Productivity and Trade Orientation: Turkish Manufacturing Industry Before and After the Customs Union

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Abstract

We analyse productivity dynamics in Turkish manufacturing since the early 1980s. In particular, we examine inter-industry differences in productivity growth rates with respect to industries' trade orientation with a special emphasis on the effects of the customs union between Turkey and the European Union. The customs union agreement, which came into effect in 1996, had an important impact on imports from the EU resulting in 23 per cent increase in import penetration from the EU from 1995 to 1998.

Plant level productivities are estimated for the 1984-2000 period following the procedure of Olley and Pakes (1996). Our estimates indicate that Turkey has achieved the largest productivity gains in import competing industries during periods of rapid decline in protection rates, and import competing sector have been more successful in raising their productivity than export oriented and non-tradeable sectors throughout the period under consideration.

JEL Classification**:** F13, D24, C14.
Keywords**:** Production function; customs union; semi-parametric estimation; import penetration; domestic competition.

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I. Introduction

The impact of trade liberalization on productivity and economic growth has received considerable attention in recent policy debates (for recent review, see Tybout 2000 and 2001, Epifani, 2003, Erdem and Tybout, 2003). To start with, there is no consensus in the theoretical literature on the impact of trade reform on productivity. Some researchers claim that trade openness might improve productivity growth through three distinct channels: i) disciplining effect of imports, ii) increasing variety of available inputs, and iii) facilitating technology diffusion from abroad. However, as Rodrik (1988) and (1991) emphasized, trade openness might have adverse impact on productivity growth, as domestic producers, who faced with reduced market shares, become less willing to bear the cost of adopting superior technologies.

Besides the theory, there is also a large body of empirical literature on the impact of trade policy reforms on productivity growth. These studies use data at the country-, industry- and plant-level to shed light on the impact of trade liberalization and policy reforms on productivity growth, but the evidence is mixed. Cross-country studies of Edwards (1993) and Ben-David (1993) report beneficial impact of trade openness. However, Rodriguez and Rodrik (2000) and Rodrik (1999) have criticized these studies on methodological grounds. The major points of criticism focus on the difficulty of controlling for institutional and country specific factors across countries, and the lack of an analysis of counterfactual scenarios. A legitimate question to be asked is what would have happened had the country not adopted the policy changes (Srinivasan and Bhagwati 1999).

Unfortunately, results from studies that use industry level data are also mixed. Although Tybout, de Melo and Corbo (1991) find no evidence of overall productivity improvement in Chile after its trade liberalization, and Tybout and Westbrook (1995) report weak evidence linking trade liberalization to productivity in Mexico, Harrison (1994) finds a positive impact of trade reform in Ivory Cost, and Ferreira and Rossi (2003) report a large positive impact in Brazil.

Recent availability of longitudinal data at the plant level has allowed researchers to analyze productivity dynamics by taking into account the heterogeneity of plants (for a review, see Tybout, 2001). Empirical studies that use plant-level data mostly point to increased productivity gains during increased trade openness although there are some studies that find opposing results (see, for example, a recent study on India by Epifani 2003). There is no strong consensus on the specific causes of productivity gains partly due to difficulties in delineating several mechanisms that may be operating simultaneously. There is some evidence suggesting that these gains result from the disciplining effect of imports, especially in import competing sectors, and intra plant productivity improvements (for recent examples see Pavcnik, 2002; Muendler, 2002; Hay, 2001). Moreover, it is found that participation in international activities is behind intra plant productivity improvements (see Clerides, Lach and Tybout 1998; Aw, Chen and Roberts, 1997; Kraay, Soloaga and Tybout, 2001).

We contribute to this literature by providing evidence on the productivity response to trade barrier reductions for the Turkish manufacturing plants. We analyze plant level data for 51 four-digit SIC industries spanning the period of 1984-2000, which is a period of significant changes in trade policy. Using the same database from 1984-1996, Ozler and Yilmaz (2005) show that trade reforms of the 1980s and early 1990s had substantial impact on productivity growth in manufacturing industry. Furthermore, they show that the sectors that attained the largest productivity gains are the import-competing sectors. We extend Ozler and Yilmaz's (2005) analysis of productivity growth to include the period after the Customs Union agreement with EU went into effect in January 1996.

We calculate plant level total factor productivity implementing an estimation method developed by Olley and Pakes (1996), which uses investment as the proxy to address the potential simultaneity bias in production function estimations. We compare these findings with total factor productivity estimates derived from production function estimations. An inspection of the evolution of total factor productivity over time suggests that during periods of most rapid decline in protection rates productivity gains are largest. We also find that productivity gains in import competing sectors are higher than other sectors.

The paper is organized as follows. In the next section, we provide a brief history of the Turkish trade regime since 1980. The data source is described in Section III. In Section IV a brief presentation of Olley-Pakes method is presented. Section V contains a discussion on the main findings of plant level total factor productivity analysis. Section VI is the conclusion section.

II. Trade Regime in Turkey

Turkey introduced a number of structural reforms in 1980 following the severe balance of payment crisis in the late 1970s. A major component of the reform package consisted of policy changes to achieve greater trade openness. In the early years of the program (1980-1983) the emphasis is on encouraging exports through various direct and indirect measures (for example, export tax rebates, preferential export credits, foreign exchange allocations and the duty-free access to imports). During this period, the total subsidy rate received by manufactured goods exporters reached 20-23 percent (Milanovic, 1986).

Although some steps were undertaken towards elimination of import barriers during the 1980-1983 period, the import regime became subject to radical reforms after 1984. First, quantitative restrictions were rapidly phased out (Togan 1994), and a large number of commodities were allowed to be imported without any prior permission.[1] Changes in quantitative restrictions are argued to have

[1] The import regime was based on classification of commodities into three groups: 'prohibited' list, 'imports subject to permission' list, and 'liberalized' list. With the changes announced in 1984 around 60% of 1983

resulted in considerable elimination of trade barriers. It is suggested that the wedge between the domestic and international price of imports imposed by quantitative restrictions was 50 percent in 1980, and that it declined by 10 percent every year, falling down to 20 percent in 1984, and 10 percent in 1985, and finally to zero by 1986 (Krueger and Aktan 1992).

Second, there were significant reductions in tariff rates, especially on imports of intermediate and capital goods in the late 1980s and early 1990s. Though tariffs on certain goods (for example, consumer goods) were increased temporarily after the elimination of quantitative restrictions, this did not lead to an increase in overall nominal protection rates, because imports of the goods in these categories were severely restricted before 1984. The output-weighted average nominal tariff rate for the manufacturing industry stood almost unchanged from 75.8 percent in 1983 to 76.9 percent in 1984, however, declined to 40 percent in 1990 and to 20.7 percent in 1994.

