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Publication date:
2008

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Yu, W., & Babula, R. (2008). *Dynamic economic relationships among China's cotton imports and the EU market for apparel exports*. Fødevareøkonomisk Institut, Københavns Universitet. IFRO Working Paper, No. 3, Vol.. 2008

Dynamic Economic Relationships among China's Cotton Imports and the EU Market for Apparel Exports

Institute of Food and Resource Economics (FOI)

Working Paper 2008/3

Dynamic Economic Relationships among

China's Cotton Imports and the EU Market for Apparel Exports

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Abstract

The expiration of the WTO Agreement on Textiles and Clothing (ATC) in January 2005 coincided with surges of China's apparel exports and apparent increases in China's cotton imports, the former of which has led to trade conflicts between China and its main trading partners, and the latter of which has seemingly prompted China to relax its restrictions on cotton import.

Using recent monthly data, this study employs a VAR model to investigate the inter-linkages between China's and its competitors' apparel exports to the EU and between China's apparel exports and its cotton imports. Our analysis shows that (1) there appears to be a downward-sloping and elastic demand curve for China's apparel products by the EU, implying that increased export volume from China has led to proportionally larger drops in prices of Chinese apparel products; (2) China's and its competitors' apparel exports to the EU are imperfect substitutes and the "crowding out" effects of Chinese apparel exports seem to be modest in the EU market; (3) the inter-relationship between China's apparel exports and its demand for imported cotton is found to be statistically significant. However, increased apparel exports from China

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induce proportionally larger increases in its cotton imports. In particular, the end of the ATC is shown to boost China's apparel exports by nearly 16 percent. This increase "magnifies" China's demand for imported cotton by 75 percent. This discrepancy is possibly due to the relaxation of China's import restrictions on cotton following the end of the ATC which led to the extra boost in China's cotton imports.

Keywords

Key words: Textile and Clothing, Cotton, International Trade, China, European Union
JEL Classifications: F14; Q16; C32; C53.

ISBN 978-87-92087-58-4 (print, Dynamic Economic Relationships among China's Cotton Imports and the EU Market for Apparel Exports)
ISBN 978-87-92087-59-1 (on-line, Dynamic Economic Relationships among China's Cotton Imports and the EU Market for Apparel Exports)

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1. Introduction

Following the termination of the WTO Agreement on Textiles and Clothing (ATC) on January 1, 2005, international trade of textiles and clothing – previously controlled by a quota-based system – has finally returned to the general rules of the WTO (more specifically, the GATT). This historical event also marked noticeable increases in China's textile and clothing exports, which has created ramifications both domestically and internationally.

Domestically, increased exports of apparel have led to increased demand for cotton to the extent that China has to increase its cotton imports. Upon the accession to the WTO in 2001, China set up Tariff Rate-Quota (TRQ) systems for several agricultural products, including cotton. The quota for cotton was set at 0.78 million tons in 2000 and was scheduled to rise to 0.894 million tons in 2004. For the year 2002 and 2003 when China first notified the WTO of its imports under the TRQs, the notified in-quota cotton imports either fell short of the quota or right at the quota. In 2004, however, the amount of notified cotton imports (1.91 million ton) more than doubled the scheduled quota for that year (0.894 million ton). In 2005, notified cotton imports were 2.57 million tons, as compared to the same scheduled quota of 0.894 million tons. Two interesting observations emerge. First, the surge of imports of cotton actually started a year before the end of the ATC, perhaps because apparel producers in China began stocking up cotton in anticipation of the end of the ATC. Second and perhaps more interesting, the Chinese government actually included a large amount of over-quota imports in the notified in-quota imports for both 2004 and 2005, indicating that these over-quota imports were actually charged the lower in-quota tariff for both 2004 and 2005.[3] This is surely a unilateral relaxation of import restrictions by the Chinese government, perhaps in responding to the lobby of apparel producers for increasing their access to cheaper supply of raw cotton.

Nevertheless, it would be mistaken to say that the sole objective of China's cotton import policy is to ensure access to imported cotton for the apparel producers. In fact, from May 1, 2005, China started to institute a "sliding scale" tariff on "a certain

[3] An analysis of data obtained from the official website of the Ministry of Agriculture of China (www.agri.gov.cn) reveals that, for the years 2002, 2003, 2004 and 2005, the actual total cotton imports all exceeded the notified in-quota imports by a very small margin. Therefore it appears that only a small portion of these imports were not treated as in-quota imports.

level" of out-of-quota cotton imports.[4] The purpose of this instrument was to ensure that the tariff-included price of imported cotton is set at a "reasonable" level so as not to disrupt China's domestic cotton production. The level of the sliding scale tariff depends on the price of the cotton imports, with higher-priced imports facing lower tariffs and lower-priced imports facing higher tariffs. The tariff rate fluctuates between 5% and 40% (which is the final bound tariff or the highest possible out-of-quota tariff for cotton imports).

Taken together, the *de facto* relaxation of the cotton quota and the introduction of the sliding scale tariff suggest that the Chinese government is working a fine line between balancing the interests of China's apparel producers and cotton farmers, in responding to the export opportunities arising from the end of the ATC. Against this backdrop, it would be interesting to investigate the extent to which the surge in apparel exports has led to increased cotton imports into China and whether the relaxation of China's import restrictions on cotton has further contributed to the increase in cotton imports.

Internationally, the surge of Chinese apparel exports has resulted in changes in the trade patterns of world textile and clothing markets. For instance, in a summary published on the European Commission's Trade Issues website on June 15, 2006, it is written that

> "China's share of exports to the EU in these textiles categories liberal ized on 1 January 2005 has increased sharply at the expense of traditional EU suppliers, mainly in Asia but also in North Africa and the ACP. There has, however, been only a modest rise in textile imports to the EU, either in the 35 products liberalized on 1 January 2005, or in total textile imports…in general, in 2005, China increased its exports to the EU by 42% in value and by 36% in volume. For categories liberalized in 2005 there was an increase in China's market share by 130% in volume and 82% in value…all other major suppliers have suffered export displacement in products liberalized in 2005."[5]

[4] This was discussed in the Chinese Finance Minister's press conference held on December 15, 2005. Transcript of the press conference (in Chinese) was obtained from the official website of the Ministry of Finance of China: http://www.mof.gov.cn/news/20051215_1500?11138.htm.

[5] This paragraph appeared in http://ec.europa.eu/trade/issues/sectoral/industry/textile/pr150606_en.htm.

