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SOME ECONOMETRIC EVIDENCE ON THE IMPACT
OF THE MULTIFIBER AGREEMENT ON THE
GERMAN CLOTHING INDUSTRY

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**SOME ECONOMETRIC EVIDENCE ON THE IMPACT OF THE MULTIFIBER AGREEMENT
ON THE GERMAN CLOTHING INDUSTRY**

1. Introduction

Since 1974, the year of the first Multi-fiber Agreement (MFA), a considerable number of studies has analyzed the economic impact of quotas such as those of the MFA on industrialized countries. Examples are the studies by Hamilton (1980), Morkre and Tarr (1980), Wolf et al. (1984), and GATT (1984), to name a few. Most of the work so far has relied either on models of the comparative static type, with reasonable parameters substituted,¹ or on more ad hoc comparisons of pre- and post-MFA market shares or other similar indicators. However, there seems to be a dearth of econometric evidence, in particular for Germany. The present paper is intended to start filling this gap. Its purpose is to investigate the effect of the MFA quotas and MFA-induced voluntary export restraints (VERs) on the German clothing industry.

The paper is organized as follows. The theoretical background is detailed in the next section. After that the data is briefly described followed by a discussion of the results. The paper ends with a summary of the main points.

¹See for example the study by Gross (1984) for Germany which utilizes a Johansen-type general equilibrium model.

2. The Theoretical Model

The study is based on a model explaining domestic and import demand as well as export supply of clothing. The model is of the partial equilibrium type, i.e. the clothing industry is taken to be small compared to the size of the whole economy. Perfect substitutability between imports and domestically produced goods is assumed.² Further, the small country assumption of international trade is employed making world export supply infinitely elastic. Both assumptions, perfect substitutability and infinite world export supply, render the domestic price equal to the world price in the absence of trade restrictions.

Real domestic demand (q^d) is explained by the function

$$q^d = f^d(Y, p, p^a, G)$$

+ - +

where Y is real disposable income, p domestic price, p^a the price of a substitute, and G a vector of other demand shifters. Here as in all other equations, the hypothesized signs of the partial derivatives are indicated by plus and minus signs underneath the respective variable. No sign implies that theoretically the sign is indeterminate.

Perfect substitutability of foreign and domestic goods implies³

²This assumption seems to be reasonable considering that most of Germany's trade in clothing is taking place with other members states of the European community. Clothing imported from less developed countries, on the other hand, are produced to a considerable extent according to particular specifications which make them marketable domestically.

³See for example the discussion in Leamer and Stern (1970, pp. 11-12).

that real import demand (M) can be written as

$$q^m = f^m(S, Y, p, p^a, qt)$$

+ - + -

where **S** is a vector of domestic supply shifters and where qt stands for a combination of MFA related import quotas and VERs.⁴

Export supply (X) is assumed to be a function of the country's export price p^x , its domestic price p , and real income in the export markets Y^x

$$q^x = f^x(Y^x, p^x, p)$$

+ + +

Under the small country assumption and in the absence of tariffs, quotas, and other restrictions to trade, it is clear that p^x and p are equal to the world price. However, in the real world characterized by such impediments to trade these three prices are generally not the same. The effect of quotas and VERs relevant to this paper can be incorporated as follows. In a small country setting and for constant nominal tariffs, domestic price is a function of world price. In real terms, i.e. compared to prices of non-clothing, it is hypothesized to increase following introduction of the MFA quota and VER system⁵

$$p/p^a = f^p(qt)$$

+

The German export price reflects the market conditions in the main

⁴In what follows, a tighter quota or more stringent VER is interpreted as $dqt > 0$.

⁵See for example Pearson (1983) for a graphical exposition for the case of the U.S. footwear industry.

importing countries of German clothing. To a large extent, these are other industrialized countries which have also implemented the protective sanctions of the MFA and which fall in the category of a small country. Hence, depending on how strictly the MFA is applied in these countries compared to Germany, one can expect the ratio of p^x and p to increase or to fall following introduction of the MFA.

$$p^x/p = f^{px}(qt)$$

The model is closed by the equilibrium condition

$$q^d = q^s + q^m - q^x$$

which implicitly defines domestic supply q^s .⁶

The model's comparative static properties regarding the effect of a quota can be derived as follows. If one assumes that a tighter quota or VER raises domestic price, $dp/dqt > 0$, the quota's impact on domestic and import demand as well as export supply can be calculated by simple partial differentiation

$$df^d/dqt = df^d/dp dp/dqt < 0$$

$$df^m/dqt = df^m/dp dp/dqt + df^m/dqt < 0$$

$$df^x/dqt = df^x/dp^x dp^x/dqt + df^x/dp dp/dqt$$

According to the derivatives, a tighter quota reduces domestic consumption

⁶Of course, it is possible to implicitly define instead any of the other three variables. Domestic supply is chosen for empirical reasons, i.e. the well known difficulty to generate a positive relationship between own price and quantity. See Mutti and Bale (1981, p.360) for a similar problem.