Turkey introduced the value added tax (VAT) system in 1985. The same VAT rate is applied to domestically produced and imported goods. There have been a number of changes in VAT rates, and the general rate was 18 percent as of December 2006.[2]

The most important change in the trade regime in Turkey was initiated by the customs union between the EU and Turkey which came into effect on January 1st of 1996. As Zahariadis (2002) notes, "[a]part from the liberalisation of tariffs and the adoption by Turkey of the EU's common external tariff for industrial products and the industrial components of processed agricultural products, the agreement also embraces a number of deep integration elements." These include the harmonisation of Turkey's competition policy legislation to that of the EU, the adoption of the Community's commercial policy towards third countries (including textile quotas and the free trade agreements with all the EU's preferential partners), and of the EU *Acquis* regarding the standardisation of industrial products.

As a result of changes in the import regime in the 1980s, the share of imports in GDP and, consequently, the share of taxes on imports in total tax revenue (and in GDP) increased sharply in the mid-1980s (Figures 1 and 2, and Table 1). The import penetration rate[3] for manufacturing increased from 15 percent in 1980 to 22 percent in 1984, and remained at that level until the early 1990s. The share of import taxes in total tax revenue increased rapidly from only 9 percent in 1980 to 26 percent in 1985 and to 30 percent in 1988, and started to decline after 1993, partially as a result of a continuous increase in other taxes.

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imports were no longer subject to restrictions or approvals by authorities. The number of commodities in the 'prohibited' list, which was around 500 in 1984, was reduced to almost zero by 1985. The share of commodities in the 'subject to permission' list, which accounted for 46% of manufactured imports in 1984, was reduced to 22% in 1986 and 6% in 1988.

[2] "Reduced rate" (1 percent or 8 percent) is applied for certain categories of food and newspapers and magazines.

[3] The import penetration rate is defined by the ratio between imports and domestic supply (domestic output *plus* imports).

The most important direct impact of the customs union (CU) is observed in the case of the composition of import tax revenue. With the CU Turkey had to lower its import tariffs from an un-weighted average of 13.5 percent in 1995 to 3.6 percent in 1996 (and a median tariff rate of 8.1 percent in 1995 to 1.2 percent in 1996)[4]. This effectively implied a decrease in import tariff revenues from 2.8 percent of total tax revenues in 1995 to 1.0 percent average over the last three years. Thus, the share of import taxes (including the VAT on imports) in GDP declined during the process of establishing the customs union with the EU, from 4 percent in 1993 to 3 percent in 1998.

We analyze changes in import penetration rates and especially the penetration rates of imports from the EU as a simple measure of trade creation to shed light on the effects of the CU. Since we use the plant level data for the 1984-2000 period, we analyze changes in trade intensities only in this period.

Weighted (by the sectors' shares in domestic sales) average import penetration in the manufacturing industry did not change much in the late 1980s and early 1990s (17.5 percent in both 1984 and 1993), but it tended to increase, almost continuously since 1993 (from 17.5 percent in 1993 to 29.6 percent in 2000. In the case of the imports from the EU[5], we observe a similar pattern: the share of imports from the EU countries in total domestic supply remained about 13 percent in the late 1980s and early 1990s, but European firms achieved to double their market share in eight years (from 12.2 percent in 1992 to 23.6 percent in 2000). The increase in penetration rates was more pronounced in 1995 and 1996, where the economy went through a demand expansion.

The difference between the total and European import penetration rates is the penetration rates for imports from non-EU countries. During the 1990s, the non-EU import penetration rates remained almost at the same level, around 5 percent. Thus, it is safe to conclude that the EU increased its market share not at the expense of imports from other countries. In a simplistic sense we can also claim that this is an indication that at the aggregate level there was 'trade creation' without 'trade diversion'.

Following the CU agreement Turkish exports to the EU had not increased substantially. One reason for this is that the EU had already removed tariff on imports from Turkey long before the CU went into effect, and the export to the EU-output ratio increased to some extent in the early 1990s. However, the increased import penetration forced local firms to take measures in order to compete with imports. As shown below the result was increased productivity and increased competitiveness potential, especially in medium-technology industries like motor vehicles, consumer durables and consumer electronics, and Turkey performed quite well in foreign markets since the 2001 economic crisis.

From a welfare perspective the effect of CU agreement should not be evaluated only on the basis of trade policy measures and their impact. Aside from trade-related implications the CU

[4] See sectoral tariff data in Togan (1997).
[5] The EU refers to EU-15.

agreement foresaw changes in the commercial policy as well. Among these the most important is the enactment of the Competition Law and the establishment of the Competition Authority. Even though the implementation of the law is far from perfect, it is an important step in the right direction in prohibiting monopolistic tendencies and abusive use of market power. The concentration ratios published regularly by the Turkish Statistical Institution clearly show that the 4-firm concentration ratios (the output share of the top-four firms) continue to be high in many important industrial sectors. While approximately 56 percent of the 4-digit SIC industries were characterized as having high (CR4s between 51 percent and 70 percent) and very high concentration ratios (CR4s above 70 percent) in 1996, this ratio stayed almost unchanged by 2000. However, because of the increase in the import penetration rates, one may expect a decline in the market power of local producers.

There are a few studies that analyzed the welfare effects of the CU on Turkish economy. For example, Harrison, Rutherford and Tarr (1996), by using a fully fledged computable general equilibrium model of Turkey, showed that with the CU Turkish welfare would increase between 1 and 1.5 percent of GDP. De Santis (2001) developed a similar CGE model on Turkey. While these models are static in nature, it is possible to incorporate some form of dynamics into these models, via investment and capital stock. Zahariadis (2002) looked at the effects of "deep integration" in the completion of the EU-Turkey customs union by focusing on technical barriers to trade (standards harmonization), as well as barriers emerging from border formalities and related procedures, and found that gains from deep integration are found to be smaller than tariff related ones. But he suggests that "the estimated gains could indeed be much stronger through a more detailed specification of the effects of deep integration" because the multi-sector, multi-region CGE model used in the analysis does not take into account efficiency gains that would emerge as a result of the adoption of EU standards by Turkish domestic producers.

