NBER WORKING PAPER SERIES

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Working Paper 12579
http://www.nber.org/papers/w12579

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2006

We thank Deirdre Daly for help with the data, and Yue Li and seminar participants at FRBNY for helpful comments. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 12579
October 2006
JEL No. F1,F13,F14

ABSTRACT

Quota restrictions on United States imports of apparel and textiles under the multifibre arrangement (MFA) ended abruptly in January 2005. This change in policy was large, predetermined, and fully anticipated, making it an ideal natural experiment for testing the theory of trade policy. We focus on simple and robust theory predictions about the effects of binding quotas, and also compute nonparametric estimates of the cost of the MFA. We find that prices of quota constrained categories from China fell by 38% in 2005, while prices in unconstrained categories from China and from other countries changed little. We also find substantial quality downgrading in imports from China in previously constrained categories, as predicted by theory. The annual cost of the MFA to U.S. consumers was about $100 per household.

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1. INTRODUCTION

The economic analysis of trade policy is as old as economics, but the ratio of convincing evidence to theory remains small. The reason is simple: trade policies generally change gradually, making it hard to untangle the effects of policy from the effects of other factors that influence trade. A related empirical problem, highlighted by Trefler (1993), is the political endogeneity of protection, which creates the need for valid instrumental variables for protection in most analyses of the effects of trade policy.

This paper uses a natural experiment in U.S. trade policy to get around these thorny inference problems. The system of bilateral quotas known as the multifibre arrangement (MFA) regulated global trade in apparel and textiles for many decades, and a major achievement of the Uruguay Round concluded in 1995 was that WTO members agreed to phase out MFA quotas no later than January 1, 2005. Like most big importers, the U.S. delayed the bulk of MFA liberalization until literally the last moment, with hundreds of binding quotas still in place until midnight on December 31 2004. As the new year dawned, a veritable tsunami of cheap textile and apparel products from China and other developing countries started to swamp U.S. ports. This large, sudden, fully anticipated, easily measured, and statistically exogenous change in trade policy provides the natural experiment that we use in this paper to test some simple theories about the effects of quotas.

We test two fundamental predictions: binding quotas raise prices and lead to "quality upgrading", that is, a shift in the mix of products under a given quota toward more expensive goods. These predictions are resoundingly confirmed: when the MFA ended, prices and quality of U.S. imports in previously quota-constrained categories fell dramatically, especially on quota-constrained goods from China. By contrast, non-constrained imports showed no systematic changes in prices or quality. These results are highly robust, and require no restrictive assumptions on functional form or exogeneity.

We are also able to calculate non-parametric bounds on what the MFA cost U.S. consumers in 2004: the equivalent variation was as much as $16.4 billion, and the compensating variation was at least $6.9 billion. Taking the midpoint of these numbers gives an annual cost per household of $105.

2. U.S. TRADE POLICY IN APPAREL AND TEXTILES

A variety of restrictions have long affected trade in textile and apparel products.[1] One of the broadest sets of policies, however, became effective in 1974. The MFA established a system of quotas, negotiated bilaterally, that limited imports of textile and apparel products.

Participants in the Uruguay Round of trade talks agreed to phase out the MFA beginning in 1995. The MFA was replaced by the Agreement on Textiles and Clothing (ATC) which put in place a system for gradual elimination of quantitative restrictions. The ATC incorporated a series of stages, with phase-outs occurring at the beginning of 1995, 1998, 2002, and 2005, at which time all remaining quotas were eliminated. Between 1995 and 2005, remaining quotas were progressively enlarged, using agreed-to increasing growth rates. The agreement also established a special safeguard mechanism for protection against surges and a monitoring body to supervise implementation.

When the MFA first came into effect, China was not a member of the World Trade Organization (WTO), so it was not a part of the initial MFA phase-out process. However, upon accession to the WTO at the end of 2001, China became eligible for participation in the MFA quota elimination process. Thus, the United States generally implemented the first three stages of "integration" (i.e., into the MFA quota liberalization program) for China in the first part of 2002.[2] When it joined the WTO, China also agreed to a special safeguard on its textile and apparel exports. Under this safeguard mechanism, if a WTO member felt that textile and apparel imports from China threatened to "impede the orderly development of trade in these products," it could request that China limit its exports to that country, generally for no more than one year. If consultations did not lead to a different solution, China would agree to hold its exports of the given product "to a level no greater than 7.5 per cent (6 per cent for wool product categories) above the amount entered during the first 12 months of the most recent 14 months preceding the month in which the request for consultations was made." This

[1] The analysis in this section is based on Evans and Harrigan (2005).

[2] See Federal Register, Volume 66, No. 249, December 28, 2001; Federal Register, Volume 67, No. 53, March 19, 2002; WTO (2001) "Report of the Working Party on the Accession of China." WT/MIN(01)/3, November 10, 2001; and International Trade Commission (2004) "Textiles and Apparel: Assessment of the

safeguard mechanism will remain in place until December 31, 2008. As we will discuss below, there was one such safeguard quota in effect on U.S. imports from China in 2005 even after all MFA quotas were eliminated on January 1, and twelve new safeguard quotas were imposed in mid-2005.

The MFA was not the only U.S. trade policy that affected apparel and textile trade in 2000-2005. However, these other policies saw no significant change between 2004 and 2005. Since our empirical analysis below looks exclusively at time-series variation during this period, we mention these other policies only briefly here.

In addition to agreeing to eliminate quantitative restrictions as part of the implementation of the Uruguay Round, the United States agreed to reduce its tariffs on textile and apparel products. According to the Office of Textiles and Apparel (OTEXA, a division of the U.S. Commerce Department that administers the US's MFA quotas) tariffs on textile and apparel products were slated to decline from a trade weighted average of 17.2 percent ad valorem in 1994 to a trade weighted average of 15.2 percent ad valorem in 2004. The majority of these reductions were phased in over the 10 years.[3]

Regional liberalization efforts have also affected the degree to which quantitative restrictions constrain trade. The main regional agreements affecting the period which we examine are the Caribbean Basin Initiative/ Caribbean Basin Economic Recovery Act (CBI/CBERA) and the North American Free Trade Agreement (NAFTA).[4] The CBI/CBERA programs, initially enacted in the mid-1980s, provided preferential treatment for imports from twenty-four countries in that region.[5]

Competitiveness of Certain Foreign Suppliers to the U.S. Market." Investigation No. 332-448. USITC Publication 3671.