as well as imports. On the other hand, the direction of change of exports is indeterminate. Using the equilibrium condition, the quota's impact on production q^S can be derived as

$$dq^S/dqt = df^d/dqt - df^m/dqt + df^x/dqt$$

Similar to the case of exports, the direction of change of q^S depends on the relative strength of several derivatives and hence is an empirical rather than a theoretical matter.

Given a production function such as $q = f^q(L, K, A)$, where L , K , and A represent labor input, capital input, and technology, respectively, an increase in q^S translates into an increase in labor input and capital input. Since the reaction of q^S to a tighter quota is not determined theoretically, neither then is the reaction of labor input dL/dqt , which is given by

$$dL/dqt = [(dq^S/dqt) - (df^q/dK dK/dqt)] / (df^q/dL).$$

As is evident from the above expression, the change in employment is also dependent on MFA related net investment, i.e. dK/dqt . If one postulates that net investment is dependent on output, dK/dqt may be written as

$$dK/dqt = dK/dq^S dq^S/dqt.$$

3. Empirical Analysis

The model is estimated on annual data for the sample period 1962-81. The data relate to the aggregate clothing industry. Import and export figures include all transactions regardless of origin or destination. All indexes have 1980 as their base year. Real quantities are expressed in constant 1980 DM.⁷ The variables q^d , q^m , q^x , and real income are measured in per capita terms.

Due to the difficulty of quantifying the multitude of diverse MFA related quotas and VERS the study utilizes a dummy variable approach. Two sets of dummy variables are tried as a proxy for the variable qt . The first set consists of two variables, D1 and D2. D1 equals unity for the duration of both the first and the second MFA agreement, i.e. for the years 1974-81. D2 is one for the duration of the second MFA, i.e. from 1978 to 1981. The second dummy variable set consists of variable D3. It is zero in 1974, the beginning of the first MFA agreement, and increments by one each year up to 1981, the end of the second MFA agreement. In contrast to the first set of dummy variables, which allows for an increase in protection only at the beginning of the second MFA agreement in 1978, D3 implies a steady increase in protection by quotas and VERS related to the MFA. This seems to be a reasonable assumption given that adjustment to the MFA has not been instant but gradual. Only over time did all the options of protecting the home market from unwanted imports become apparent to the

⁷An exception are the variables of the cost function which is estimated in place of a production function to derive the production elasticity of labor. They are measured in 1976 dollars instead.

signatory countries. This is clearly evidenced by the steady increase in quotas and VERs after 1975. The definitions of the other variables and their sources are summarized in the data appendix.

A double-logarithmic form is chosen for the estimating equations of the model. This is mainly done for convenience of interpretation against the background that neither functional form is strongly favored on the basis of log-likelihood values.

The estimating equations correspond to those of the theoretical model, except for the following differences. In both the domestic demand and the import demand equation the variables p and p^a introduced strong collinearity when they entered the equations separately.⁸ After some experimentation⁹ with alternative parameter restrictions to reduce the dimensionality of the regression, it was decided to include p^a in its instantaneous growth form rather than in log levels in the domestic demand equation. The unemployment rate u was substituted for the vector G . For the import demand function, the differences in logs of p and p^a proved to be an acceptable parameter restriction. Two variables were tried for S , the vector of supply shifters in the import demand equation, i.e. the real wage and capacity. Although both assumed the correct sign, the capacity variable was chosen because it introduced less collinearity and gave a marginally better fit. Finally, collinearity also precluded the separate inclusion of p^x and p . As in the import demand equation, the coefficients

⁸This showed up in insignificant coefficients and odd signs.

⁹The experimentations were guided by the usual statistics of quality of fit and plausibility of signs.

of the two price variables are restricted to the same absolute value.