III. Data

The Turkish Statistical Institute (TurkStat; formely known as the State Institute of Statistics, SIS) collects the plant level data set used in this study. TurkStat periodically conducts the Census of Industry and Business Establishments (CIBE).[6] In addition, TurkStat conducts the Annual Surveys of Manufacturing Industries (ASMI) that covers all establishments with 10 or more employees.[7] The set of addresses used during ASMI are those obtained by the Census (CIBE). In addition, every non-census year, addresses of new private establishments with 10 or more employees are obtained from the

[6] Since the formation of the Republic of Turkey, the CIBE has been conducted 7 times (in 1927, 1950, 1963, 1970, 1980, 1985, and 1992).

[7] TurkStat also collects data on establishments with less than 10 employees (micro establishments). However, up to 1992 data on these establishments were collected only during CIBE years. Since then Turkstat collected annual data for only a small sample of micro establishments.

chambers of industry.[8] For this study we use a sample that matches plants from CIBE and ASMI for the 1984-2000 period.[9]

The data is well suited for our purposes because it contains information on variables that are commonly used in the estimation of plant level production functions. Specifically, the data includes value of sales, number of employees, values of material inputs, electricity, fuels and investment (details of variable construction are relegated to the Appendix). Unfortunately, not all the key variables needed for this study have been collected for establishments in the 10-24-size group.[10] Thus our sample consists of plants with 25 or more employees.

We limit the sample to only on *private establishments*.[11] In the resulting sample we have 61,054 observations for 10,350 plants in 23 three-digit SIC industries. Because of entry and exit of plants, we use an unbalanced data set. However, entry or exit each constitutes a small percentage of total number of plants within each year.

Sectors are classified into three groups as "import competing", "export oriented" and "non-traded" based on sectoral level of imports, exports and sales values. Import penetration and export-output ratios are also calculated for each sector (see the Appendix for details).

IV. Plant Level Productivity Estimation: Methodology

Estimates of plant level productivity in this study are based on a method proposed by Olley and Pakes (1996) (OP from here on). The method is developed to address potential simultaneity biases that arise in production function estimations. This is illustrated by considering a Cobb-Douglas production function in log-levels as described below:

$$y_t = \beta_0 + \beta_l \cdot l_t + \beta_k \cdot k_t + \beta_m \cdot m_t + \beta_e \cdot e_t + \beta_f \cdot f_t + \omega_t + \eta_t \qquad (1)$$

where y_t is output, l_t is the labor input and k_t is the capital stock and, m_t is material inputs, e_t is electricity and f_t stands for fuel. Subscript *t* denotes time and the firm subscript, *i*, is omitted for simplicity. Plant specific "error" term, ε_t is composed of a plant-specific productivity component, ω_t, and an i.i.d. component, η_t ($\varepsilon_t = \omega_t + \eta_t$). The latter term has no impact on the firm's decisions. The

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[8] Thus plant entry can be observed in every year of the sample. Though not reported here, in the CIBE years we observe a larger number of new plants, and a higher fraction of smaller plants. Both of these observations reflect the concerted effort by TurkStat to include all establishments in the CIBE years.

[9] The ASMI and CIBE data are available in a machine-readable form starting from 1980. For this study we limited the sample for the post 1983 period primarily because in the years prior to 1983 the quality of data is less reliable and much work is needed for its improvement.

[10] During the 1983-92 period, 10-24 and 25+ size groups were administered different surveys.

[11] The unit observed in the data is a plant, not a firm. However, in Turkish manufacturing sector most of plants are single plant establishments.

productivity term, ω_t, which is not observed by the econometrician, is known by the firm, and it impacts the firm's decision rules. A simultaneity problem arises when there is contemporaneous correlation both within firm *i* and across time *t* between ε_t and the firm's inputs in the firm specific sequences.[12]

To address the simultaneity problem OP use investment to proxy for the part of the error correlated with inputs where investment demand function is then written as follows:

$$i_t = i_t(\omega_t, k_t)\,.$$

For positive values of investment, $i_t(\omega_t, k_t)$ is inverted to yield ω_t as a function of capital and investment $\omega_t = (i_t, k_t)$. Even though we leave the firm's exit decision in this exposition, OP account for exit; we present results that estimate OP with and without exit for comparisons with other methods. Substituting this expression into equation (1) yields output in terms of observable variables:

$$y_t = l_t \cdot \beta_l + \beta_m \cdot m_t + \beta_e \cdot e_t + \beta_f \cdot f_t + \phi_t(i_t, k_t) + \eta_t\,, \tag{2}$$

where $\phi_t(i_t, k_t) = \beta_0 + \beta_k \cdot k_t + \omega_t(i_t, k_t)$. Consistent parameter estimates of the coefficients on the variable inputs can then be obtained using a semi-parametric estimator (for example by modeling ϕ_t as a polynomial series expansion in capital and investment as in OP).

A separate effect of capital on output from its effect on a plant's investment is obtained in a second stage by assuming that ω_t follows a first order Markov process and capital does not immediately respond to the innovations in productivity, where the innovation in productivity is defined as:

$$\xi_t = \omega_t - E\left[\omega_t \mid \omega_{t-1}\right].$$

Under these assumptions consistent estimates of β_k is obtained from the estimation of the following equation:

$$y_t^* = y_t - l_t \cdot \beta_l - \beta_m \cdot m_t - \beta_e \cdot e_t - \beta_f \cdot f_t = \beta_0 + \beta_k \cdot k_t + E\left[\omega_t \mid \omega_{t-1}\right] + \eta_t^* \tag{3}$$

[12] In the case of a two input production function, when both capital and labor are correlated with the productivity shock, but labor's correlation is significantly higher, and that labor and capital are correlated with each other, the parameter estimate of the labor coefficient will tend to be overestimated and the parameter estimate of capital will be underestimated. It is generally not possible to sign the biases of the coefficients when there are many inputs all of which potentially have varying degrees of correlation with the error term ε_t.

where, y_t^* is output net of contribution of labor, electricity, fuels and intermediate inputs and and $\eta_t^* = \xi_t + \eta_t$. Since a by-product of the first stage is an estimate of ω_t a consistent estimate of $E[\omega_t \mid \omega_{t-1}]$ can be obtained and estimation of equation (3) yields consistent estimates of β_k.[13]

The production functions are estimated for all ISIC (Revision 2) 4-digit industries for which we have sufficient number of observations.[14] Estimation results, presented in Table 2 reveal that the coefficient estimates of material inputs are the largest in all industries (averaging about 0.67 across industries). The next largest is the labor coefficient, followed by the coefficients of electricity, capital stock and fuel variables. Both material inputs and labor elasticities are statistically significantly at standard levels of confidence and are of expected sign. Except a few exceptions, other inputs (capital, electricity and fuel) do not have statistically significant negative coefficients. For most of the sectors, scale elasticity estimates are around one indicating the existence of constant returns to scale.