High level consultations and discussions between China and the US and between China and the EU on China's apparel exports followed. The latter was resolved on June 11, 2006 as China and the EU essentially agreed to set up temporary quotas to limit apparel exports from China. These temporary quotas will last until the end of the 2008. Since a large amount of textile and apparel exports from China had already reached the EU ports prior to the June 11 deal and exceeded the agreed-upon limits and thus stranded, China and EU had to enter into another round of discussion to deal with these stranded goods and were able to reach a deal on September 5, 2005. In the presence of these trade conflicts, it would be equally interesting to investigate whether the end of the ATC has actually led to permanent increases in China's apparel exports to the EU, whether the alleged surge in Chinese textile and apparel exports have actually crowded out exports that originated from the EU's traditional suppliers, whether the temporary quotas triggered by the initial export surge from China have slowed down the expansion of Chinese exports, and whether those temporary export limits have noticeable impacts on China's cotton imports.

To our knowledge, these questions have not been systematically answered using rigorous econometric tools. Therefore, the purpose of this paper is to gather the necessary time series data for conducting formal econometric analysis of the above questions. In particular we are interested in investigating the empirical interrelationships among Chinese cotton imports, and Chinese and its competitors' (i.e. the rest of the world or ROW for short) apparel exports to the EU, and in estimating the market-propelling parameter estimates on these interrelationships. The more specific questions we attempt to answer in this study include:

- How do China's cotton imports respond to a shock (rise or fall) in EU-bound exports or their prices?

- How do changes in China's apparel exports to the EU or their prices influence prices and quantities of competing exports from the ROW? Do increased Chinese exports crowd out competing ROW exports noticeably?

- Conversely, how do changes in the ROW's apparel exports to the EU influence prices and quantities of China's apparel exports?

We have fortunately procured monthly data on Chinese and its competitors' quantities and prices of apparel exports to the EU, as well as quantities and prices of cotton imports into China. These data accord us an opportunity to conduct an econometric analysis to answer the above questions.

The rest of the paper is organized as follows. Section 2 is devoted to the discussion of the econometric model, the underlying data set, and the statistical adequacies of the econometric model. In section 3, we discuss the results from three sets of simulations of the impulse response functions. Section 4 reports the strength of endogenous variable interrelationships in the model through the analysis of forecast error variance decompositions. Section 5 analyzes important deterministic binary components of the model. The last section concludes.

2. Econometric Model, Data, and Statistical Model Adequacy

2.1. Model, Data, and Data Sources

We have gathered a monthly time series data set describing the quantities and values of China's apparel exports to the EU, quantities and values of apparel exports from the ROW into the EU (excluding intra-EU apparel trade), as well as quantities and values of China's cotton imports. These series cover the period from January 2000 to April 2007.

Data on China's and ROW's apparel exports into the EU (referring to the EU25) are extracted from the database maintained by EUROSTAT.[6] By dividing values of exports by the corresponding export quantities, we also obtain the corresponding unit values, which are used as proxies for export prices. In total, four variables from the EUROSTAT database are used in our subsequent econometric analysis, including:

- QAPCHINA: China's exports of apparel products to the EU25 in 100 kilograms

[6] More specifically, these data are for "articles of apparel and clothing accessories, not knitted or crocheted", which is the group G_62 in the EUROSTAT external trade database, accessible from http://ec.europa.eu/eurostat.

- PAPCHINA: Price of China's apparel exports to the EU25, proxied by the unit value (€/100kg) calculated from the value and quantity of exports from China to the EU25

- QAPROW: The ROW's apparel exports to the EU25 in 100kg

- PAPROW: Price of the ROW's apparel exports to the EU25, proxied by the unit value (€/100kg) based on the value and quantity of exports from ROW to EU25.

Data on quantities and values of China's cotton imports are gathered manually from the official website of China's Ministry of Agriculture (http://www.agri.gov.cn), where monthly tables recording exports and imports of major agriculture products exist. We include the following two variables in our analysis:

- QCOTCHINA: Quantity of China's raw cotton imports in tons

- PCOTCHINA: Price of China's cotton imports in US$10,000/ton, proxied by unit value calculated from values and quantities of China's cotton imports.

In addition, another variable DIFPWORLD which describes the US price index for apparel products was also gathered for purposes of capturing non-EU apparel market conditions.

We specify, estimate, and simulate a monthly vector autoregression (VAR) model for the above monthly variables in natural logarithms (denoted throughout via the upper-cased labels). A VAR model of the above variables was considered because evidence from unit root tests suggested that QAPCHINA, PAPCHINA, QAPROW, PAPROW, QCOTCHINA, and PCOTCHINA were stationary in logged levels, and that the non-EU apparel price DIFPWORLD was integrated of order-1 (I(1)) or non-stationary in logged levels.[7] Since evidence suggests that six of the seven variables are likely I(0)

[7] Dickey-Fuller or augmented Dickey-Fuller (DF, ADF) tests were applied to the seven variables in logged levels. The following ADF pseudo-T or $T\mu$ were all negative and had absolute values above the 10-percent absolute critical value of 3.15: -3.64 for QCOTCHINA, -3.8 for PCOTCHINA, -4.4 for QAPCHINA, -6.7 for QAPROW, and -4.01 for PAPROW. Evidence at the 10 percent level was sufficient to reject the null hypothesis of non-stationarity in each case. The DF $T\mu$ test value of -2.54 for PAPCHINA was nearly (marginally) sufficient at the 10 percent significance level to reject the null of nonstationary. Following the advice of Harris (1995) and Kwiatowski et. al. (1992) in cases of marginal DF unit root test results, we used the recommended test developed by Kwiatowski

in logged levels, then cointegration was not an issue, and the above-defined variables was estimated as a VAR of six logged levels variables and one variable in first differences of logged levels (to be discussed below). As noted by Juselius (2006), Patterson (2006), and Hamilton (1994), the VAR framework is a reduced form one, where quantities are neither those specifically demanded or specifically supplied, but are rather those quantities or prices that clear the market.

The VAR model posits each of the seven variables as a function of a designated number – here three – of lags of itself and of the remaining six variables in the system.[8] The seven-equation VAR model is as follows:

X(t) = a(1,1)*QCOTCHINA(t-1) + a(1,2)*QCOTCHINA(t-2) + a(1,3)*QCOTCHINA(t-3)
+ a(2,1)*PCOTCHINA(t-1) + a(2,2)*PCOTCHINA(t-2) + a(2,3)*PCOTCHINA(t-3)
+ a(3,1)*QAPCHINA(t-1) + a(3,2)*QAPCHINA(t-2) + a(2,3)*QAPCHINA(t-3)
+ a(4,1)*PAPCHINA(t-1) + a(4,2)*PAPCHINA(t-2) + a(2,3)*PAPCHINA(t-3)
+ a(5,1)*QAPROW(t-1) + a(2,2)*QAPROW(t-2) + a(2,3)*QAPROW(t-3)
+ a(6,1)*PAPROW(t-1) + a(6,2)*PAPROW(t-2) + a(2,3)*PAPROW(t-3)
+ a(7,1)*DIFPWORLD(t-1) + a(7,2)*DIFPWORLD(t-2) + a(7,3)*DIFPWORLD(t-3)
+ a(C)*INTERCEPT + a(D)*DETERMINISTIC + e(t)