[3] See OTEXA 1995.

[4] The Andean Trade Preference Act (ATPA) was another program that provided benefits that, in some cases, applied to trade in apparel. The (ATPA) was signed into law on December 4, 1991, but excluded many apparel products. Ineligible products included, "textile and apparel items subject to textile agreements on the date that the ATPA took effect." See Shelburne (2002).

[5] Note that benefits were subject to the countries satisfying certain conditions.

3. THEORY: PRICE, QUALITY, AND WELFARE EFFECTS OF QUOTAS

The specification of MFA quota limits always had two features:

1. They were fairly broad, potentially including many different products. Some examples are "Womens' and girls' dresses, cotton" and "Mens' and boys' sweaters, wool".
2. They were specified not in value terms but in terms of physical quantities (numbers of dresses, square meters of fabric, dozens of pairs of socks, etc).

What does economic theory predict about the effects of such broad, quantity-specified quotas?[6]

Trivially, a binding quota will reduce the quantity of imports, but beyond this the effects depend on details of demand and market structure. Numerous authors have pointed out that no simple "tariff equivalents" exist for quotas except in the simplest of cases; for example, see Anderson (1988) and Feenstra (2004, Chapter 8). Some of the more interesting analyses of the economics of quotas occurs when markets are imperfectly competitive; see, for example, the celebrated paper of Krishna (1989). What virtually any model predicts is that binding quotas will raise prices. That is, in the absence of a binding quota, prices of the products imported under the quota would be lower.

A slightly subtler effect is that a binding quota on a broad category causes "quality upgrading", a phenomenon first analyzed by Falvey (1979) and Rodriguez (1979).[7] Quality upgrading occurs when the quota causes the composition of imports to be tilted toward goods that would be relatively more expensive under free trade.

There are potentially two distinct types of quality upgrading: changes in characteristics of given varieties, and a shift in demand toward higher-quality varieties (see Feenstra (2004, Chapter 8) for details). The latter is what we study, and the economics is simple: with a physical quantity quota, firms set quota rents as the same dollar amount over marginal cost. This means that high cost/quality goods see their

[6] An alternative type of quota is one where the value of imports is restricted rather than the physical quantity.

[7] The quality upgrading insight appears to have occured to Falvey and Rodriguez independently, with each paper somewhat grudgingly citing the working paper version of the other.

relative price fall, so relative quantities sold go up.[8] Evidence of this type of quality upgrading is provided by Boorstein and Feenstra (1991) for quota-constrained U.S. steel imports in the 1970s. We will ignore within-variety change, which may be substantial. For example, Feenstra (1988) find substantial within-model quality upgrading in response to the US quota on Japanese cars in the mid-1980s. The two quality-upgrading effects are complementary, so our measure of quality upgrading will be a lower bound.

Quality upgrading is socially inefficient, and causes a welfare cost to quotas that would not be present under an equally restrictive tariff. Even in the absence of quality upgrading binding quotas will impose efficiency costs and will redistribute income. From the standpoint of importing country welfare, the MFA is particularly costly since it allows exporters to keep quota rents. Calculating welfare costs of protection generally requires details about demand and supply, information that can be estimated imprecisely at best. However, the total effect of any policy (including a quota) on consumers can be computed using measures of equivalent and compensating variation. Letting a superscript 0 denote the pre-reform, quota-ridden equilibrium and a superscript 1 denote the post reform equilibrium, the standard definitions of equivalent and compensating variation are

$$EV = \mu\left(\mathbf{p}^0;\mathbf{p}^1,m^1\right) - m^0 = \mu\left(\mathbf{p}^0;\mathbf{p}^1,m^1\right) - \mathbf{p}^0\mathbf{x}^0$$

$$CV = m^1 - \mu\left(\mathbf{p}^1;\mathbf{p}^0,m^0\right) = \mathbf{p}^1\mathbf{x}^1 - \mu\left(\mathbf{p}^1;\mathbf{p}^0,m^0\right)$$

where m is expenditure on imports in each situation, $\mu\left(\mathbf{p}^0;\mathbf{p}^1,m^1\right)$ is the amount of income needed at the old prices $\mathbf{p}^0$ to be just as well off as you are at the new situation, and $\mu\left(\mathbf{p}^1;\mathbf{p}^0,m^0\right)$ is the amount of income needed at the new prices $\mathbf{p}^1$ to be just as well off as you were at the old situation. Thus, *EV* uses base period prices to compare the two situations, and *CV* uses current period prices. In our context, *EV* is the amount consumers would have to be paid to be willing to go back to the MFA after it ended, and *CV* is the amount they would have been willing to pay to get rid of the MFA before it disappeared.

Calculation of *EV* and *CV* requires knowing the form of the expenditure function μ, knowledge we do not have. However, elementary revealed preference logic establishes the following inequalities:

[8] This is also known as the Alchian-Allen/Washington apples effect. See Hummels and Skiba (2004).

$$\mathbf{p}^0\mathbf{x}^1 \geq \mu\left(\mathbf{p}^0;\mathbf{p}^1,m^1\right)$$

$$\mathbf{p}^1\mathbf{x}^0 \geq \mu\left(\mathbf{p}^1;\mathbf{p}^0,m^0\right)$$

so

$$EV \leq \mathbf{p}^0\mathbf{x}^1 - \mathbf{p}^0\mathbf{x}^0 = \mathbf{p}^0\left(\mathbf{x}^1 - \mathbf{x}^0\right) = EV^{UB} \quad (1)$$

$$CV \geq \mathbf{p}^1\mathbf{x}^1 - \mathbf{p}^1\mathbf{x}^0 = \mathbf{p}^1\left(\mathbf{x}^1 - \mathbf{x}^0\right) = CV_{LB} \quad (2)$$

where *LB* and *UB* stand for lower bound and upper bound respectively. The bounds EV^{UB} and CV_{LB} are easy to calculate using the data at hand, and are easy to interpret. EV^{UB} is simply the amount of money required to purchase the 2005 import bundle using 2004 prices, minus the 2004 import bill. CV_{LB} is the 2005 import bill minus the amount of money required to purchase the 2004 import bundle at 2005 prices.

EV and *CV* answer different questions, and so neither is an unambiguous measure of consumer welfare change. In situations where prices are on average falling, further revealed preference logic establishes that $EV \geq CV \geq 0$. Thus, the interval $[CV_{LB}, EV^{UB}]$ will contain all reasonable answers to the question, "how much did the MFA cost U.S. consumers"?