We compute industry level total factor productivity (calculated as output share weighted plant level productivities) to gain some insights into stylized facts of the period. Total factor productivity for plant *i*, in year *t* is

$$TFP_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \hat{\beta}_e e_{it} - \hat{\beta}_f f_{it} - \hat{\beta}_k k_{it} \tag{4}$$

where TFP_{it} is the logarithm of the total factor productivity, y_{it} is the log level of real output for plant *i* at time *t*. Omitting the subscripts, l, *m*, *e*, *f* and k represent log levels of labor, material inputs, electricity, fuels and capital for plant *i* at time *t*. $\hat{\beta}$s with the appropriate subscripts are parameter estimates obtained from production function regressions.

Sector level productivity in year *t* is defined as output share weighted average of plant level productivities:

$$TFP_t = \sum_i \theta_{it} \cdot TFP_{it}$$

where, θ_{it} is output share of plant i in total industry output in year *t*. Productivity levels are calculated for whole manufacturing as well as sub-categories of manufacturing classified according to their trade orientation.

V. Total Factor Productivity in Turkish Manufacturing: Estimation Results

Olley-Pakes parameter estimates of production functions for 51 industries (mostly at the 4-digit level)

[13] Olley and Pakes (1996) use a series expansion as well as kernel estimator for this stage. Also note that a constant can not be identified separately from the polynomial expansion in investment and capital.
[14] We estimated production functions by using other methods such as fixed effects estimates. Since the results were qualitatively the same, we report only the results from the OP estimates.

are presented in Table 2. Figure 4 depicts TFP levels for the manufacturing sector, and sub-sectors classified by trade orientation.

The dynamics of TFP growth in Turkish manufacturing reveals that that are three sub-periods that can be defined in terms of the pattern of TFP growth: 1985-1988, 1988-1994, and 1994-2000 (see Figure 4). This periodization is also marked with major changes in trade policy and macroeconomic conditions. For example, we observe a rapid real devaluation of the Turkish lira in the first sub-period whereas TL appreciates in real terms in the last two periods which are separated by a sharp devaluation of TL during the 1994 crisis (Figure 3). In terms of trade openness, the first period is characterized by a relative stability in import penetration and export-output ratios. In the second period, especially in the early 1990s, the import penetration increased whereas we observe a decline in export-output ratio. The import penetration ratio increased sharply in the third period, and the export output ratio followed the same trend, albeit at a slower pace.

TFP behaved in a similar way in all three sub-sectors. We observe a decline in TFP levels in the first period, followed by a rapid increase in the second period, and stagnation in TFP levels in the third period, with the exception of import competing sectors that achieved remarkable growth in TFP in this period as well. Moreover, sub-period comparisons by industry trade orientations reveals the largest productivity gains in import competing sectors in all sub-periods.

Once we obtain the 4-digit sector-level TFP growth rate estimates, we then calculate the weighted-average total factor productivities for the whole manufacturing industry, as well as for the import-competing, export-oriented and non-traded manufacturing sectors (see Figure 7).

Productivity growth in the manufacturing industry never fell below 5 percent between 1989 and 1993. This was quite an achievement. As discussed above this was mostly due to rapidly rising public sector real wages that had also affected the wages in private manufacturing plants. After this performance, however, both estimates show that there was very little productivity growth, on average, from 1993 to 2000.

At first inspection, the customs union did not have a significant impact on sector level productivity. According to OP estimates, total factor productivity in the manufacturing industry as a whole increased by 4 percent, from 130 in 1995 to 134 in 2000.

When we compare the productivity growth performance over the 1996-2000 period with the one in 1991-1995 period, the average TFP growth rate is lower after the CU. The same is true for sub-sectors. Contrary to one's expectations about the positive effects of the CU, for the majority of 4-digit SIC manufacturing industries the average TFP growth rate for the 1996-2000 period is lower than the average growth rate for the 1991-95 period. Actually, when one looks at the data more closely, it becomes apparent that those industries with lower productivity after the CU had higher import penetration rates as of 1995.

Import-competing sectors' productivity performance has been ahead of export-oriented and non-traded sectors, especially during the 1988-1993 period. The productivity gap that was created in that period continued after 1994. For example, productivity in import competing sectors increased for 14 percent from 1995 to 2000 whereas it stagnated in export-oriented and non-traded manufacturing industries.

In order to assess the impact of trade regimes on total factor productivity, we perform a simple regression analysis. One-year lagged import penetration (IP) rate and export-output (EO) ratio are used as explanatory variables in the fixed effects regression of ISIC 4-digit productivity levels along with time trend and/or time dummies. We use one-year lagged IP and EO ratios in order to correct for any simultaneity problem that may arise at the sector-level. The regressions are undertaken for the whole period (1984-2000) as well as for the 1990s. In order to check whether import penetration rates and export-output ratios have differential effect after the CU, we included IP and EO variables interacted with the CU dummy which takes the value one after 1995.

The regression results with are presented in Table 3. The regression for 1984-2000 and 1991-2000 periods produce quite similar results. When the time trend (Table 3A) or time dummies (Table 3B) are included the import penetration rate does not have a statistically significant coefficient. The export-output ratio, on the other hand, has significantly positive effect on productivity irrespective of the time trend or time dummies used.

The coefficient estimates for the time trend clearly shows an upward trend in TFP levels over time. However, this upward trend somehow flattened out after the CU. In other words, total factor productivity continued to increase after the CU, albeit at a slower pace.

The coefficient estimates for IP rate and EO ratio after the CU are statistically significant. While the effect of IP rate on productivity level turns into positive and become statistically significant after the CU, the effect of EO ratio after the CU is statistically significantly lower than its effect before the CU.

Because of the fact that Turkey lived through sharp upward and downward macroeconomic turns over the period of analysis, it is also important to check whether the results reported in Table 3 are robust to the use time dummies that take a better account of the idiosyncratic year effects. When we use the time dummies rather than the time trend as a right hand side variable, the coefficient estimates for the IP rate and EO ratio do not differ substantially. Unlike the pre-CU period, an increase in the IP rate tends to have a positive effect on productivity with a one-year lag. The effect of export orientation on productivity tends to decline statistically after the CU went into effect, a result similar to the case with the time trend.