The asterisk denotes the multiplication operator. The residual vector is distributed as white noise. X(t) + QCOTCHINA(t), PCOTCHINA(t), QAPCHINA(t), PAPCHINA(t), QAPROW(t), PAPROW(t), and DIFPWORLD(t). The a-coefficients are ordinary least squares (OLS) estimates with the first parenthetical digit denoting the seven endogenous variables. The a(C) term denotes a vector of OLS estimates on the intercept. The a(D) term denotes a vector of OLS estimates on various deterministic variables comprising the vector DETERMINISTIC. More specifically, DETERMINISTIC includes a series of 11 centered seasonal binary variables to capture seasonal influences because all data are monthly series, as well as two binaries to account for the termination of the Agreement of Textiles and Clothing (ATC) in January

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et. al. (1992) – the KPSS test – as a supplemental test to determine PAPCHINA's stationarity properties (see also Babula, Bessler, and Payne 2004, p. 6). KPSS test evidence at the one percent significance level was insufficient to reject the null of PAPCHINA's stationarity. Consequently, given the marginal DF test evidence and the KPSS test results, we concluded that PAPCHINA is likely stationary. With an ADF $T\mu$ value of -1.3 for the non-EU apparel price, evidence at the 10 percent level was insufficient to reject the null that the price was nonstationary, and was thus taken as nonstationary and included in the VAR model in first differences of logged levels. We chose a 10-percent significance level based on analysis in Harris (1995).

[8] The three-order lag emerged from our application of the lag selection procedure developed by Tiao and Box (1978).

2005, and the June 2005 resolution between the EU and China on imposing temporary quotas on apparel imports sourced from China.

Note that the inclusion of the DIFPWORLD variable in the model is an effort to capture non-EU apparel market conditions, and given its non-stationarity in logged levels, was included in first-differences.[9] As a result, interpretations, especially with respect to impulse response analysis, do not have straightforward interpretations. Therefore, this variable was included only for enhancing model specification and we do not directly attempt to examine or interpret model results it generates.

2.2. Statistical Adequacy of the Estimated Model

We provide two sets of evidence to demonstrate the notable statistical strength of our model: diagnostic test evidence attesting to the model's specification adequacy, and selected plots of the model's in-sample fitted values with observed values (hereafter, fitted vs. actual values). Following previous research, we provide evidence from three diagnostic tests on the VAR model equations (in Table 1) that shows the model has achieved literature-established standards of statistical adequacy (see Andersen et. al. 2007, pp. 106-107). The F-test evidence rejected the null hypothesis that an equation's (non-intercept) regression estimates were zero for all six equations. Evidence from the Ljung-Box portmanteau tests was insufficient at the five percent significance level to reject the null hypothesis of model adequacy. Following Granger and Newbold's (1986, pp. 99-100) recommendation against sole reliance on Ljung-Box portmanteau evidence, we provided Dickey-Fuller unit root tests on the equations' estimated residuals. In all cases, evidence at the five percent significance level was strongly sufficient in all seven cases to reject the null of nonstationary residuals suggesting adequate specification (see Andersen et. al. 2007, p. 106). We deemed that QAPROW is likely adequately specified when the marginal Ljung-Box result was considered with the F-test and DF values that strongly suggested model adequacy.

The second set of evidence is included in the plots of fitted vs. actual values for the three quantity variables – QAPCHINA, QAPROW, and QCOTCHINA in Figures 1,

[9] DIFPWORLD is the first difference of a non-EU apparel price to reflect non-EU apparel market conditions. This is proxied by the first difference in the logged level of the seasonally un-adjusted U.S. producer price index or PPI for apparel, textile and apparel products group, series number WUP0381 obtained from the U.S. Department of Labor, Bureau of Labor Statistics (Labor, BLS 2007).

2, and 3 respectively. These quantity equations generate in-sample predicted values that closely track actual data, including behavior on and around abrupt behavioral turning points such as for QAPCHINA in 2006, and for QAPROW and QCOTCHINA in 2004.[10]

We contend that the diagnostic evidence in table 1 and figures 1-3 reveal a VAR model of reasonable statistical adequacy. The model meets literature-established diagnostic standards for a statistically adequate model (see Andersen et. al. 2007, pp. 106-107).

3. Three Model Simulations with the Impulse Response Function

To answer the dynamic questions for each aforementioned issue, we analyze the impulse response function that simulates, over time, the effect of a one-time shock in one of the system's series on itself and on other series in the system. The method that converts the VAR model into its moving average representation (a series of nonlinear combinations of the VAR model regression coefficients) is well-known and not summarized here (see Sims 1980; Bessler 1984; Hamilton 1994). By imposing a one-time exogenous shock on one of the VAR system's variables, we examine the quarterly impulse responses of the other respondent endogenous variables. This permits the discernment of what the sample's long run and historical trends would generate as answers to the dynamic questions related to the issues.

As discussed in Patterson (2000), Hamilton (1994), and Babula and Rich (2001), the VAR econometric framework is a reduced form model, and the shocks that we imposed on the model may arise from an array of alternative events on the demand or supply side of the model. More specifically, a shock in price or in quantity could conceivably and alternatively arise from a demand-side or supply-side event. The reduced form model captures the average long run patterns in the data and the impulse response function depicts "generic" shocks and long run average impulse responses averaged over all sorts of demand and supply events encompassed by the sample (Babula and Rich 2001; Andersen et. a. 2007, pp. 108-109; Hamilton 1994). Our results illuminate the dynamic nature of the modeled markets' price/quantity transmission effects that could arise from alternatively sourced events and provide a starting point

[10] Owing to space limitations, we chose not to report fitted vs. actual value plots for the three price variables, although fitted prices did track actual values reasonably well. These plots are available from the authors on request.

of discussion for analysis of more specific demand and/or supply events, when coupled with specific working knowledge of the modeled markets.

We simulated the VAR model's impulse response function under three shocks: increases in the market-clearing quantity of China's EU-bound apparel exports (QAPCHINA), the market-clearing price of China's EU-bound apparel exports (PAPCHINA), and the market-clearing quantity of the ROW's EU-bound apparel exports (QAPROW).