4. DATA AND MEASUREMENT

Our trade data come from the Census Bureau, and are analyzed at the 10-digit Harmonized System (HS) level, the most disaggregated classification available. Each import observation includes information on date, source country, value in dollars, and physical quantity (such as number of shirts).

Apparel and textile quotas are administered by the Office of Textiles and Apparel (OTEXA), a division of the Department of Commerce. Quotas apply to country-specific quota groups constructed by OTEXA and these quota groups contain multiple 10-digit HS codes[9]. From OTEXA we obtained information on annual quota levels from 2002 through 2005, as well as the fill rate, which is the proportion of the quota which was used

[9] Within a given quota group, there may be multiple 3-digit OTEXA categories (also constructed by OTEXA) and within each of those, there may be multiple individual 10-digit HS10 codes. The quota groups are closely related to the 3-digit OTEXA categories, but do not necessarily aggregate the same categories for each country. Thus, there may be more quota groups in a given year than 3-digit categories, though the former is almost always coarser.

by the end of each calendar year. For our empirical analysis we define a quota as binding if the fill rate is greater than or equal to 90%[10]. In most cases non-binding quotas will have no effect on prices, but our welfare calculations are not affected by the assumption that quotas bind if and only if the fill rate is at least 90%.

To illustrate the dimensions of the data, in 2005 the US imported goods in 173 quota groups and 3,704 10-digit HS codes from 193 countries. The total value of US imports in textile and apparel in 2005 was $97.5 billion, or 4.8% of total US imports.

The simplest measure of prices that can be constructed from this data is unit value, which is defined as the total value of shipments divided by the physical quantity. That is, for each country and each quota group, the unit value in a given year is defined as

$$UV_{cqt} = \frac{\sum_{i \in I_{ct}} v_{cit}}{\sum_{i \in I_{ct}} x_{cit}},$$

where v_{cit} is the dollar value of imports of HS10 code i in time t from country c, x_{cit} is the quantity of imports, and I_{ct} is the set of HS10 codes in quota group q imported in time t from country c. We can re-write the definition of unit value to emphasize the fact that the unit value is a quantity-weighted average of the prices of individual goods:

$$UV_{cqt} = \sum_{i \in I_{ct}} \omega_{cit} p_{cit}, \qquad \omega_{cit} = \frac{x_{cit}}{\sum_{i \in I_{ct}} x_{cit}} \tag{3}$$

Equation (3) makes it clear that unit values for a given quota group-country can change over time even if all individual prices are unchanged: the set of goods can change, and/or the relative quantities consumed can change. This property is sufficient to demonstrate that changes in quota group unit values should not be used as measures of quota group price change. Feenstra (1994) proposes an exact price index which accounts for changes in the set of goods as well as changes in relative quantities consumed, and we adopt his methodology for constructing price indices in what follows.

[10] Industry experts define a quota as restrictive or "constraining" if it is filled to between 85 and 90 percent. This is because complexities in the quota management system (including complex aggregates) can make it difficult to completely fill a quota. The EU defines quotas 95 percent filled as constraining. See USITC (2002). Evans and Harrigan (2005) provide evidence that the price effect of MFA quotas is a step function in the fill rate, with the step at about 90%.

Following Feenstra (1994), suppose that the expenditure function for textiles and apparel imports in a quota group *q* from country *c* is of the CES form, given by

$$e\left(\mathbf{p}, I_{qct}, \mathbf{b}\right) = \left[\sum_{i \in I_{qct}} b_i p_{it}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \qquad (4)$$

Aside from functional form there are three assumptions embedded in this specification which deserve comment. First, the index *i* denotes an HS10 code-country combination, which means we assume that all goods from a certain country in a given HS10 code are perfect substitutes. Second, the taste parameters **b** do not change over time. Finally, the elasticity of substitution $\sigma > 1$ is the same across goods within the quota group.

To develop the Feenstra price index we need to introduce some notation. Omitting the implicit *qc* subscripts to reduce clutter, define

I_t = set of goods imported in year *t*

I_{t-1} = set of goods imported in year *t-1*

$I_{t,t-1}$ = set of "overlap goods" imported in year *t* and in year *t-1*

It will always be the case in our application that $I_{t,t-1}$ is non-empty; often we'll have $I_{t,t-1} = I_t = I_{t-1}$. Next, define

$$\lambda_t = \frac{\sum_{i \in I_{t,t-1}} v_{it}}{\sum_{i \in I_t} v_{it}} \leq 1, \qquad \lambda_{t-1} = \frac{\sum_{i \in I_{t,t-1}} v_{it-1}}{\sum_{i \in I_{t-1}} v_{it-1}} \leq 1$$

so λ_t = (expenditure on overlap goods in *t*)/(total expenditure in *t*). In most cases this fraction will be close to one. Then define

$$\lambda_{t,t-1} = \frac{\lambda_t}{\lambda_{t-1}}$$

This ratio of ratios can be greater than or less than one. If there isn't much product churning from period to period the numerator and denominator will both be close to one, so the ratio will be close to one as well.

With this notation established, we can introduce the exact price index *F* associated with the expenditure function (4):

$$\ln F\left(\mathbf{p}_t, \mathbf{p}_{t-1}, \mathbf{x}_t, \mathbf{x}_{t-1}\right) = \sum_{i \in I} w_{it} \ln \frac{p_{it}}{p_{it-1}} + \frac{1}{\sigma - 1} \ln \frac{\lambda_t}{\lambda_{t-1}} \qquad (5)$$

where $\sum_{i \in I} w_{it} = 1$ and σ is an unknown parameter. The expenditure weights are given by

$$s_{it} = \frac{p_{it} x_{it}}{\sum_{i \in I} p_{it} x_{it}} = \frac{v_{it}}{\sum_{i \in I} v_{it}} = \frac{v_{it}}{v_t}$$

$$w_{it} = \frac{\ln \frac{s_{it-1}}{s_{it}} \left(s_{it} - s_{it-1} \right)}{\sum_{i \in I} \ln \frac{s_{it-1}}{s_{it}} \left(s_{it} - s_{it-1} \right)}$$

This rather baroque expression for the weights can be understood more easily by noting that

$$w_{it} \simeq \frac{s_{it} + s_{it-1}}{2} \qquad \text{and} \qquad \lim_{(s_{it} - s_{it-1}) \to 0} \left[\ln \frac{s_{it-1}}{s_{it}} \left(s_{it} - s_{it-1} \right) \right] = s_{it}$$

which implies that the Feenstra index is very similar to a standard chain-weighted price index, with the most important wrinkle being that it accounts for new goods.

