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Openness and Productivity Growth in Turkish Manufacturing

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Abstract

This paper examines the dynamics of productivity growth in Turkish manufacturing industry before and after the liberalization of the economy. Using industry level data, the paper shows that the move from import-substituting industrialization to an outward-oriented strategy improved growth performance and it is productivity that is responsible for almost half of the growth in value added. There is also evidence that industries that face stronger competition after reform observed higher productivity growth rates whereas increased exports do not significantly affect productivity.

JEL Codes: F14, F43, O47, O52

Keywords: Trade liberalization, total factor productivity growth, Turkey

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Türk İmalat Sektöründe Dışa Açıklık ve Verimlilik

Öz

Bu çalışma ekonominin serbestleşmesi öncesi ve sonrası Türk imalat sanayisinde verimlilik büyümesinin dinamiklerini inceliyor. Makale, sektör düzeyinde veri kullanarak, ithal ikameci sanayileşmeden dışa yönelik stratejiye geçişin büyüme performansını ve verimliliğini geliştirdiğini ve bunun neredeyse katma değer artışının yarısını sağladığını gösteriyor. Ayrıca, artan ihracat verimliliği anlamlı olarak etkilenmezken, reform sonrası daha güçlü rekabet ile yüz yüze gelen endüstrilerde daha yüksek verimlilik artışının gözlendiğine dair işaretler de bulunmaktadır.

JEL Kodları: F14, F43, O47, O52

Anahtar Kelimeler: Dış ticarette serbestleşme, toplam faktör verimliliği büyümesi, Türkiye.

1. Introduction

It has been forcefully argued that international trade and openness is very effective in promoting growth. There is a long list of literature on the importance of trade in improving economic welfare, however, it is not clear how it interacts with long-run economic growth and productivity. This paper discusses the extent of the effect of international trade on growth performance and productivity dynamics in Turkey by comparing two decades before and after opening the economy.

The ambiguity about the effectiveness of trade is partly due to various theoretical models that often reach conflicting results, and partly due to inconclusive empirical research. Most of the arguments for freer trade developed in the 1970s lacked analytical foundations, "too often, the preferred method of proof is a casual appeal to common sense," (Rodrik, 1995) and are one-sided and incomplete leading to contradictory conclusions once rigorously analyzed[1]. The new trade theory, to remedy the failures of earlier research, provides a more rigorous analysis of the relationship between trade and growth, however, reaches ambiguous conclusions. In static models of international trade, for example, the presence of externalities (imperfect competition and/or increasing returns to scale) may force domestic firms to reduce their mark-ups and to expand their output, thus generating a welfare gain; but it may also cause contraction of import competing industries that are more likely to observe increasing returns to scale, especially in a developing country, and lead to a deterioration in economic growth.

Similarly, the predictions of growth theory vary with the assumptions on which the model is based. In neo-classical growth theory, trade policy has no effect on long-run growth, but speeds up the transition to the steady state. On the other hand, endogenous growth models of learning-by-doing or technological spillovers predict higher long-run growth rates for open economies (Grossman and Helpman, 1991). In general, these models predict that initially backward economies catch up with the leaders when the economy is opened to free trade. Yet, if spillovers are constrained by national boundaries and international trade forces less developed economies to specialize in

[1] Two major arguments have been easily dismissed by Rodrik (1995). It has been argued, for example, that relative-price distortions through tariffs and investment subsidies prohibit learning by increasing the relative-profitability of these industries. Yet, these arguments tend to ignore that it is also true that the opposite holds for industries that are at a disadvantage because of the same policies. Similar arguments for X-efficiency, that tariffs increase entrepreneurial slack in import-competing sectors because they raise the relative price of these industries', overlook that the same tariffs should decrease such a slack in other industries.

primary goods production rather than technology-intensive sectors, the effect of opening the economy to free trade could be disastrous[2].

Since theory does not provide an unambiguous relationship between trade policy and growth, empirical analysis becomes more and more important to bear upon the issue. The existing empirical work, either multi-country case studies of early 1970s or cross-country econometric approach, such as Dollar (1992), Sachs and Warner (1995) and Edwards (1998), while producing a positive link between trade policy and growth, is far from being convincing. Rodriguez and Rodrik (1999) scrutinize the most cited research on the relationship between trade and growth and conclude that they are not persuaded of a significant negative relationship between restrictive trade policy and growth. Both Edwards (1998) and Rodriguez and Rodrik (1999) conclude that more disaggregated country studies are required for further understanding of the relationship between trade and economics of innovation and productivity.