Table 2 summarizes the results of the three impulse response simulations. Following previous VAR econometric research, we applied Kloek and Van Dijk's (1978) Monte Carlo simulation methods to generate *t*-values for all impulse responses and considered only those for Table 2 that achieved statistical significance at the 10 percent level. The results, in turn, illuminate the dynamic aspects of a respondent variable's shock-induced effects: direction of responses, response patterns and durations, response multipliers, and strength of interrelationships among endogenous variables. The multipliers reveal the long run average percentage change in a respondent variable per percentage change in the shocked variable. Sign is important: a positive (negative) sign suggests that the respondent variable's reaction is in the same (opposing) direction as the shock. For example, a negative value of table 2's QAPCHINA multiplier from a rise in PAPCHINA (simulation 2) suggests that on average historically, each percent rise in the price of EU-bound and China-sourced apparel elicits a one percentage decline in the quantity of such EU-bound apparel from China.

The model's estimated residuals may be contemporaneously correlated, and one must incorporate information inherent in such correlations if compromised inference is to be avoided and if VAR econometric results such as impulse responses and forecast error variance (FEV) decompositions are to reliably reflect observed patterns (Bessler 1984). Previous research has traditionally employed the Choleski decomposition in order to utilize the information inherent in the contemporaneously correlated current errors (Bessler 1984; Andersen et. al. 2007). We followed this prior work and imposed a Choleski decomposition in order to orthogonalize the current innovation matrix, such that the variance/covariance matrix is identity. Each simulation's decomposition requires an arbitrarily imposed, and presumably theoretically based, Wold causal ordering among the current values of the VAR model's seven endogenous variables.[11]

3.1. Simulation 1: An Increase in Chinese exports of EU-bound apparel

An increase in Chinese apparel exports to the EU or QAPCHINA elicits an own-price decline that begins "immediately after" (i.e. within 29 days of) the shock's occurrence. The PAPCHINA responses last for five months, and unfold in a bell-shaped pattern. On average historically, each percentage rise in QAPCHINA elicits declines in own price of 1.3 percent

The QAPCHINA increase does not elicit statistically significant declines in competing ROW apparel exports to the EU, suggesting no apparent crowding out of ROW apparel exports by China-sourced apparel exports in the EU market. However, each percentage rise in QAPCHINA does influence price of competing ROW exports. The QAPCHINA increase elicits declines in PAPROW that take four months to engage, and which last for three months. The "drag-down" in the prices of competing ROW apparel in the EU market is mild, insofar as each percentage QAPCHINA increase, on average historically, elicits a far less than proportional decline of -0.13 percent in PAPROW. Given that the surge in Chinese EU-bound apparel exports elicits no significant crowding-out of the competing ROW products, and elicits a mild price decline in PAPROW, this result may suggest that Chinese and ROW apparel products are imperfect substitutes in the EU market.

A surge in Chinese exports of EU-bound exports of apparel has noticeable implications for Chinese raw cotton imports. Within four months of the increase in QAPCHINA, China's raw cotton imports rise for six months, unfold in a bell-shaped pattern, and increase 2.6 percent for each percentage rise in Chinese EU-bound apparel exports. Cotton import price is also augmented by a surge in QAPCHINA that takes

[11] The following three orderings were chosen for the three shock simulations with the shocked market variables placed atop the ordering, and with the actually shocked variable serving as the ordering's first variable: (1) QAPCHINA, PAPCHINA, QAPROW, PAPROW, DIFPWORLD, QCOTCHINA, PCOTCHINA for simulation 1's imposed increase in QAPCHINA, (2) PAPCHINA, QAPCHINA, PAPROW, QAPROW, DIFPWORLD, PCOTCHINA, QCOTCHINA for simulation 2's imposed increase in PAPCHINA; and (3) QAPROW, PAPROW, QAPCHINA, PAPCHINA, DIFPWORLD, QCOTCHINA, PCOTCHINA for simulation 3's imposed increase in QAPCHINA. These orderings follow procedures in Babula and Bessler (1989, 1990), Babula and Rich (2001), and Andersen et al. (2007).

half a year to react, thereafter rises for four months, and ultimately climbs by 0.6 percent for each percentage rise in PCOTCHINA.

3.2. Simulation 2: An Increase in the price of EU-bound apparel exports from China

A rise in the EU import price of China-sourced apparel (PAPCHINA) has a number of impacts on the EU apparel imports and the Chinese raw cotton imports.

First, the PAPCHINA increase elicits “immediate” declines in the quantity of China-sourced apparel exports into the EU. Such decreases take on a bell-shaped pattern that endures for five months. Ultimately, each percentage rise in PAPCHINA elicits a percent decrease in QAPCHINA, suggesting a unity own-price elasticity of ultimate response of equilibrium quantity of exports. Given normal demand and supply changes in responding to a price change, the negative sign of this QAPCHINA multiplier suggests that the negative demand response of EU apparel importers dominates the positive Chinese export responses, such that the -1.0 value of the multiplier may be considered as a lower limit estimate of the own-price elasticity of EU demand for Chinese apparel exports in this reduced form framework. The EU’s elastic demand for Chinese apparel exports may be explained by its ability to switch its sourcing from China to the ROW, the later of which is shown below to be substitutable, to some degree, for QAPCHINA.

Second, that ROW-sourced exports are competing substitutes for China-sourced product in the EU apparel market is suggested by the PAPROW responses. As the price of China-sourced apparel exports to the EU rises, the price of exports from the ROW to the EU also rises. The increase in PAPROW begins during the shock’s engagement, lasts a month, and ultimately climbs 0.2 percent for each percentage increase in PAPCHINA. This less-than-unity PAPROW multiplier, coupled with the lack of any statistically significant crowding-out of ROW-sourced exports, may suggest a modest imperfect substitutability between China -sourced and ROW-sourced apparel exports into the EU.

Third, the positive shock to PAPCHINA has some rather involved effects on the Chinese market for raw cotton. The effects have both short-run and intermediate or longer-run dimensions. Generally speaking, given the supra-unity values of the estimated cotton market’s multipliers (for both quantities and prices of cotton imports into China, as can be seen from Table 2), the Chinese cotton market is highly sensitive to changes in prices of Chinese apparel exports. PAPCHINA-induced effects on China's cotton imports apparently include a positive export supply effect first, followed by a longer-run negative demand effect, possibly due to reduced apparel exports from China. The rise in the PAPCHINA influences the price of imported cotton in China (PCOTCHINA). First, it elicits what appears from table 2 to be initial positive effects on PCOTCHINA from the export supply side as Chinese apparel producers demand more raw cotton. This leads PCOTCHINA to rise immediately for about a month, and ultimately increase two percent for each percentage increase in PAPCHINA. After three months, a second and more time-enduring effect that appears to be demand-oriented arises. PCOTCHINA begins declining for seven months, taking on a bell-shaped monthly pattern, and ultimately declining 2.8 percent for each percentage rise in PAPCHINA. So a rise in the price of China-sourced apparel exports seems to first augment Chinese cotton import price as apparel suppliers demand more cotton, only to be followed by a demand-driven secondary effect on PCOTCHINA as higher apparel prices dampen the EU's demand for Chinese apparel exports.