Finally, following Boorstein and Feenstra (1991) among others, we calculate a quality index as the ratio of the unit value index to the exact price index. The key difference between the unit value index and the exact price index is that the former uses physical quantity shares in each year as weights for the prices in forming the average price over the quota group, while the latter uses value share weights when forming the index. Expressed in logs, we have

$$\ln \frac{Q_t}{Q_{t-1}} = \ln \frac{UV_t}{UV_{t-1}} - \ln F\left(\mathbf{p}_t, \mathbf{p}_{t-1}, \mathbf{x}_t, \mathbf{x}_{t-1} \right) \tag{6}$$

The interpretation of (6) is that if the unit value index increase more than the exact price index, then the quality index rises, reflecting the fact that consumption has shifted towards more expensive goods within the category. We will call this phenomenon quality upgrading, and when it is reversed we will call it quality downgrading. It is worth emphasizing that quality change under this measure is purely a consequence of changes in consumption patterns, not changes in the quality of any individual goods within the category.

To implement the price and quality indices defined by (5) and (6) requires data on unit values and quantities of imports by country, time, and HS10 code, all data that we have. The Feenstra index (5) also requires an estimate of the elasticity of substitution σ across products within a given quota group from a given country. Broda and Weinstein (2006) have calculated related elasticities using the estimation methodology developed by Feenstra (1994), but their results are not directly useable for our purposes. The reason is that the Broda-Weinstein elasticities refer to the substitution across countries of classes of goods that are much more aggregated than the quota groups that we use. Nonetheless, the Broda-Weinstein results are useful for getting an idea about plausible values of σ for our purposes. For example, they report an elasticity of 3.02 for SITC 841, "MEN'S OR BOYS' COATS, JACKETS, SUITS, TROUSERS, SHIRTS, UNDERWEAR ETC. OF WOVEN TEXTILE FABRICS (EXCEPT SWIMWEAR AND COATED OR LAMINATED APPAREL), and this elasticity is representative of those that they find for other apparel and textile SITC codes[11]. If we take 3 as a reasonable estimate of the cross-country elasticity of substitution for a broad apparel/textile category, it seems likely that the elasticity of substitution within countries for less broad categories would be higher. In the results that we report below we use $\sigma = 5$ but our results are not at all sensitive to changing σ in the range [2,10]. The reason for this insensitivity is simply that there is not much change over time in the set of goods imported within each quota group-country, so that the term $\ln\left(\frac{\lambda_t}{\lambda_{t-1}}\right)$ in the Feenstra index (5) is close to zero.

The empirical unimportance of the new goods adjustment in our application means that the Feenstra price index will be numerically very close to standard chain-weighted indices. Such indices can be derived from flexible functional forms which are less restrictive than the CES used to develop (5).

5. RESULTS

For all U.S. imports of apparel and textiles and for every exporting country and quota group, we construct price and quality indices over time using (5) and (6). While we have data beginning in 2002, we focus on the difference between 2004 and 2005, since the MFA expired on January 1 2005.

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[11] The full list of elasticities is available on Broda's website, at http://faculty.chicagogsb.edu/christian.broda/website/research/unrestricted/Research.htm

Even before the end of the MFA, a large majority of U.S apparel and textile imports were not subject to binding quotas: in 2004, only 19% of imports came in under a binding quota, a number that fell to 3.5% in 2005. The reason that the quota share didn’t fall to zero is that, as noted above, some quotas were re-imposed (mainly on China) in mid-2005 after the increase in imports in early 2005 led to calls for protection. Table 1 summarizes market shares and quota coverage for the top 20 exporters in 2004 and 2005; except for Mexico and Canada, all the biggest exporters had large shares of their trade come in under binding quotas.

Table 2 reports price and quality change results for the top 20 exporters. We report price and quality changes separately for goods subject to a binding quota in 2004 and goods which were not quota constrained. The results are most dramatic for the largest exporter, China: prices fell an amazing 38% for previously constrained goods, with quality falling by 11%. By contrast, there was no change in price or quality for previously unconstrained goods. The value of apparel and textile imports from China grew by 44%, and this was mainly in previously constrainmed goods, which increased their share of China’s exports from 19% in 2004 to 36% in 2005. This is exactly what trade theory predicts, and the magnitudes are striking.

The South Asian exporters India, Pakistan, and Bangladesh have results similar to China, though smaller in magnitude: big drops in price (especially for Pakistan) and some drop in quality in previously constrained goods, little change in unconstrained categories. Hong Kong had similar price drops in all goods, with quality downgrading as expected in previously constrained goods and some quality increase in other goods. Among other previously constrained exporters in the top 10, Korea and Indonesia also had experiences consistent with theory.

An interesting anomaly is Mexico, which saw price and quality *increases* when quotas were removed (and not much change in unconstrained categories). However, given that just 0.6% of Mexico’s exports were subject to binding quotas, this result doesn’t seem too important.

The country results reported in Table 2 are illustrated in Figure 1, which reveals the strong negative correlation (-0.77) between price changes and increases in imports.

The results just summarized are striking, but Table 2 can not address the question of whether the differences between constrained and unconstrained categories are statistically significant. To answer this question we estimate a two way fixed effect model. Pooling across countries *c* and quota groups *g*, we estimate

$$\ln F_{cgt} = \alpha_{cg} + d_t + \beta^F c_{cgt} + \gamma^F q_{cgt} + \varepsilon_{cgt} \quad (7)$$

where $\ln F_{cgt}$ is the exact price index (5), α_{cg} is a fixed effect for each country-quota group, d_t is a time fixed effect, and ε_{cgt} is an error term. Our measures of the effects of quotas are also dummy variables: c_{cgt} takes the value 1 if the quota group was binding on December 31, 2004 (defined as fill rate greater than 90%) and 0 otherwise, and q_{cgt} takes the value 1 if the quota group had a quota re-imposed in 2005 that was binding and 0 otherwise.

Thus β^F is the average reduced form effect of ending a binding quota on the exact price index, using only within-*cg* variation over time, and controlling for the average price change in each year. The effect β^F is identified by difference-in-difference variation: it says how prices in quota constrained categories changed in 2005 as opposed to prices in unconstrained categories. The null hypothesis is that β^F <0.