As we have seen earlier in Table 1, the jump in the import-penetration rate after the CU defined over the total trade was almost all due to the jump in the import-penetration rate with the EU.

It is therefore possible that the increase in import-penetration rate defined over the trade with the EU has a more significant effect on productivity level and growth. For this reason, we repeat the sector-level fixed-effect regressions over trade with the EU. The results are presented in Table 4. These results are also in line with the results we obtained with IP and EO defined over the whole trade. Import-penetration rate from the EU has positive effect on productivity in manufacturing sectors after the CU.

Finally, we repeat the fixed-effect regressions of productivity on import penetration rate and export-output ratios with plant-level productivity measures for 2-digit SIC industries. When we include time trend along with real exchange rate, import-penetration rate and export-output ratio on the right-hand-side, we obtain the positive effect of import-penetration rate on productivity after the CU. The important result is that the positive effect of increased import penetration after the CU is observed in all two-digit industries.

VI. Conclusions

In this paper, we examine plant-level productivity in Turkish manufacturing industry between 1984 and 2000, a period of tremendous changes in Turkish trade regime. Using an unbalanced panel of manufacturing plants for the 1984-2000 period, we estimate plant level productivities. The estimation is undertaken following the procedure of Olley and Pakes (1996) so as to eliminate potential simultaneity biases that are present in OLS estimations.

We analyse plant productivities in several different ways. First we create industry averages and inspect their evolution over time and across sectors by trade orientation. We observe that productivity gains are largest in import competing industries, compared to export-oriented and non-traded sectors. As has been shown by Ozler and Yilmaz (2003) trade liberalization between 1983 and 1996 had substantial impact on total factor productivity. In this paper, we showed that even though the productivity performance of manufacturing sectors slowed down substantially after 1996, this was mostly due to worsening macroeconomic environment. In the aftermath of the CU in 1996, productivity increased in sectors along with increased import penetration rates.

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TABLES

Table 1. Import penetration and export-output ratio in Turkish manufacturing industry (1984-2000)

	Weighted Average				Un-weighted Average			
	Total Trade		Trade with EU		Total Trade		Trade with EU	
year	IP	EO Ratio	IP	EO Ratio	IP	EO Ratio	IP	EO Ratio
1984	0.175	0.201	0.126	0.093	0.174	0.243	0.125	0.081
1985	0.172	0.209	0.125	0.097	0.174	0.294	0.128	0.160
1986	0.177	0.169	0.132	0.084	0.184	0.211	0.133	0.109
1987	0.180	0.197	0.131	0.108	0.176	0.246	0.131	0.141
1988	0.171	0.202	0.126	0.101	0.190	0.270	0.144	0.107
1989	0.158	0.185	0.109	0.096	0.178	0.257	0.128	0.112
1990	0.177	0.162	0.131	0.093	0.203	0.284	0.154	0.120
1991	0.170	0.163	0.121	0.092	0.203	0.282	0.139	0.124
1992	0.175	0.162	0.122	0.091	0.205	0.249	0.146	0.116
1993	0.194	0.151	0.138	0.077	0.224	0.216	0.163	0.097
1994	0.200	0.231	0.144	0.113	0.233	0.306	0.169	0.142
1995	0.222	0.211	0.165	0.109	0.233	0.266	0.171	0.129
1996	0.278	0.240	0.223	0.123	0.278	0.330	0.210	0.153
1997	0.272	0.238	0.220	0.115	0.270	0.282	0.201	0.120
1998	0.278	0.243	0.220	0.125	0.269	0.286	0.200	0.134
1999	0.261	0.262	0.212	0.147	0.267	0.318	0.199	0.158
2000	0.296	0.250	0.236	0.136	0.279	0.314	0.201	0.145

Source: Author's calculations.

Table 2. Olley-Pakes production function parameter estimates (1984-2000)