The same rise in Chinese apparel export price also has a dually-phased impact on quantities of Chinese cotton imports (QCOTCHINA). As PAPCHINA rises, Chinese cotton imports immediately react, rise for a month, and ultimately climb by 1.1 percent for each percentage PAPCHINA increase. This could be a reaction from Chinese apparel suppliers demanding more cotton in responding to the rise in apparel export price. After three months, a seemingly demand-driven effect on QCOTCHINA surfaces: imports begin falling, decline for seven months, and decrease 2.8 percent for each percentage PAPCHINA increase. As with Chinese import cotton price, a rise in PAPCHINA augments Chinese cotton imports as apparel suppliers react to stronger export prices, and ultimately decline as EU demand for the now higher-priced Chinese apparel falls.

3.3. Simulation 3: An increase in ROW-sourced apparel exports to the EU (QAPROW)

The interchangeability and inter-relationships of China-sourced and ROW-sourced apparel is further established with the results of the third scenario when an increase in QAPROW is simulated. As QAPROW rises, EU import prices of such products begin to decline immediately, decline for a month, and ultimately fall by 0.6 percent for each percentage rise in quantity. For similar reasons concerning simulation 2's results, the QAPROW multiplier of -0.6 is interpreted as a lower-limit estimate of the own-price elasticity of EU demand for ROW-sourced apparel.

Each percentage rise in QAPROW elicits an immediate, one-month decline in EU imports of Chinese apparel that ultimately reaches 0.5 percent for each percentage QAPROW increase. So there appears some modest crowding-out of China-sourced exports into the EU by ROW-sourced apparel exports.

Interestingly, a surge in ROW-sourced apparel in the EU market appears to augment Chinese cotton imports – perhaps a counterintuitive result at first glance. Each percentage rise in QAPROW elicits an immediate one-month rise in Chinese cotton imports, which ultimately reaches 2.1 percent. One possible explanation of this result is that even though the increase in QAPROW "crowds out" apparel exports from China (as reported in the last paragraph) into the EU market, Chinese apparel suppliers are able to redirect their exports into other markets. Moreover, increased supply into the EU markets by the ROW may suggest reduced supply by the ROW into other export destinations. As such, total apparel exports from China may not necessarily decline. Another way to justify this result is that the increased supply of ROW apparel exports may be caused by the growth in the world apparel market. Such a growth scenario would conceivably increase demands for apparel from all sources. In either case, increased cotton import demand would follow naturally. Nonetheless, resolving full explanations for this result is beyond the direct purview of our estimated and data-limited model, and is relegated to future research efforts that will preferably have the benefit of a richer set of data series and longer time series samples.

4. Strength of Endogenous Variable Interrelationships: An FEV Analysis

To focus on the final dynamic question posed above concerning strength of endogenous variable interrelationships, we analyze forecast error variance (or FEV) decompositions. This is a well-known accounting method for VAR model residuals, and prior research demonstrates that analysis of such decomposition patterns primarily focuses on the strength of causal relationships among the endogenous variables (see Bessler (1984), and Lloyd et. al. (2001), among others). An endogenous variable's FEV is attributed to shocks in each endogenous variable, including itself. Analysis of FEV decompositions not only provides evidence of the simple existence of a causal relationship among variables, but also illuminates the strength and dynamic timing of such a relationship (Bessler 1984, p. 111). A variable is considered endogenous (exogenous) when large (small) proportions of its FEV are attributed to other variables' variation at a particular (here monthly) time horizon (Bessler 1984, pp. 111-112). Decompositions of two or more variables may be added together at a horizon for collective effect. Typically, a variable's FEV is more attributed to own variation and hence exogenous at shorter run horizons, and tends to become more on other endogenous variables at longer run horizons (Babula and Bessler 1989, 1990). Patterns of FEV decompositions for the seven endogenous variables are summarized in table 3. Due to space considerations, we highlight selected FEV-based findings that we deem of greatest relevance and interest. We analyze three sets of FEV decompositions on (i) price and quantity of EU-bound apparel exports from China; (ii) price and quantity of EU-bound apparel exports from the ROW; and (iii) price and quantity of Chinese raw cotton imports.

4.1. FEV decomposition analysis on the China-sourced apparel variables

At the shorter run horizons of three months or less (Table 3), the quantity of EU-bound apparel exports from China is highly exogenous with no less than about 71 percent of its behavior explained by own-variation. Thereafter, own-variation falls in importance in explaining QAPCHINA behavior to about 50 percent. The second most important explanatory of QAPCHINA is its own-price that explains up to about 17 percent of the price's variation. This latter point is consistent with simulation 2's result whereby a half-year of statistically significant QAPCHINA impulses emerge from an own-price shock.

Both the quantity and price of ROW-sourced apparel exports to the EU collectively and moderately influence and explain QAPCHINA variation, a result that is consistent with the statistically significant response in QAPCHINA and PAPCHINA that were elicited from scenario 3's simulation of a rise in ROW's apparel exports to the EU. Further, the price and quantity of ROW-sourced apparel export to the EU collectively account for up to about 12 percent of the China-sourced quantity's behavior. Up to nearly a fifth of the QAPCHINA variation is attributed behavior of the two Chinese cotton market variables.

The price of China's EU-bound apparel exports is rather endogenous with no more than about 28 percent of its behavior attributable to own-variation. The largest explanatory variable of PAPCHINA is its own-quantity that accounts from 46 to 60 percent of the price's behavior, which is consistent with the statistically strong QAPCHINA-induced price responses obtained from simulation 1. Collective influences on the price of China-sourced apparel in the EU from the price and quantity of competing ROW-sourced apparel are modest. Collectively, the two Chinese cotton import market variables explain up to 17 percent of PAPCHINA's behavior.

4.2. FEV decompositions for ROW-sourced apparel variables

The quantity of ROW-sourced apparel exports to the EU is rather exogenous at shorter-run horizons (1-3 months) when no less than 64 percent of its behavior is explained by own-variation. However, in the longer run, only about 56 percent of QAPROW behavior is attributed to its own-variation. The second most important QAPROW explanatory is its own-price that explains up to about 21 percent of the quantity's behavior.

Table 3's FEV decompositions fortify the indications that ROW-sourced and China-sourced apparel exports to the EU are substitutable, albeit imperfectly so, in the EU market. More specifically, the price and quantity of China-sourced apparel exports to the EU have clear, though modest, influence on QAPROW. As expected with a variable designed to capture conditions in the non-EU apparel market, the DIFPWORLD variable appears to exert more influence on ROW-sourced apparel export behavior than on China-sourced exports.