Among an array of recent country studies, Kim (2000), for example, investigates the effects of trade policy on productivity growth in Korean manufacturing and finds a significant negative effect of quantity restrictions on productivity growth, though the importance of this finding diminishes in the face of estimated bleak productivity growth. Pavcnik (2002) uses plant level manufacturing data to evaluate productivity gains from trade liberalization in Chile and concludes, through a careful econometric analysis, in favor of liberalization, especially significantly higher productivity growth in import competing sectors. Nonetheless, she fails to identify any significant effect of trade on the productivity of exporting firms. Similarly, Clerides, Lach and Tybout (1998) using Colombian, Mexican and Moroccon, Aw, Chen and Roberts (1997) using Taiwanese and Bernard and Jensen (1999) using U.S. data find that the correlation between exports and productivity is mostly due to self-selection, that is, exporting does not accelerate productivity growth, instead typically more productive firms are involved in export market.

Earlier studies on Turkey report a positive impact of trade liberalization on productivity. The study by Krueger and Tuncer (1982) report that productivity growth was faster during the periods of liberalization. Similarly, Nishimizu and Robinson (1984) find that productivity growth increases with export expansion. Both of these studies cover the 1963-1976 period, when trade policy in Turkey was ‘a protectionist’s dream’ (Levinsohn, 1993), despite some and rather weak liberalization attempts. The

[2] In particular, models that emphasize technology transfer also distinguish the channel through which trade affects productivity growth. Some of these models argue that increasing imports enhance productivity growth directly as inputs into production and indirectly through reverse-engineering of these goods (Connolly, 1998); and others claim that exporting sectors experience higher productivity growth in the presence of sector specific learning-by-doing due to specialization forced by trade and thus increased size and sectoral learning (Feeney, 1999).

paper by Levinsohn (1993) is the first one that exploits the reforms of the 1980s, and tests 'imports as a market discipline' hypothesis. His results show that for majority of industries, removing barriers to import decreases market power. Finally, the study by Foroutan (1996) concludes that industries that are classified as export industries grew faster after 1980.

This paper contributes to the same debate by analyzing productivity performance of the Turkish manufacturing before and after trade liberalization. One of the criticisms of the existing empirical literature is that openness measures are not good indicators of trade policy. The empirical analysis starts with an evaluation of the performance of Turkish manufacturing industry under two distinct trade regimes without relying on any openness measure. The long span of data provides evidence whether productivity gains are persistent. It also helps to avoid the problem observed in studies with short time dimensions, namely, that the relationship between trade liberalization and productivity growth is blurred because it is not clear whether the gains are due to trade policy changes or concurrent other shocks. Furthermore, identifying different sub-periods under the same trade regime allows some control for macroeconomic factors, in particular, macroeconomic uncertainty, that are quite common in developing countries and that might also affect results adversely. The paper finds that there is indeed an improvement in the productivity performance of Turkish manufacturing industry after the economy is opened to free trade. Growth accounting exercise shows that improvement in productivity is responsible for almost 50% of value-added growth. The results also hint to a number of potential limitations, namely, that the pace of productivity growth declines somewhat in later years of liberalization and that factor accumulation was faster during the import-substituting industrialization period.

Previous research based on plant level data has well established that exporting firms are more efficient than their domestic competitors, but few, Bernard and Jensen (1999) and Clerides et al. (1998), have tested the causality. This paper attempts to provide evidence for the direction of causality between trade variables, export growth and changes in import penetration, and productivity growth. To overcome the endogeneity problem the paper employs vector autoregressions and Granger-causality tests. The efficiency of the estimation is achieved using the panel structure of the data and consistency is established by the use of the generalized method of moments estimation.

The results indicate that trade share, measured as the share of imports and exports in total output, Granger-causes productivity growth and that the effect is positive, thus supports the hypothesis that increased trade improves productivity performance. Decomposing trade into exports and imports and applying causality tests show that higher import-sales ratio improves productivity in that industry, whereas there is no evidence of causality from exports to productivity, confirming earlier results. The results provide support for models where technology is assumed to diffuse through

imports, but indicate that there is no significant learning-by-exporting. Furthermore, the analysis shows that faster growth in productivity improves trade balance by increasing exports and by reducing the level of import penetration.

The rest of the paper is organized as follows: next and the following sections describe the Turkish experience and the data. Section 4 compares the growth of output, factor inputs and productivity before and after trade reforms. The section also provides a growth accounting exercise. Section 5 discusses Granger-causality tests between trade and productivity growth using data after 1980. Finally, section 6 concludes.