The coefficient γ^F measures the reduced form effect of new quotas in 2005 on prices of the restricted goods in 2005, relative to the baseline, which includes all goods. There were 13 quotas active on Chinese exports in 2005, which can be mapped into 11 binding quotas on categories which were in use pre-2005. Of these 11 binding quotas, 9 were on categories which were also subject to binding quotas in 2004, thus $\beta^F + \gamma^F$ is the total average effect on price in 2005 for these 9 categories; for the other two, the effect is just γ^F.

Analogously, we regress the quality indices on the same explanatory variables,

$$\ln Q_{cgt} = \alpha_{cg} + d_t + \beta^Q c_{cgt} + \gamma^Q q_{cgt} + \varepsilon_{cgt} \quad (8)$$

Following the logic in the preceding two paragraphs, the hypothesis that quotas cause quality upgrading leads us to expect $\beta^Q < 0$.

We estimate equations (7) and (8) for all countries and quota groups, and separately for China and all other countries. The results are reported in Table 3. When all countries are pooled together, the effect of a binding quota in 2004 is to lower prices in 2005 by 17%, a result which is highly statistically significant. The quality downgrading effect is smaller, at -3%, and significant at the 10% significance level. More illuminating results are seen when China is separated from other countries. The binding quota effect is -37% for China, and -9% for other countries, both of which are statistically significant. Quality downgrading is large and significant for China (-6%, t = -1.94), but essentially zero for all other countries.

Curiously, γ^F is large (-15% for prices, -14% for quality), significant and *negative* for China. We would have expected γ^F to be positive because theory predicts that re-imposing quotas in 2005 should raise the price of these goods. But considering that reinstating the quotas in 2005 was a protective measure against the onslaught of cheap Chinese goods, it is not hard to interpret the negative γ^F: the US saw the prices of these quota groups dropping and reinstated quotas to keep them from dropping even more. Thus, γ^F is picking up the initial price and quality fall resulting from the end of the MFA.

The statistical results can be visualized quite effectively using smoothed histograms, or kernel densities. Figure 2 plots the distribution of log price changes between 2004 and 2005 for all quota groups except the 11 quota groups that had quotas re-imposed in 2005 (we leave out these 11 because doing so yields a clearer picture of the MFA's effect on prices). Quota groups which were constrained in 2004 are plotted separately from unconstrained quota groups in Figures 2 and 3, and China is separated from other countries. As one would expect from the regression results, the distribution for constrained quota groups is centered to the left of the unconstrained quota group's distribution: constrained quota groups tend to have greater price falls in 2005 than unconstrained quota groups. The effect is much larger for China than for other countries.

Figure 3 has the same structure as Figure 2, but plots log quality changes rather than price changes. There is clearly evidence of systematic quality downgrading in formerly constrained quota groups from China, but little if any evidence of the same phenomenon outside China.

Finally, to calculate the consumer welfare costs of the MFA, we compute the bounds on equivalent variation and compensating variation as defined in (1) and (2), taking 2004 as the pre-reform period and 2005 as the post-reform period. For welfare comparisons, the correct price to use in each year is the price received by foreign residents, which means that the price should not include tariff revenue. The correct treatment of transport charges depends on who pays them: if foreigners pay them then the price relevant to U.S. residents does not include transport charges, but if U.S. residents pay the transport charges then they should be included in the price for welfare calculations. We have accurate data on transport costs but not on their incidence, so we report calculations using the two extreme assumptions that they are paid completely by foreigners (the f.o.b. or "free on board" price) and completely by U.S. residents (the c.i.f or "cost, insurance, and freight" price). The results are

	f.o.b prices	c.i.f. prices	average
EV^{UB}	\$15.7 billion	\$16.8 billion	\$16.2 billion
CV_{LB}	\$6.2 billion	\$6.8 billion	\$6.5 billion

The interpretation of these numbers is straightforward, and we focus on the average of the f.o.b and c.i.f numbers for simplicity. The equivalent variation between 2004 and 2005, or the amount US consumers would need to be paid to go back to the pre-reform period, was as much as \$16.2 billion. The compensating variation, or the amount US consumers would have been willing to pay to be rid of the MFA in 2004, is at least \$6.5 billion.

How big are these numbers? There were 111 million households in the U.S. in 2005, and the median household spent about \$1,400 on apparel[12]. Our calculation of CV_{LB} implies an annual cost of \$59 per household (4.2% of the median apparel budget), while EV^{UB} implies an annual cost of \$146 per household (10.4% of the median apparel budget). Taking the midpoint of these estimates gives an annual consumer cost of the MFA of \$102, which is 7.3% of the median household's apparel budget.

The beneficiaries of the MFA included holders of quota rights, and the U.S. workers and firms who benefited from protection. There were 737,000 U.S. workers in

[12] The number of households comes from the Census Bureau's 2005 American Community Survey. Median household expenditure on apparel is taken from the Bureau of Labor Statistics' 2004 Consumer Expenditure Survey, which reports (Table 1) that the middle quintile of consumer units (which are similar

the apparel and textile sectors in 2004, with an average annual salary of $31,500[13]. We can not estimate what employment and earnings in these sectors would have been in the absence of the MFA, but it seems likely that this import competing sector would have been badly hit. What we can do is calculate the consumer cost per job of providing MFA protection. Dividing our bounds on equivalent and compensating variation by employment imply a consumer cost of between $8,800 and $22,000 per job protected, or between 28% and 70% of average wages in the industry. Taking midpoints gives an estimate of $15,400 per job, nearly half of the average salary.

6. CONCLUSION

The end of the MFA in 2004 provided a unique opportunity to robustly test some simple predictions of the theory of trade policy: quotas raise prices and lead to inefficient quality upgrading. We showed that this is exactly what happened: in quota constrained categories, prices fell 38% from China and quality fell 11%. The price effects were also substantial for non-Chinese exporters, with little evidence of quality downgrading.

We are also able to calculate the consumer welfare cost of the MFA, and find that it was between $6.5 and $16.2 billion. Taking the midpoint of this range implies an annual cost per U.S. household of $102, which is about 7.3% of the median household budget. Scaling the midpoint estimate of consumer cost by domestic employment in the apparel and textile sector, we find that the consumer cost per job protected was about 50% of the average salary in the sector.

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to households) spent $1,477 on “Apparel and services”, a category that includes dry cleaning, tailoring, etc, so we round down to $1,400.