Sic4	L **	t_L	E	t_E	F	t_F	M **	t_M	K	t_K	Nobs
3111	0.09	2.9	0.07 **	4.8	0.01	0.8	0.76	42.8	0.06 **	5.2	372
3112	0.28	7.8	0.06 **	3.7	-0.01	-0.8	0.67	38.4	0.07 **	4.5	360
3113	0.12	8.3	-0.0003	0.0	0.03 **	3.9	0.76	58.5	-0.03	-0.6	816
3115	0.22	9.9	0.03 **	2.7	0.04 **	3.7	0.69	52.3	0.03	0.7	712
3116	0.22	11.1	0.10 **	9.2	0.01 **	2.9	0.73	64.1	0.04 **	8.0	1097
3117	0.16	9.1	0.04 **	3.9	-0.0001	0.0	0.77	48.0	0.01	0.9	751
3119	0.11	3.4	0.06 **	3.8	0.02	1.5	0.75	37.6	-0.04	-0.8	401
3121	0.11	3.4	0.06 **	4.1	0.02 *	2.4	0.81	60.9	0.02	1.1	547
3122	0.22	11.7	0.003	0.4	0.02 **	3.5	0.79	77.8	-0.06 **	-3.3	677
3134	0.15	3.4	0.08 **	3.2	0.00	0.1	0.68	32.8	-0.03	-0.8	372
3140	0.04	0.9	0.11 **	3.3	0.02	0.8	0.74	21.8	0.00	0.2	185
3211	0.21	23.2	0.05 **	9.2	0.03 **	12.0	0.67	142.4	0.02 **	2.9	4471
3212	0.25	13.7	0.03 **	3.0	0.03 **	4.3	0.65	66.4	0.06 **	3.4	987
3213	0.21	18.9	0.04 **	5.5	0.02 **	3.5	0.71	113.5	-0.03	-1.4	2224
3214	0.25	7.7	0.01	0.6	0.05 **	3.2	0.68	34.0	0.06 **	6.0	304
322	0.27	24.6	0.05 **	7.2	0.01 *	2.4	0.62	127.5	-0.04	-1.5	4850
3231	0.32	9.7	0.10 **	4.5	0.01	0.6	0.62	39.4	0.07 **	6.2	546
3240	0.30	9.9	0.01	0.8	0.03 **	2.8	0.74	44.5	0.02	1.0	430
3311	0.18	6.2	0.07 **	5.6	0.01	1.1	0.71	51.8	0.03 *	2.4	670
3320	0.26	9.1	0.06 **	3.9	0.004	0.4	0.74	42.6	-0.02	-0.4	570
3411	0.33	5.4	0.01	0.4	0.02	0.9	0.68	22.9	0.08 **	4.0	225
3412	0.21	6.6	0.10 **	6.1	-0.01	-1.2	0.64	36.0	-0.02	-0.8	558
3419	0.20	3.7	0.03	1.1	0.06 **	2.7	0.71	21.0	0.08 **	4.5	186
3421	0.06	2.7	0.07 **	4.6	0.03 **	2.8	0.69	44.6	0.08 **	7.1	903
3511	0.30	6.5	0.03 +	1.7	0.05 **	3.2	0.55	24.7	0.12 **	6.9	323
3521	0.23	6.3	0.08 **	5.2	0.02	1.2	0.73	34.6	0.04 *	2.1	410
3522	0.28	11.3	0.05 **	3.7	0.01	1.0	0.64	41.5	0.01	0.5	728
3523	0.28	7.2	-0.01	-0.5	-0.01	-0.9	0.62	29.6	0.09 **	2.9	402
3529	0.23	7.7	0.05 **	3.7	0.01	0.7	0.72	48.4	-0.06	-0.9	481
3559	0.20	8.5	0.03 **	3.0	0.02 *	2.2	0.64	52.7	-0.23 **	-4.2	754
3560	0.21	14.2	0.05 **	8.5	0.03 **	6.7	0.68	78.3	-0.11 **	-3.5	1895
3610	0.39	7.7	0.14 **	5.2	0.05 *	2.4	0.46	17.2	0.04	1.3	315
3620	0.31	11.4	0.07 **	5.4	0.03 **	3.7	0.56	27.8	0.10 **	7.1	495
3691	0.44	19.1	0.002	0.1	0.19 **	16.1	0.35	36.2	0.03 **	3.1	1627
3692	0.23	6.3	0.28 **	17.3	0.07 **	5.9	0.40	21.8	0.03	1.5	642
3699	0.27	10.1	0.06 **	5.3	0.03 **	3.4	0.62	44.8	0.08 **	4.6	1070
3710	0.19	14.3	0.06 **	10.4	0.01	1.4	0.72	131.3	0.00	0.1	1846
3720	0.25	11.9	0.02 +	1.7	0.01	0.7	0.76	64.8	-0.10	-2.2	740
3811	0.22	9.7	0.04 **	3.8	0.03 **	3.2	0.68	52.6	0.10 **	10.6	894
3812	0.24	5.9	0.08 **	3.2	0.03 *	2.1	0.68	28.5	0.07 **	6.7	374
3813	0.18	7.6	0.06 **	5.4	0.02 *	2.2	0.68	47.9	0.07 **	9.7	966
3819	0.25	15.4	0.06 **	7.2	0.02 **	3.7	0.67	70.2	0.06 **	9.5	1684
3822	0.31	6.8	0.03	1.3	0.05 **	3.4	0.61	26.5	0.05 **	3.0	373
3823	0.34	5.8	0.09 **	3.0	-0.02	-0.9	0.59	18.7	0.04	1.5	316
3824	0.37	11.7	0.02	1.5	0.01	1.0	0.67	38.0	0.03 **	5.8	810
3829	0.26	13.4	0.02 +	1.9	0.03 **	4.6	0.66	64.1	-0.08	-1.7	1600
3831	0.29	10.6	0.02	1.5	0.003	0.3	0.69	45.0	0.04 **	3.0	738
3832	0.26	7.4	0.01	0.5	-0.01	-0.6	0.71	49.4	0.07 **	4.3	501
3833	0.13	3.6	0.07 **	3.3	-0.03 *	-2.0	0.75	36.8	0.07 **	9.0	295
3839	0.26	13.9	0.08 **	8.0	0.02 *	2.1	0.61	53.9	0.08 **	7.0	1075
384	0.27	19.0	0.04 **	6.0	0.03 **	4.66	0.60	76.1	0.09 **	9.25	2550

Table 3. TFP level and trade orientation -- Olley-Pakes estimates

A. Fixed Sector Effects Only

	1984-2000					
Import Penetration (-1)	0.757** [0.166]	0.021 [0.149]	0.093 [0.152]	-0.009 [0.185]	-0.227 [0.156]	-0.229 [0.153]
Export-Output Ratio (-1)	0.217* [0.084]	0.241** [0.085]	0.265** [0.089]	0.144+ [0.078]	0.248** [0.081]	0.247** [0.082]
IP(-1)_after	---	---	---	0.677** [0.086]	0.414** [0.087]	0.576** [0.089]
EO(-1)_after	---	---	---	-0.038 [0.052]	-0.224** [0.051]	-0.129* [0.056]
Time trend	---	0.024** [0.002]	0.031** [0.003]	---	0.022** [0.002]	0.031** [0.003]
Trend_after	---	---	-0.006** [0.002]	---	---	-0.012** [0.002]
Observations	816	816	816	816	816	816
R-squared	0.51	0.60	0.60	0.56	0.62	0.63
	1991-2000					
Import Penetration (-1)	0.417* [0.174]	0.106 [0.195]	0.163 [0.194]	0.04 [0.217]	-0.107 [0.214]	-0.149 [0.213]
Export-Output Ratio (-1)	0.306* [0.120]	0.243* [0.112]	0.244* [0.109]	0.310** [0.119]	0.319** [0.115]	0.264* [0.115]
IP(-1)_after	---	---	---	0.285** [0.086]	0.192* [0.088]	0.301** [0.096]
EO(-1)_after	---	---	---	-0.112* [0.050]	-0.181** [0.052]	-0.119* [0.050]
Time trend	---	0.013** [0.004]	0.030** [0.007]	---	0.014** [0.004]	0.033** [0.007]
Trend_after	---	---	-0.008** [0.002]	---	---	-0.011** [0.003]
Observations	510	510	510	510	510	510
R-squared	0.78	0.79	0.79	0.79	0.79	0.80

Notes: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%

B. Fixed Sector and Year Effects

	1984-2000		1991-2000	
Import Penetration(-1)	0.096 [0.147]	-0.219 [0.147]	0.151 [0.199]	-0.145 [0.214]
Export-Output Ratio(-1)	0.280 ** [0.084]	0.263 ** [0.076]	0.253 * [0.115]	0.287 * [0.118]
IP(-1)_after	---	0.559 ** [0.085]	---	0.276 ** [0.093]
EO(-1)_after	---	-0.142 * [0.056]	---	-0.137 ** [0.049]
Observations	816	816	510	510
R-squared	0.64	0.67	0.80	0.81