2. The Turkish Experience

Turkey, after twenty years of import-substituting industrialization, which came to an end in 1979 following a severe payment crisis that paralyzed the second half of seventies, was forced to move to an outward-oriented growth strategy by liberalizing first trade and then the financial system[3]. In January 1980, Turkish government undertook a major devaluation of the currency and promoted exports through a variety of tools such as tax rebates, credit subsidies and foreign exchange allocations for the imports of intermediate goods. In 1984, an Import Program was initiated. With this program quantity restrictions were eliminated significantly (60 percent of 1983 imports are liberalized) and tariffs for the majority of imports were reduced by 20 percent (Baysan and Blitzer, 1990). As of 1988, major trade liberalization was already established. During the same period a significant cut in real wages was also observed. The share of wages in value added fell down to 17% in 1988 from 30% in 1980. Reduced wages meant cheap inputs for industry as well as a reduction in domestic absorption, both of which contributed to the increase in exports. In 1989, the government moved to financial liberalization by allowing real exchange rate to appreciate and by liberalizing capital account fully. The new policies aimed to increase inflows of funds into the domestic economy in order to ease the financing of public deficit. The financial liberalization reform coincides with populism in Turkey. The removal of barriers in political life in 1987 that were established in 1980 after a coup, strong pressures by trade unions, and defeat of the governing party in 1989 local elections mounted populist pressures on government. Consequently, real wages increased significantly ending almost a decade long low wage period.

Despite successful and rapid liberalization of trade and capital markets, macroeconomic stability could not be established. Inflation was reduced to 35% in the first few years of reform from an over 100% level in 1980, but increased back again to

[3] The nature and effects of liberalization have been discussed in detail in Aricanli and Rodrik (1990), Senses (1994) and Togan and Balasubramanyam (1996), among others.

a plateau above 60% after 1988. Fiscal deficit kept increasing and public sector borrowing requirement reached well above 10% in the early years of 1990s.

Turkish manufacturing observed a rapid export and a modest import growth after 1980. Both the dollar value and volume of manufacturing exports rose drastically. The export-output ratio rose from a mere 4% until 1980 to over 20% in the next sixteen years while the volume of manufacturing exports grew 17% annually. The leading exporters in 1980, textiles, food and clothing industries were later joined by iron and steel, rubber, fabricated metal and electrical machinery industries; these industries' export shares increased from less than 2% in 1980 to more than 10% at the end of the sample period. The volume of imports, on the other hand, rose by 8% per annum, mostly after 1988. Despite an 18% increase in 1984 immediately after liberalization, imports rose very slowly thereafter. The share of imports in total domestic sales of manufacturing industry increased only to 20% in 1995 from 15% in 1980. The composition of imports that consisted of mostly durable goods, particularly chemicals, miscellaneous petroleum products and machinery did not change significantly.

In the empirical analysis the sample period is divided into four sub-periods, two under each trade regime, to avoid any misleading conclusion because of recession years or changes in other policy variables. The sub-periods before 1980 are defined by the balance of payment crisis that began in 1976 and quite apparent in the data. While it is possible to identify different periodizations for the liberalization process, two particular periods are chosen: 1980-1988 as the first phase, when trade liberalization took place, and 1989-1996 as the second phase corresponding to financial liberalization. It should be noted that the second phase also coincides with populism. With the removal of barriers in political life and strong pressures by trade unions, real wages increased drastically in 1988 reaching their pre-1980 level.

3. Data

The data is obtained from Annual Surveys of Manufacturing Industry conducted by the Turkish Institute of Statistics (formerly State Institute of Statistics) and cover private establishments with ten or more persons engaged. The details of the data, construction of price indices and capital stock variables are described in the appendix.

The productivity measure used in the paper is total factor productivity, defined as the residual after the contribution of accumulation of all factors is removed from output

growth[4]. More formally, suppose value added is produced by using two inputs[5], labor and capital, and technology, *A*:

$$Y = F(A,K,L) \tag{1}$$

Totally differentiating this function, assuming Hicks-neutral technology, and with some manipulation one obtains:

$$\frac{dY}{Y} - \frac{dK}{K} = s_L\left(\frac{dL}{L} - \frac{dK}{K}\right) + (\mu - 1)s_L\left(\frac{dL}{L} - \frac{dK}{K}\right) + (\gamma - 1)\frac{dK}{K} + \frac{dA}{A} \tag{2}$$

where s_J is the share of *J*th input total revenue, μ is the markup and γ is the returns to scale parameter.