[13] Source is the Bureau of Economic Analysis. The industry is defined as NAICS 1997 codes 313/314/315/316, which is Textile Mills, Textile Product Mills, Apparel Manufacturing, and Leather and Allied Product Manufacturing.

Table 1 - U.S. Apparel and Textile imports, top 20 exporters

	quota coverage 2004	market share	
		2004	2005
China	19.4	20.3	27.2
Mexico	0.6	9.4	8.2
India	36.8	4.4	5.2
Hong Kong	54.0	4.4	3.7
Canada	0	4.0	3.5
Indonesia	64.2	2.9	3.2
Pakistan	41.0	2.8	3.0
Vietnam	29.2	3.0	2.9
Honduras	0	2.8	2.7
Bangladesh	35.0	2.3	2.5
Italy	0	2.8	2.5
Korea	27.6	3.3	2.4
Thailand	18.1	2.5	2.3
Philippines	31.7	2.1	2.0
Dom.Repub.	51.4	2.3	2.0
Taiwan	19.4	2.5	1.9
Guatemala	21.3	2.1	1.9
Cambodia	44.4	1.6	1.7
Sri Lanka	28.0	1.8	1.7
Turkey	2.3	2.0	1.7
Other	n/a	20.8	17.9
Total	19.0	100.00	100.00

Notes to Table 1: Quota coverage in 2004 is defined as the share of the country’s apparel and textile exports to the U.S. which came in under a binding quota.

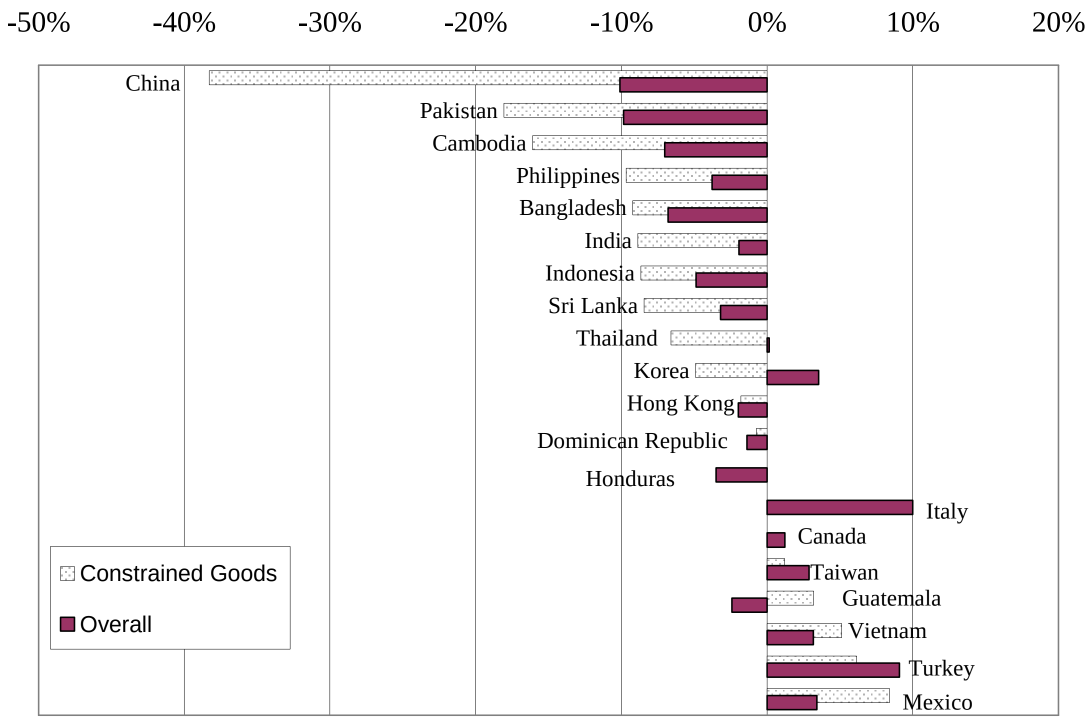
Table 2 - Price, quality and value change 2004-2005, U.S. Apparel and Textile imports, top 20 exporters

		Constrained		Unconstrained		
Country	Market Share 2004	Price	Quality	Price	Quality	Value of Imports
China	20.3	-38.3	-10.8	0.7	0.0	44.2
Mexico	9.4	8.4	9.8	3.4	-0.1	-6.2
India	4.4	-8.9	-3.0	2.2	0.0	25.9
Hong Kong	4.4	-1.8	-2.6	-2.3	4.7	-9.2
Canada	4.0			1.2	-1.0	-4.7
Korea	3.3	-4.9	-3.8	6.6	-0.7	-21.9
Vietnam	3.0	5.1	0.0	2.4	0.2	5.9
Indonesia	2.9	-8.7	-2.3	2.8	2.4	18.0
Honduras	2.8			-3.5	2.3	3.8
Pakistan	2.8	-18.1	0.4	-2.8	1.6	14.3
Italy	2.8			10.0	0.3	-3.9
Taiwan	2.5	1.2	1.0	3.3	0.6	-19.1
Thailand	2.5	-6.6	-2.4	1.9	-3.1	-2.6
Dom. Rep.	2.3	-0.7	-0.5	-2.0	5.4	-7.3
Bangladesh	2.3	-9.2	-0.7	-5.3	-0.7	19.1
Philippines	2.1	-9.7	-3.7	-0.8	-0.8	-0.8
Guatemala	2.1	3.2	5.0	-3.9	-0.5	-6.5
Turkey	2.0	6.1	-16.6	9.2	4.5	-8.3
Sri Lanka	1.8	-8.4	-2.1	-0.8	-0.9	5.8
Cambodia	1.6	-16.1	-5.3	1.8	-0.6	19.7