The demand and supply equations are estimated by single equation techniques. This is justified by the small country assumption, which renders p and p^x exogenous, and by the assumption that the clothing industry is small compared to all of industry or compared to the whole economy. As for the reported statistics, t-ratios are given in parenthesis. $Q(n)$ is the Box-Pierce Q-statistic for nth order autocorrelation with n degrees of freedom, $BP(n)$ the test statistic of the Breusch-Pagan test for heteroskedasticity with n degrees of freedom. Both tests are distributed as χ^2 . CUSUM identifies the value of the CUSUM Test for the constancy of parameter estimates.¹⁰ $CUSUM^2$ is the corresponding statistic of the CUSUM of Squares Test. Both CUSUM and $CUSUM^2$ are given for the more relevant forward recursive regressions only.

The preferred estimates of the demand and supply equations are

$$\ln q^d = 5.39 + .83 \ln Y - .31 \ln p - .040 \ln u + .52 \ln p^a$$

(9.0) (-2.1) (-2.1) (1.1)

$$R^2 = .962 \quad DW = 1.74 \quad Q(3) = 2.09 \quad BP(4) = 1.81$$
$$CUSUM = .60 \quad CUSUM^2 = .26$$

$$\ln q^m = 5.32 - .99 \ln CAP + 3.74 \ln Y - 1.53 \ln (p/p^a) - .046 D3$$

(-2.7) (15.5) (-1.3) (-4.1)

$$R^2 = .996 \quad DW = 2.15 \quad Q(3) = 1.76 \quad BP(4) = 5.54$$
$$CUSUM = .79 \quad CUSUM^2 = .35$$

¹⁰ See Brown, Durbin, and Evans (1975) for details. A short description can also be found in Johnston (1984).

$$\ln q^x = -6.93 + 2.45 \ln Y^x + 1.61 \ln (p^x/p)$$

(41.8) (2.1)

$$R^2 = .991 \quad DW = 1.91 \quad Q(3) = 1.39 \quad BP(2) = 4.07$$
$$CUSUM = .62 \quad CUSUM^2 = .25$$

For none of the three equations do the reported statistics indicate an apparent misspecification. Neither any Q-statistic nor any CUSUM or CUSUM² is significant at the five percent level. The same holds for the BP-statistic at the ten percent level.¹¹

To identify the impact of MFA quotas and VERs, both sets of dummy variables, D1 and D2 and alternatively D3, were tried in the import demand equation. Judged by the standard regression statistics, the above equation with D3 proved clearly superior. This supports the hypothesis that the restrictiveness of the MFA has grown over time. It may also be interpreted as evidence in favor of a shift in focus of restraints from textiles to clothing over time (Gatt 1984, pp. 80-81). Given the log-linear specification of the equation along with the definition of D3, the coefficient of D3 can be interpreted as the instantaneous growth rate of total imports resulting from the introduction of MFA quotas and VERs. The value of -.0455 translates into an annual growth rate of -4.4 percent.¹² Hence, after eighth years of MFA, from 1974 to 1981, imports are ceteris paribus approximately 30 percent lower than they would have been without

¹¹The more stringent ten percent significance level is employed for the Breusch-Pagan test since research on the finite sample properties of this test suggest that the test rejects the null hypothesis when it is true less frequently than indicated by the selected Type I error. See Judge et al. (1982) for details.

¹²The discrete growth rate i is related to the continuous growth rate r by the equation $i = \exp(r) - 1$.

MFA.

To assess the impact of the reduction in imports on domestic production and employment, the impact of the MFA on domestic price and export price has to be taken into account. The two corresponding price equations are given by¹³

$$\ln p/p^a = .14 - .0072 t + .00027 D1 + .013 D2$$

(-7.8) (.03) (1.8)

$$R^2 = .969 \quad DW = 1.59 \quad \text{Rho} = .35 \quad Q(3) = 6.34 \quad BP(3) = 2.32$$

$$\ln p^x/p = -.0047 - .0027 t + .016 D1 + .040 D2$$

(-2.3) (1.4) (3.2)

$$R^2 = .491 \quad DW = 1.87 \quad Q(3) = 1.95 \quad BP(3) = 2.71$$

Similar to the case of the demand and supply equations, the statistics reported for the two price equations do not point to serious misspecification problems. Economically, the equations can be interpreted as follows. Since the clothing industry is considered to be small, p^a or its rate of change will be unaffected by the introduction of MFA quotas or VERs. Hence, the first derivative of the dependent variable of the first price equation with respect to D_i ($i=1,2$) is equal to the corresponding first derivative of the numerator, $\ln p$. It immediately follows that the coefficients of D_i ($i=1,2$) approximate the average percentage rate of change of p due to the MFA. This change is zero from an economic and statistical point of view during the first MFA phase. The second MFA phase,

¹³The first price equation is corrected for first-order autocorrelation using the Cochrane-Orcutt technique. The statistic Rho gives the estimated value of the autocorrelation coefficient.

on the other hand, seems to have caused a price increase of 1.3 percent on average for the clothing industry as a whole.