Table 4. TFP level and trade orientation – Trade with EU (Olley-Pakes estimates)

A. Fixed Sector Effects Only

	1984-2000					
Import Penetration (-1)	1.049 ** [0.195]	0.377 * [0.162]	0.457 ** [0.164]	0.256 [0.213]	0.096 [0.174]	0.092 [0.166]
Export-Output Ratio (-1)	0.257 * [0.111]	0.285 * [0.122]	0.296 * [0.123]	0.171 [0.108]	0.273 * [0.115]	0.254 * [0.116]
IP(-1)_after	---	---	---	0.746 ** [0.108]	0.415 ** [0.105]	0.576 ** [0.108]
EO(-1)_after	---	---	---	-0.06 [0.070]	-0.267 ** [0.071]	-0.177 * [0.074]
Time trend	---	0.023 ** [0.002]	0.029 ** [0.003]	---	0.021 ** [0.002]	0.030 ** [0.003]
Trend_after	---	---	-0.006 ** [0.002]	---	---	-0.010 ** [0.002]
Observations	816	816	816	816	816	816
R-squared	0.52	0.6	0.6	0.56	0.62	0.63
	1991-2000					
Import Penetration (-1)	0.671 ** [0.189]	0.253 [0.212]	0.334 [0.211]	0.249 [0.246]	0.078 [0.239]	0.048 [0.236]
Export-Output Ratio (-1)	0.312 * [0.141]	0.326 * [0.137]	0.329 * [0.132]	0.287 + [0.146]	0.357 * [0.148]	0.313 * [0.142]
IP(-1)_after	---	---	---	0.302 ** [0.106]	0.178 [0.109]	0.292 * [0.114]
EO(-1)_after	---	---	---	-0.103 [0.067]	-0.187 ** [0.070]	-0.126 + [0.067]
Time trend	---	0.014 ** [0.004]	0.032 ** [0.007]	---	0.014 ** [0.004]	0.034 ** [0.007]
Trend_after	---	---	-0.009 ** [0.002]	---	---	-0.011 ** [0.003]
Observations	510	510	510	510	510	510
R-squared	0.78	0.79	0.79	0.78	0.79	0.8

Notes: Robust standard errors in brackets. + significant at 10%; * significant at 5%; ** significant at 1%

B. Fixed Sector and Year Effects

	1984-2000		1991-2000	
Import Penetration(-1)	0.468** [0.164]	0.119 [0.164]	0.342 [0.221]	0.084 [0.244]
Export-Output Ratio(-1)	0.349** [0.111]	0.310** [0.102]	0.346* [0.136]	0.340* [0.142]
IP(-1)_after	---	0.551** [0.102]	---	0.263* [0.109]
EO(-1)_after	---	-0.197** [0.073]	---	-0.147* [0.065]
Observations	816	816	510	510
R-squared	0.65	0.66	0.8	0.81

Figure 1. Import penetration and export-output ratio (1980-2000)
(Calculated directly from Raw Data on X, M and Output for the manufacturing sector as a whole)

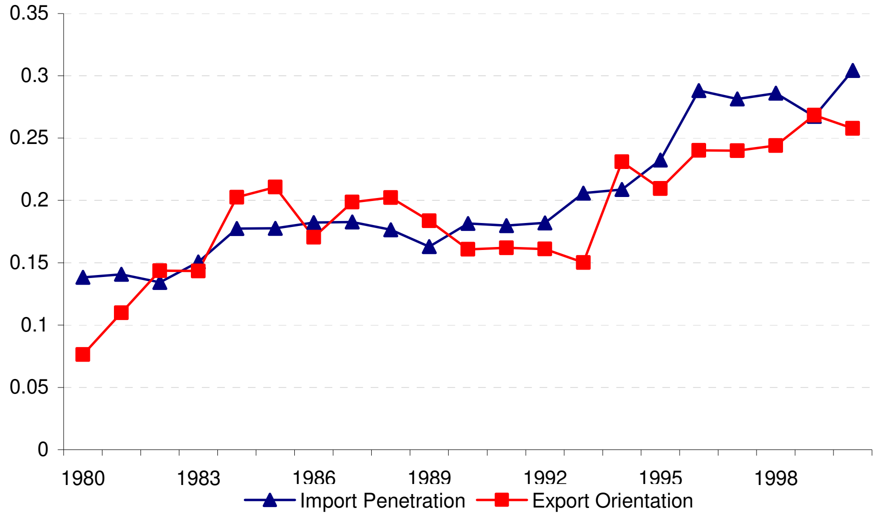
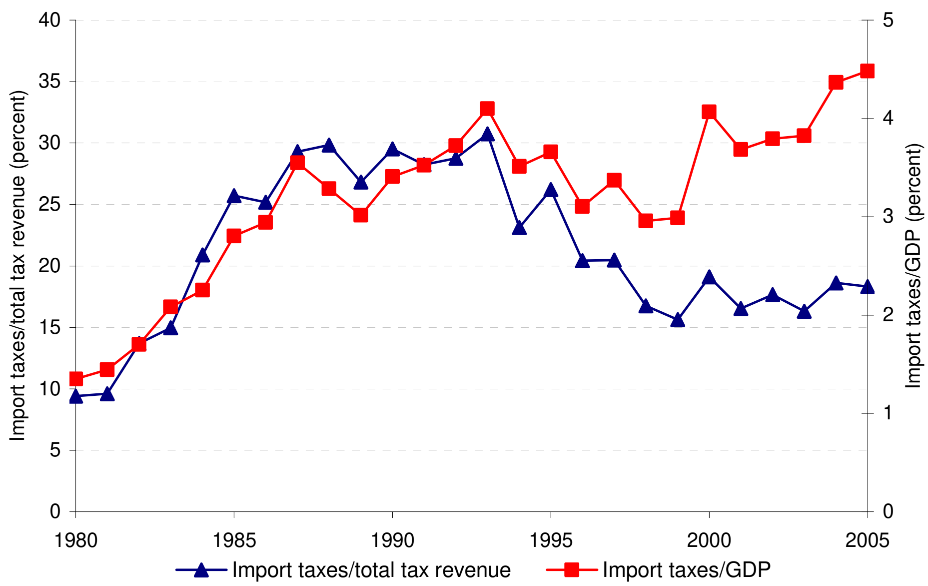
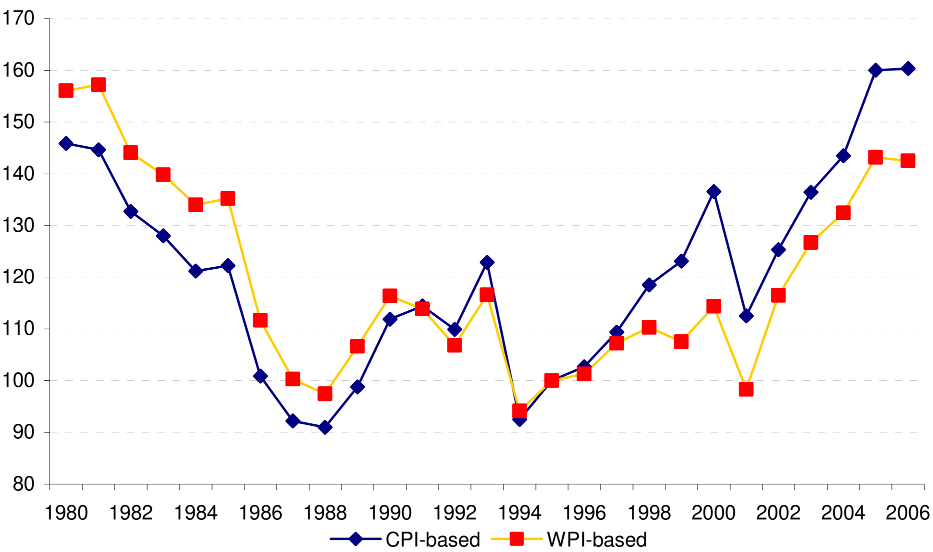