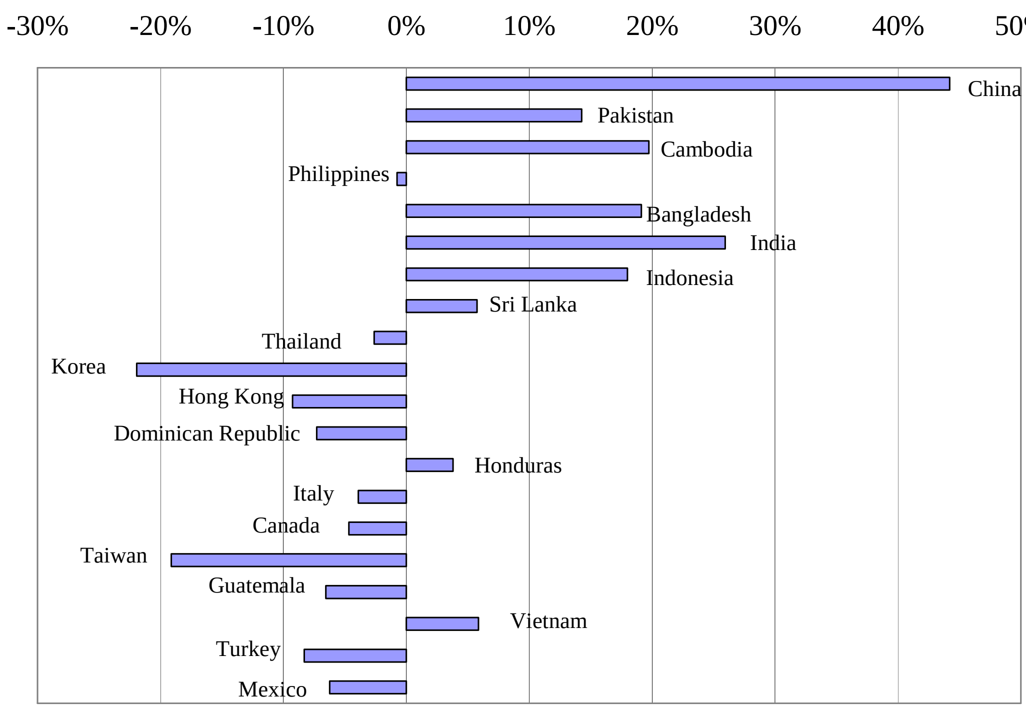
Notes to Table 2: All numbers are percentages. Columns labeled "constrained" are imports which were subject to binding quotas in 2004, "unconstrained" did not face a binding quota in 2004. See text for discussion of how the price and quality indices are calculated.

Figure 1 - Price and value change 2004-2005, top 20 exporters

(a) prices



(b) value



Notes to Figure 1: Subset of data reported in Table 2.

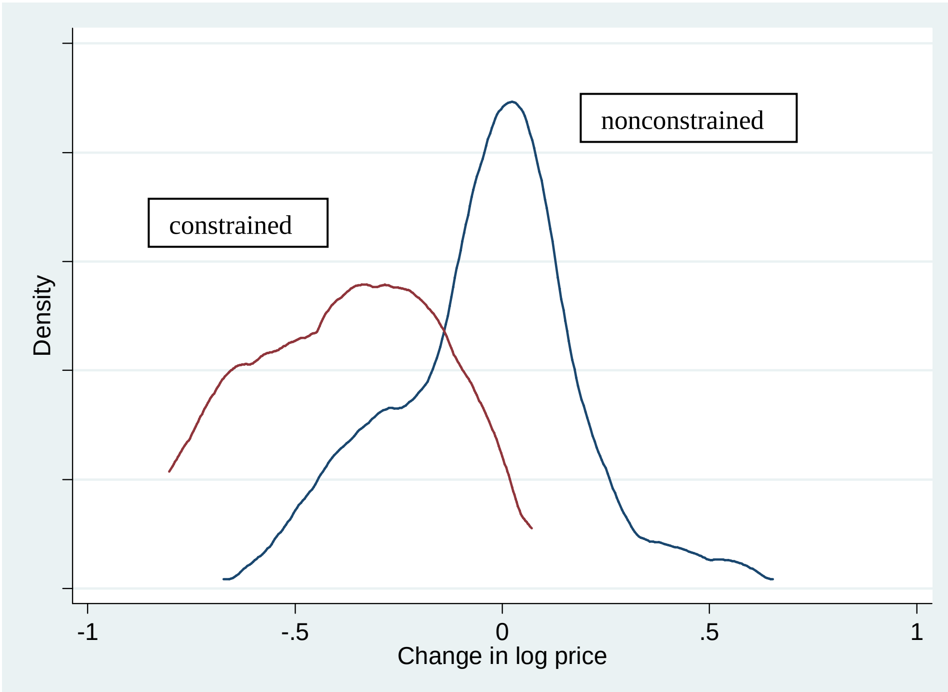
Table 3 - Estimates of effects of MFA elimination on price, quality

		All Countries	China	Non-China
Price	2003	0.03 *4.79*	-0.03 *-1.04*	0.03 *4.89*
	2004	0.03 *2.95*	0.05 *1.64*	0.03 *2.83*
	2005	0.03 *3.44*	-0.01 *-0.33*	0.03 *3.45*
	β^F	-0.17 *-7.94*	-0.37 *-6.84*	-0.09 *-5.14*
	γ^F	-0.37 *-6.09*	-0.15 *-1.98*	
Quality	2003	0.01 *1.95*	-0.01 *-0.48*	0.01 *1.99*
	2004	-0.01 *-1.61*	0.00 *0.14*	-0.01 *-1.62*
	2005	-0.02 *-2.03*	-0.01 *-0.42*	-0.02 *-2.01*
	β^F	-0.03 *-1.86*	-0.06 *-1.94*	-0.01 *-0.87*
	γ^F	-0.17 *-2.54*	-0.14 *-1.86*	
Sample size	total	22,860	448	22,412
	Quota groups	8,849	150	8,699