In interpreting the export price equation, one has to take into account that both p^x and p change at the same time. Hence, the coefficients of D_i ($i=1,2$) have to be interpreted as average percentage rates of change of the ratio of p^x and p resulting from the MFA. The corresponding percentage change in p^x would be 1.6 for the first phase of the MFA and 4.3 percent for the second MFA phase.¹⁴

Since most of Germany's exports go to developed countries which also participate in the MFA, the difference in price increases suggests that the MFA restrictions were more severe in other developed countries than in Germany. Higher price increases for export prices than for domestic prices also imply that exports become relatively more attractive to domestic producers as a result of the MFA.

To determine the impact of output on labor input, a generalized Cobb-Douglas cost function is estimated.¹⁵ A cost function is utilized instead of a production function to avoid the use of any of the usually unreliable capital stock series. The estimated equation is¹⁶

¹⁴The latter figure is calculated as 0.056, the percentage change of the ratio of p^x and p , minus .013, the percentage change of p .

¹⁵See Varian (1978, pp. 41-42) for the calculations involved with duality mapping.

¹⁶The Cochrane-Orcutt technique is applied to correct for first-order autocorrelation. ρ gives the estimated autocorrelation coefficient.

$$\ln (C/r) = -1.63 - .096 t + .91 \ln (w/r) + .98 \ln q^S$$

(-18.8) (16.7) (8.3)

$$R^2 = .978 \quad DW = 1.91 \quad \text{Rho} = .26 \quad Q(3) = 4.52 \quad BP(3) = 2.02$$
$$CUSUM = .90 \quad CUSUM^2 = .12$$

where C is economic cost, w the wage rate, and r the rental rate of capital. Based on the given statistics, the estimated cost function seems to be well founded. Economically, it implies a production elasticity of labor of 0.93. The hypothesis of constant returns to scale, which requires a coefficient of unity for $\ln q^S$, cannot be rejected at any reasonable level of significance. The time trend coefficient indicates a rather steep rate of Hicks' neutral technical change of 9.8 percent. The production function corresponding to the estimated cost function can be written in log-linear form as

$$\ln q = c + .098 t + .93 \ln L + .092 \ln K$$

where c is a constant and where L and K stand for labor and capital input, respectively. For constant output and capital stock, the production function implies a continuous growth rate of employment in the clothing industry of approximately -10.5 percent which results solely from technical change.¹⁷ This is equivalent to an annual growth rate of -10 percent.

The predicted effect of the MFA quota and VER regime on quantities is summarized in table 1. The predictions of the model of the impact of the MFA are given for each year from 1974 to 1981. Columns 1 to 3 present

¹⁷This number results from straightforward application of the implicit function theorem, i.e. by taking the total differential, setting $d\ln q = d\ln k = 0$, and solving for $d\ln L/dt$.

Table 1: Predicted Changes of Consumption, Imports, Exports, Production, and Employment due to MFA, 1974-81

| Year | $d \ln q^d$ | $d \ln q^m$ | $d \ln q^x$ | $d \ln q^s$ | Percent Change in | |
|------|-------------|-------------|-------------|-------------|-------------------|------|
| | (1) | (2) | (3) | (4) | q | L |
| 1974 | 0 | 0 | .026 | .026 | .026 | .026 |
| 1975 | 0 | -.046 | .026 | .071 | .074 | .072 |
| 1976 | 0 | -.091 | .026 | .117 | .124 | .121 |
| 1977 | 0 | -.137 | .026 | .162 | .176 | .171 |
| 1978 | -.004 | -.202 | .090 | .288 | .334 | .325 |
| 1979 | -.004 | -.248 | .090 | .334 | .397 | .385 |
| 1980 | -.004 | -.293 | .090 | .379 | .461 | .448 |
| 1981 | -.004 | -.339 | .090 | .425 | .530 | .514 |

Note: $d \ln$ stands for the difference (d) in natural logs (ln).