The price of ROW-sourced EU-bound apparel exports, as with the China-sourced counterpart, is highly endogenous and primarily influenced by movements in its own-quantity and to a less extent by the movements in itself. More specifically, PAPROW's FEV decompositions suggest that from 45 to 64 percent of behavior is attributed to its own-quantity movements, and that from 13 to 21 percent of behavior is self-attributed.

The price and quantity variables for China's apparel exports in the EU play a clear and modest role in accounting for behavior of the price of ROW-sourced exports. These results are consistent with impulse response results from scenarios 1 and 2, whereby QAPCHINA and PAPCHINA elicit statistically nonzero, though rather muted, impulse responses in the price of ROW-sourced apparel exports to the EU.

4.3. FEV decompositions for China's raw cotton import market

The quantity of cotton imported into China is exogenous at shorter run horizons of three months or less, when no less than 77 percent of QCOTCHINA variation is self-attributed. Over time however, Chinese cotton imports are increasingly endogenous to the modeled system, to the point where less than 35 percent of QCOTCHINA behavior is self-attributed. The accelerated importance of PAPCHINA and QAPCHINA contributions over time in explaining Chinese cotton import market behavior is consistent with the time-enduring and dually-phased nature of scenario 2's QCOTCHINA and PCOTCHINA responses from a simulated increase in PAP-CHINA.

The price of Chinese cotton imports is highly endogenous in both the short and long terms. In the short term (three months or less) about 67 percent of its behavior is explained by variations in its own-quantity. In the long term (six months or more), the explanatory ability of changes in own-quantity diminishes to about 34 percent, while the importance of variations in quantities and prices of China's apparel exports rises and accounts for up to about 45 percent of Chinese cotton import price, a result that reinforces the statistically non-zero impulses elicited by shocks in QAPCHINA (simulation 1) and PAPCHINA (simulation 2).

5. Analysis of Deterministic Binary Components of the VAR Model

Binary variables were included to capture the effects of the end of the Agreement of Agriculture (ENDATC binary) and the temporary quotas (TEMPQTAS binary)**.** A number of such binary coefficient estimates achieved statistical significance at the 10 percent level: ENDATC in the QAPCHINA, QAPROW, and QCOTCHINA equations, as well as TEMPQTAS in the PCOTCHINA equation.[12] Given that non-binary variables were modeled in natural logarithms, we used Halvorsen and Palmquist's (1980) well-known method to convert the coefficient estimates on the binaries into average percent change effects on an equation's dependent variable from concurrent events associated with the sub-sample for which the binary variable was defined.[13] The Halvorsen-Palmquist or HP calculations suggest that**:**

- On average, China's apparel exports to the EU were 15.7 percent higher after the termination of the ATC in January 2005 than under the agreement, while

[12] The TEMPQTAS coefficient estimate generated a marginal t-value of 1.62, and we deemed this as having approached the 10-percent significance level to a degree close enough to the 1.645 critical value to be considered significant.

[13] More specifically, one takes "e" or the base of the natural logarithm, raises it to the power of the ENDFMA or TEMPQTAS coefficient estimate, subtracts 1.0, and multiplies by 100 to obtain the effect on the dependent variable (Halvorsen and Palmquist 1980). What results is the average percentage change above (if a positive calculation) or below (if a negative calculation) of all concurrent events associated with the event for which the binary was defined. Clearly, the Halvorsen-Palmquist calculation has a typical binary variable limitation of imprecision, in that the percent change effect cannot be attributed soley to the event for which the binary was defined, but must be attributed collectively to this event plus all other influential/relevant concurrent events that occurred.

ROW-sourced exports were only 0.4 percent higher. This result is hardly surprising as it confirms the end of the ATC as a catalyst for apparel exports from China. The modest increase in apparel exports from the ROW further suggests a shrinking share of the ROW's apparel products in EU apparel market.

- The increased apparel exports from China to the EU (and possibly to other destinations such as the US) following the end of the ATC has coincided with more dramatic increases in China's cotton imports. On average, Chinese cotton imports were 75 percent higher after the end of the ATC than during the agreement. This percentage increase is much higher than the average 15.7 percentage higher apparel exports reported above. One plausible explanation of this larger increase in cotton imports is that following the end of the ATC, perhaps in responding to the lobbies from the apparel producers, China actually further relaxed and adjusted its restrictions on cotton imports, which probably gave the imports of cotton an additional boost. For instance, for the year 2005 China treated 2.57 million tons of cotton imports as in-quota imports (which were subject to the lower in-quota tariff), despite the fact that the scheduled quota for that year was only 0.894 million tons (WTO, 2006).

- Chinese cotton import price was 114 percent higher during the period of the TEMPQTAs than without such events. There is no clear explanation of this seemingly counter-intuitive result. One would expect that with the temporary import quota by the EU, increases in China's apparel export would have slowed down, thereby damping Chinese apparel producers' demand for imported cotton and easing the upward pressure on cotton import prices. On the other hand, however, the binary variable on the TEMPQTA (which is set at June 2005) covers the bulk of the post-ATC periods (i.e. from January 2005 and onwards). As compared to the pre-ATC periods, it is certainly not surprising that cotton import prices were higher after the end of the ATC. Therefore, it is possible that this binary variable actually captures the effect of the end of the ATC, rather than the more modest effect of the temporary quota.

6. Summary and Conclusions

The expiration of the WTO Agreement on Textiles and Clothing in January 2005 completed the phase-out of the quota-based international trade system for textile and clothing products. This historical event coincided with surges of China's apparel exports and apparent increases in China's cotton imports, the former of which has led to trade conflicts between China and its main trading partners, and the latter of which seemed to have prompted the Chinese government to relax its import restrictions on cotton. Both observations suggest the importance and relevance of a rigorous investigation on the inter-linkages between China's and its competitors' apparel exports and between China's apparel exports and its cotton imports. Using recent monthly data (January 2000 to April 2007) on clothing and apparel exports from China and the rest of the world to the EU, as well as data on China's cotton imports for the same period, this study provides an econometric investigation on the empirical inter-relationships among markets for Chinese cotton imports, Chinese apparel exports to the EU, and China's competitors' exports to the EU markets.

Due to the statistical characteristics of the data set, a VAR model is built for the purposes of the paper. Simulated impulse responses of the VAR model in responding to various relevant exogenous shocks and the analysis of forecast error variance decompositions reveal the following:

- There appears to be a downward-sloping and elastic demand curve for China's apparel imports by the EU, as supported by the simulation results that increased apparel exports from China to the EU (QAPCHINA) lead to reduced prices of such exports and that increased prices for China's exports to the EU (PAPCHINA) lead to proportionately large reductions in the demands of such exports. The FEV analysis further shows that QAPCHINA is rather exogenous in both the short and long terms and its variations explain a large portion of the behavior of PAPCHINA, thereby confirming the simulation results.