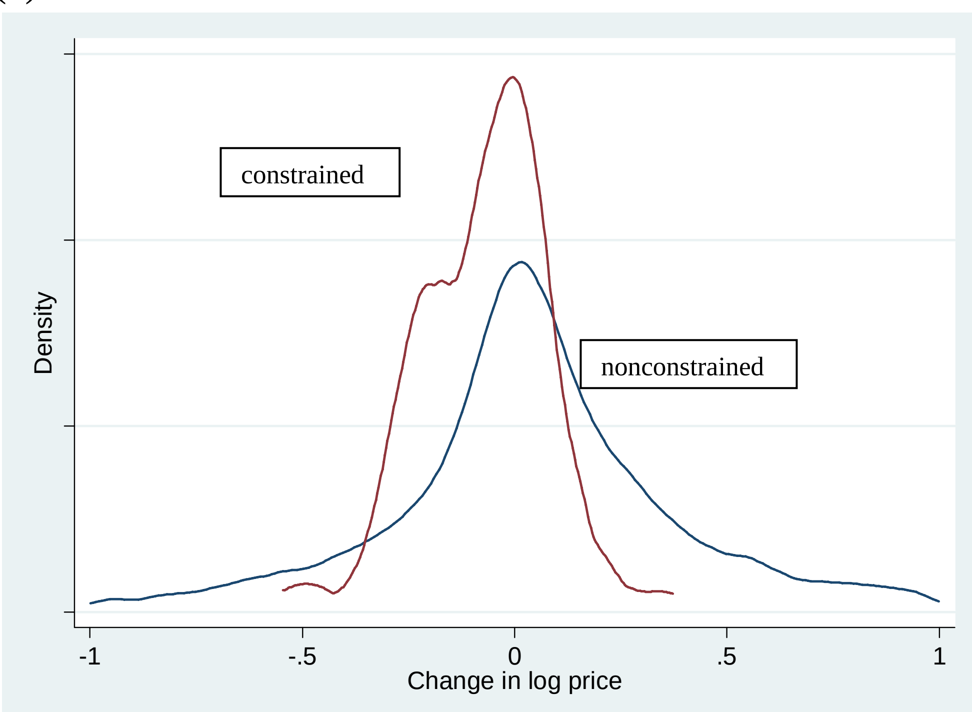
Notes to Table 3: All regressions estimated by OLS, robust *t*-statistics in *italics*. Each column in the two panels represents a single regression equation. In the first panel, the dependent variable is change in price, and in the second panel the dependent variable is change in quality. β^F is the estimated effect of a binding quota in 2004, and γ^F is the estimated effect of a binding quota in 2005. The dates 2003, 2004, 2005 are estimated year fixed effects.

Figure 2 - Distribution of price changes, 2004-2005

(a) China



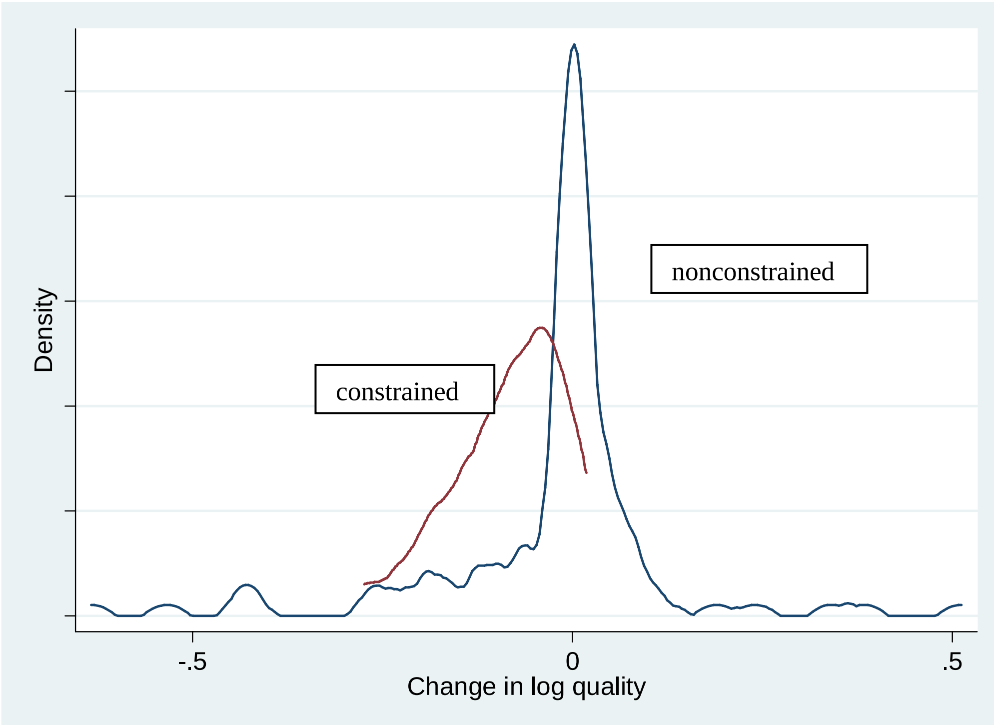
(b) all other countries



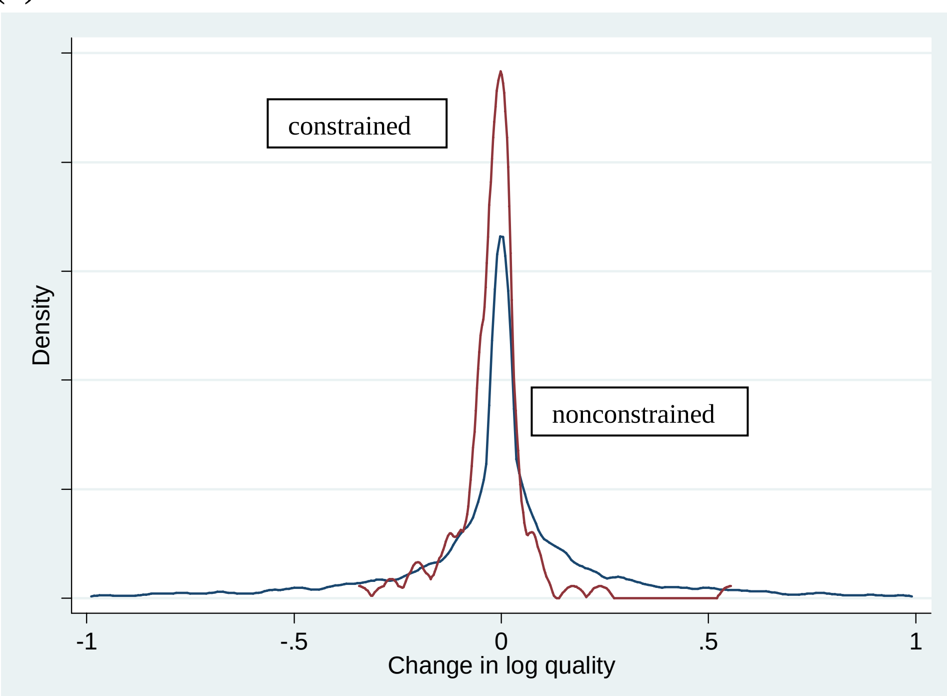
Notes to Figure 2: Kernel densities of price changes by country and quota group.

Figure 3 - Distribution of quality changes, 2004-2005

(a) China



(b) all other countries



Notes to Figure 3: Kernel densities of quality changes by country/quota group.

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