Figure 2. Revenues from import taxes, 1980-2005



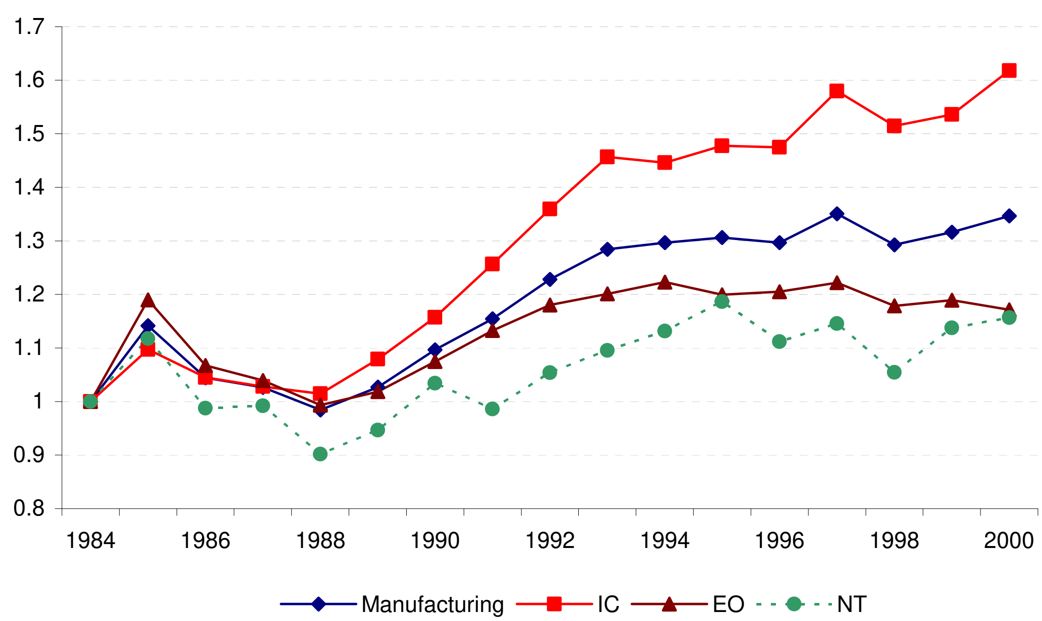
Sources: Total tax revenue from the Ministry of Finance Revenue Administration (www.gib.gov.tr/); import taxes and GDP from national accounts, the Central Bank (www.tcmb.gov.tr).

Figure 3. CPI and WPI-based real effective exchange rate (1980-2000)



Source: Central Bank of Turkey

Figure 4. TFP estimates for the manufacturing industry (1984-2000)
(output weighted average at the 4-digit SIC level)



APPENDIX
DATA CONSTRUCTION

Variables used in production function estimations:

- *Real value of output* is obtained by deflating the total annual sales revenues of a firm with a three-digit price deflator constructed by Turkish Statistical Institute. This construction has the usual problems of having "one price" for all firms, and relies on price-taking behavior at the firm level.[15] As such the deflator controls for changes due to industry level demand shocks and changes arising from inflation.
- *Material inputs* include all purchases of intermediate inputs. The nominal value of firm level annual inputs are deflated using a three-digit material input price deflator.
- *Energy* series is the sum of electricity usage and fuel consumption. Real value of *electricity* and *fuel* consumed is obtained by deflating the nominal values with the respective price deflators.
- *Labor* is the number of paid employees in a given year.
- *Capital stock* series is constructed by using perpetual inventory method. The database contains only information on investment. Detailed subcategories of investment are aggregated to buildings and structure, transportation equipment, and machinery. Since the data does not contain information on capital stock in any year we construct initial capital stock series for each establishment. Initial capital stock series (for the year before a plant enters the sample) is computed by assuming that average real investment undertaken in the first seven years of a plant represent its average investment behavior in the seven years before the plant is included in the database. Using 5, 10, and 20 percent as the depreciation rates for buildings, machinery and transportation equipment, respectively, we calculate the initial capital stock. For those establishments that are not in the data for seven years we imputed initial capital stock series. Using initial capital stocks of establishments in the same four-digit SIC activity in that year generates the imputed values, which have similar attributes (such as similar usage of energy per worker). We assume that investment occurring in the previous year enters the capital stock this year.

Trade Orientation

The trade orientation of an industry is determined at the four-digit SIC level, on the basis of sector level export, import and sales values.

- Sectors that export more than 15 percent of their sales are classified as export oriented, sectors that have import penetration rate above 15 percent are classified as import competing, and others are classified as non-traded. If a sector's export-output ratio and import penetration rate are above 15 percent, then the sector is classified as import competing or export oriented depending on whether import penetration rate is above export-output ratio or not. Since the definition of trade orientation involves a potential endogeneity we inspected its stability over time. In other words, we computed the ratios using alternative sub samples. Interestingly, trade orientation of the three digit industries does not change much over time.

[15] See Griliches and Mairesse (1995) for a discussion of problems arising from use of one price.