3	5,677.1	3,727.2	7.16	8.41
2002	46,078.6	34,496.8	5,674.9	3,463.0	8.12	9.96
2003	47,623.3	35,752.5	5,945.6	3,520.2	8.01	10.16
2004	53,161.3	32,700.8	6,647.7	3,424.8	8.00	9.55
2005	24,837.4		5,297.9		4.69	
2006	6,853.7		3,898.7		1.76	
2007	834.3		2,709.8		0.31	
Total	293,046.3	134,307.4	48,812.9	14,135.2	6.00	9.50

Notes: The unit is in million yen.