- China's and its competitors' apparel exports to the EU are imperfect substitutes, as simulation results show that the "crowding out" effect of increases in either party's exports is rather modest or even statistically insignificant and that the cross price effects are positive but quite small. The FEV analysis also confirms the modest influence of the variations of prices and quantities of

China’s apparel exports on explaining the behavior of prices and quantities of its competitors’ apparel exports, and vice versa.

- Statistically significant inter-relationship between China’s apparel exports and its demand for imported cotton has been found. More specifically, increased apparel exports from China induce proportionally large increases in its cotton imports and ultimately marginally boost the prices for imported cotton. On the other hand, increased export prices for China’s apparel products initially lead to rises in the prices and quantities of imported cotton due to positive export supply responses. However, as higher export prices ultimately drive down the demand for Chinese apparel, prices and quantities of cotton imported by China also level off. The corresponding FEV analysis reinforces the above results and suggests that variations of quantities (and to a less extent prices) of China’s apparel exports are important in explaining the behavior of both quantities and prices of China’s cotton imports, especially in the longer term.

In addition to the above, several binary variables capturing important policy development on the textile and apparel market have also been shown to be statistically significant in the model. As expected, the end of the ATC is shown to boost China’s apparel exports by nearly 16 percent (in comparison, the rest of world’s apparel exports to the EU only increased by 0.4 percent after the termination of the ATC). This increase “magnifies” China’s demand for imported cotton by 75 percent. One plausible explanation of the magnified demand for imported cotton is that the Chinese government substantially relaxed its restrictions on cotton imports following the end of the ATC.

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Appendix

Figure 1. Fitted versus Actual Values for China-Sourced Apparal Exports to the EU

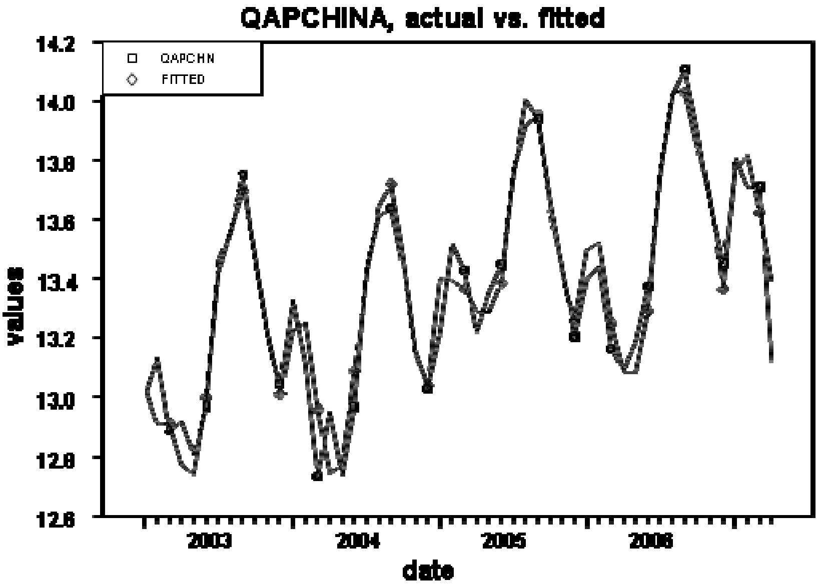

Figure 2. Fitted versus Actual Values for ROW-sourced Apparal Exports to the EU

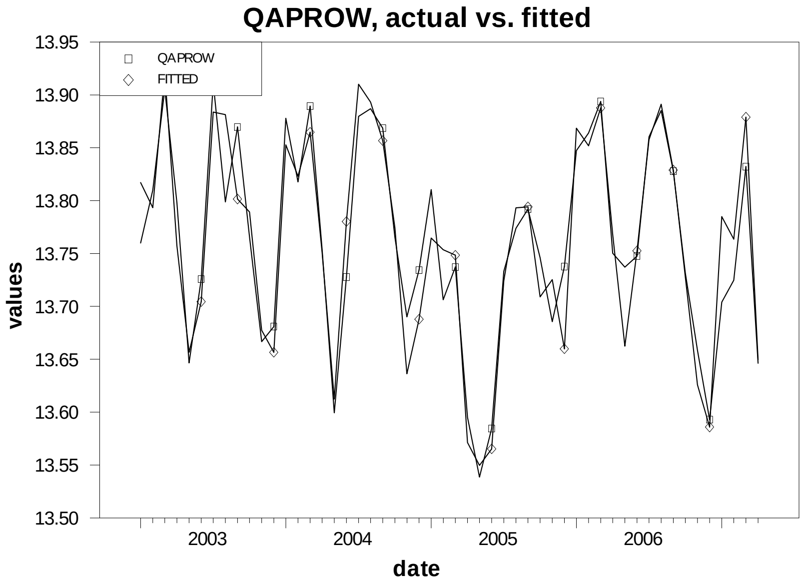

Figure 3. Fitted versus Actual Values for Chinese Cotton Imports

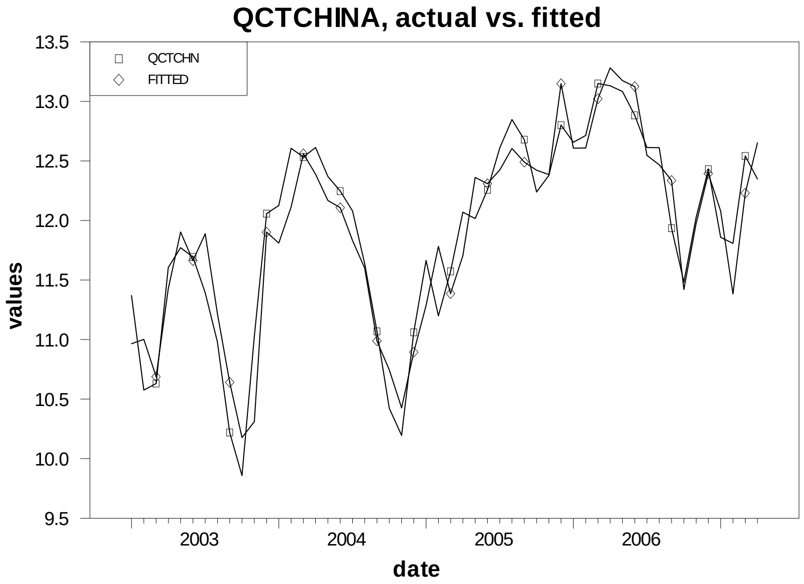

Table 1 Diagnostic test results for the VAR model of EU-bound apparel exports and Chinese raw cotton imports

Tests	QAPCHINA	PAPCHINA	QAPROW	PAPROW	DIFPAPP	QCOTCHI-NA	PCOTCHI-NA
F-tests	60.28 (p=0.05)	23.75 (p=0.0000)	8.22 (p=0.000)	3.66 (p=0.0000)	1.39 (p=0.145)	37.70 (p=0.0000)	28.54 (p=0.0000)
Lung-Box p Portmanteau (Q) tests	12.7	11.5	24.5	15.7	17.2	13.3	12.28
Dickey-Fuller unit root test on residual estimates	-9.4	-9.7	-11.0	-9.8	-9.1	-8.6	-7.3

Note: For the F-test, the null hypothesis is that non-intercept coefficient estimates are zero. Reject the null when P-values are below 0.05. For the Lung-Box portmanteau (Q) tests, the null hypothesis is that the model is adequate. Reject the null when P-values exceed 24.7. For the Dickey-Fuller unit root test on residual estimates, the null hypothesis is residuals being non-stationary. Reject the null when pseudo-T values are negative and their absolute values exceed the 2.89 critical value.