the logarithmic changes in consumption, imports, and exports, as they can readily be calculated from the estimated model equations. Column 4 gives the logarithmic changes of production. These are derived by subtracting column 2 from column 1 and adding column 3.¹⁸ As is evident from table 1, the MFA related increase in production is largely caused by a strong response of real imports to the restrictions imposed under the MFA. However, the increase in exports is also nonnegligible. The economically insignificant response of consumption reflects the fact that domestic price hardly increases despite the import restrictions imposed by the MFA. Column 5 of table 1 gives the percentage change of production attributable to the MFA.¹⁹ For the first year of the MFA, that is 1974, the model predicts that domestic production of clothing in Germany was 6.4 percent higher than it would have been without the import restrictions of the MFA. For 1981 the corresponding percentage increase is roughly 50 percent. In other words, by 1981 the MFA regime had induced the German clothing industry to produce at a level 50 percent above the one which would have prevailed without the restrictions of the MFA. Very similar results obtain for employment. The corresponding percentage changes are detailed in column 6 of table 1. The employment figures are based on the assumption that the elasticity of K with respect to q^s is unity.²⁰ Hence the

¹⁸"Change" has to be interpreted as the difference between the situation with and without MFA restrictions. The calculations implement the derivatives discussed in the theoretical section subsequent to the presentation of the model, except that logarithms are used instead of levels.

¹⁹It is calculated as $\exp(\text{col } 5) - 1$, where \exp is the exponent operator.

²⁰The elasticity can be read off the conditional demand function for K . The latter easily derives by applying Shephard's lemma to the cost function.

expression for dL/dqt , which is given in the theoretical section, reduces to

$$d \ln L = [d \ln q^S (1 - .092)] / .93$$

after it is appropriately converted into logarithms.

Overall, the figures of table 1 suggest that the import restrictions of the MFA increased output and employment very considerably above that level which would have prevailed in the absence of restrictions. This view is somewhat at odds with a recent study of the International Labour Organisation (ILO, 1980, pp. 28-32) which found the MFA to have had only a minor impact on production and employment in developed countries.

4. Conclusion

This study set out to identify the impact of the Multifiber Agreement on the German clothing industry. A multi-equation model explaining domestic demand, import demand, and export supply was estimated on industry data for the period 1962-81, which covers the first two phases of the MFA. From what the model predicts, the trade restrictions associated with the MFA are of considerable importance. For example, it is found that the MFA is responsible for a negative growth rate of real imports of 4.4 percent per year. As a consequence, real imports are approximately 30 percent lower in 1981 with MFA restrictions than without. Real exports are roughly 9 percent higher than without MFA. For both output and employment, the corresponding percentages increases are about 50 percent. Overall, these numbers seem to indicate that the MFA has led to a very substantial misallocation of

Data Appendix

| Variable | Definition | Source |
|----------------|---------------------------------------|---|
| p | output price | output price index (1980=100) from Statistisches Bundesamt "Lange Reihen", 1984, p. 181 |
| p ^a | real consumer price nonclothing | general consumer price index (CPI) adjusted for index of clothing (CPIC), (CPI-0.09063 CPIC)/0.90937, both from Stat. Bundesamt "Lange Reihen", 1984, p.186 |
| p ^x | export price index clothing | 1980=100, from Stat. Bundesamt Fachserie 17, Reihe 8, 1983 |
| Y | real per capita domestic income | disposable income from "Lange Reihen", 1984, p. 226, deflated by CPI and converted into per capita terms |
| u | unemployment rate | Sachverstaendigenrat, 1984/85, p. 68 |
| q ^s | real per capita output clothing | value of production from Stat. Bundesamt, Fachserie 18, Reihe 1 deflated by output price index and converted into per capita terms |
| q ^m | real per capita clothing imports | value of imports from all origins, Stat. Bundesamt, Fachserie 7, Reihe 7, deflated by import price index clothing and converted into per capita terms |
| q ^x | real per capita clothing exports | value of total exports from Stat. Bundesamt, Fachserie 17, Reihe 7, deflated by export price index and converted into per capita terms |
| q ^d | $q^s + q^m - q^x$ | |
| qt | MFA quota variable | equal to D1, D2 or D3 dummy variables described in the text |
| C | total economic cost clothing industry | gross value added in 1976 DM from Baumgart et al. |
| r | rental rate of capital | Jatzek and Leibfritz (1982), p. 156, table 24 |
| w | wage rate clothing | wages and salaries per employee hour, from Baumgart et al. |

resources. Given the order of magnitude involved, one can expect that it is worthwhile for the German clothing industry to vigorously lobby against all attempts to eliminate the MFA in its current practice. If the situation is similar for the clothing industries of other developed countries, one may suspect that the MFA could survive for a long time to come. Hence, in view of the political economy aspects involved, the question put forward by a booklet of the Trade Policy Research Centre (Curzon et al., 1981), "MFA Forever?" may have to be answered in the affirmative.

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