Table 2 Dynamic monthly effects of three impulse response simulations					
Respondent variable	Reaction times (months)	Response Direction	Response patterns	Response durations (months)	Multipliers
Simulation 1: Increase in Chinese exports of EU-bound apparel (QAPCHINA)					
PAPCHINA	0	Decline	Bell-shaped	5	-1.3
QAPROW	NSSR	NSSR	NSSR	NSSR	NSSR
PAPROW	4	Decrease	Bell-shaped	3	-0.13
DIFPAPP	NSSR	NSSR	NSSR	NSSR	NSSR
QCOTCHINA	4	Increase	Bell-shaped	6	+2.6
PCOTCHINA	6	Increase	Decelerating	4	+0.6
Simulation 2: Increase in the price of EU-bound Chinese apparel exports (PAPCHINA)					
QAPCHINA	0	Decrease	Decelerating	5	-1.02
PAPROW	0	Increase	N/A	1	+0.21
QAPROW	NSSR	NSSR	NSSR	NSSR	NSSR
DIFPAPP	N/A				
PCOTCHINA	Supply effect: immediate	Rise	N/A	1	+2.0
	LR demand effect: start month-5	Decline	Bell-shaped	7	-2.8
QCOTCHINA	Supply effect: Immediate	Rise	N/A	1	+1.1
	LR demand effect: start month-5	Decline	Bell-shaped	7	-2.8
Simulation 3: Increase in ROW exports of EU-bound apparel (QAPROW)					
PAPROW	0	Decrease	N/A	N/A	-0,56
QAPCHINA	1	Decrease	N/A	N/A	-0,46
PAPCHINA	NSSR	NSSR	NSSR	NSSR	NSSR
DIFPAPP	N/A	N/A	N/A	N/A	N/A
QCOTCHINA	1	Increase	Increase	N/A	+2.1
PCOTCHINA	NSSR	NSSR	NSSR	NSSR	NSSR

Note: LR denotes longer run; NSSR denotes no statistically significant responses; N/A denotes “not applicable”.

Table 3 Decompositions of forecast error variance							
Variable explained & monthly horizon	QAPCHI-NA	PAPCHI-NA	QAPROW	PAPROW	DIF-PWORLD	QCOT-CHINA	PCOT-CHINA
QAPCHINA							
1	81.29	2.64	7.49	2.71	0.72	4.42	0.45
3	71.29	3.49	7.90	4.19	2.63	7.18	3.31
6	56,77	11.92	8.30	3.35	3.06	9.54	7.07
12	50.21	17.13	7.96	3.00	2.86	12.02	6.82
18	49.90	17.44	7.93	3.00	2.86	11.99	6.88
24	49.92	17.40	7.93	3.00	2.87	11.96	6.91
PAPCHINA							
1	59.66	27.80	1.30	4.81	1.75	4.68	0.000
3	55.40	21.20	0.86	7.50	4.12	10.47	0.44
6	49.79	21.23	2.58	6.80	4.77	13.20	1.63
12	46.14	23.47	3.01	6.14	4.43	14.64	2.17
18	46.06	22.43	3.01	6.13	4.41	14.78	2.18
24	46.07	23.42	3.01	6.13	4.42	14.76	2.19
QAPROW							
1	2.85	2.91	75.84	13.79	2.64	1.11	0.88
3	2.70	2.67	63.93	19.88	5.05	2.24	3.53
6	4.03	3.25	57.46	20.96	7.54	2.84	3.91
12	4.79	3.48	56.19	20.59	7.85	3.07	4.03
18	4.90	4.05	55.63	20.41	7.80	3.16	4.05
24	5.04	4.06	55.51	20.36	7.79	3.19	4.05
PAPROW							
1	2.85	2.91	45.84	13.79	2.64	1.11	0.88
3	2.70	2.67	63.93	19.88	5.05	2.24	3.53
6	4.03	3.25	57.46	20.96	7.54	2.84	3.91
12	4.79	3.48	56.19	20.59	7.85	3.07	4.03
19	4.90	4.05	55.63	20.41	7.80	3.16	4.05
24	5.04	4.06	55.51	20.36	7.79	3.19	4.05
DIFPWORLD							
1	4.87	5.10	5.35	3.88	73.44	3.93	3.14
3	5.35	6.10	5.64	4.30	66.32	6.37	5.93
6	6.59	6.08	5.72	4.53	64.58	6.42	6.08
12	6.97	6.16	6.08	4.65	63.73	6.31	6.09
18	6.95	6.33	6.08	4.65	63.53	6.31	6.15
24	6.98	6.35	6.08	4.65	63.47	6.32	6.15
QCOTCHINA							
1	5.24	1.30	7.94	1.91	4.18	79.29	0.15
3	5.68	1.88	8.66	2.36	3.60	77.45	0.36
6	18.04	7.91	6.10	8.04	3.74	55.64	0.52
12	29.42	14.46	4.79	8.62	4.46	37.08	1.16
18	29.61	17.78	4.59	7.74	4.25	34.57	1.46
24	29.73	17.77	4.60	7.67	4.23	34.54	1.47
PCOTCHINA							
1	7.11	0.52	6.53	3.99	8.59	66.96	6.29
3	7.61	2.00	5.74	4.39	7.67	66.78	5.81
6	16.89	9.21	4.45	7.68	6.89	50.33	4.56
12	29.09	13.47	3.93	8.21	6.48	35.07	3.76
18	28.70	16.01	3.96	7.64	6.12	33.77	3.80
24	28.82	16.01	3.96	7.57	6.09	33.76	3.78

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06/07	May 2007	Derek Baker Jens Abildtrup Anders Hedetoft René Kusier	Role of regional and rural develpement policy in supporting small-scale agribusiness in remote areas
05/07	Maj 2007	Jørgen Dejgård Jensen	Analyse af tre forskellige scenarier for afgiftsændringer på fødevarer