Under the assumption of perfect competition and constant returns to scale, $\mu = \gamma = 1 = s_K + s_L$, Equation (2) reduces to

$$\left(\frac{dA}{A}\right)^{SR} = \frac{dY}{Y} - s_K\frac{dK}{K} - s_L\frac{dL}{L} \tag{3}$$

The term $(dA/A)^{SR}$ is simply the residual growth of value added after the contribution of inputs are removed and is called the Solow residual. The difference between Eqs. (2) and (3) indicates that the Solow residual overestimates the technology when there is imperfect competition and/or when industries operate under increasing returns to scale.

Measurement of trade orientation and openness is a controversial issue. Edwards (1998) and Rodriguez and Rodrik (1999) discuss that most of the indicators are limited in measuring the 'true' degree of trade protection. While the former study investigates the robustness of various indices and concludes that there is a positive relationship

[4] The results using simple non-parametric labor productivity are similar to the ones reported in the paper and available upon request.

[5] Theoretically using gross output and three inputs, using materials in addition to labor and capital, is preferable. The value-added measure assumes that intermediate inputs and other inputs of production are separable. Even if this were the case, the estimate of productivity might be biased depending on the difference between the growth rates of intermediate inputs and output. However, in the absence of a reliable price index for materials, gross-output-based-productivity series might be as biased as value-added-based-productivity series. To test the robustness of the results when value-added-based-productivity measure is used, a gross-output-based-productivity series is constructed by assuming that materials and output pries are identical. In the appendix a plot of both total factor productivity measures are displayed. Despite higher volatility of the value-added based measure, especially during crisis years, the results reported in the paper does not change in any significant way.

between openness and productivity growth regardless of the indicator used, the latter argues that Edwards' results are sensitive to the choice of weighting and identification in estimation, and name simple tariff averages and non-tariff coverage ratios as the most preferred indicators. Togan (1996) calculates the nominal and effective protection rates and quantity restrictions for various industries and selective years in Turkey. Unfortunately, the industries are not compatible with the current study, and the selected years correspond mostly to the early 1980s. Moreover, the estimated protection rates are too different from the reports prepared in State Institute of Statistics (SIS) and State Planning Organization (SPO) in specific years (Togan, undated). Also, average tariff rates reported by Togan (1996) differ from the figures provided by Baysan and Blitzer (1990) significantly[6].

Thus, to test the effects of trade directly, the paper resorts to export and import figures instead of protection rates. The export and import figures in US dollars for each industry are obtained from the World Bank Trade and Production Database. Noting that it is quite possible that a high trade dependency ratio can coexist with heavy trade distortion, and the rate of export growth is endogenous, three variables are used to measure openness. These are TRADE, defined as the ratio of the sum of exports and imports to output, EXPOUT and IMPOUT, the growth rate of export share in total output and import shares in total domestic sales, respectively.

4. Growth in Private Manufacturing Industry

To assess the impact of international conjuncture, the empirical section starts by comparing the performance of the Turkish manufacturing industry with those of successful East Asian economies. The top panel of Table 1 shows the growth rates of value added, factor inputs and total factor productivity for East Asian economies and Turkey between 1970 and 1990. The figures for the East Asian manufacturing industries are taken from Young (1995) and they are much lower than figures provided in traditional 'miracle' accounts. Still, the performance of the Turkish manufacturing industry is nowhere close to those of the East Asian economies.

The second and third panel of the same table shows the relative performance of Turkish manufacturing, before and after trade liberalization. The loss in 1970s is recovered in 1980s to a certain extent. The negative productivity growth of the pre-reform period is reversed, and growth is much higher than the East Asian economies in the latter decade. It should be noted that despite high productivity growth in the latter years, factor inputs grew relatively little, pulling the value-added growth down. High

[6] Togan (1996) calculates an average of 72.2% nominal protection rate in 1984 as opposed to 32.2% and 20.5% in SIS and SPO reports, respectively. Baysan and Blitzer (1990) report that the average tariffs decreased from 38.8% in 1983 to 22.3% in 1984.

factor accumulation of import-substituting industrialization period is almost halved after 1980.

Table 1: Comparison of Turkish manufacturing industry with manufacturing industries of the East Asian countries

		Average Annual Growth Rate of (%)				
		Output	**Capital**	**Labor**	**Total Factor Productivity**	**Total Factor Input**
Korea	***70-90***	12.9	14.1	5.5	2.6	10.3
Taiwan	***70-90***	9.7	11.2	5.6	1.5	8.2
Singapore	***70-90***	8.5	10.7	5.4	-1.0	9.5
Turkey	***70-90***	5.0	7.6	3.5	-1.6	6.6
Turkey (Priv.)	***70-90***	5.7	8.7	4.4	-1.6	7.3
Korea	***70-80***	14.6	17.0	6.6	2.3	12.3
Taiwan	***70-80***	12.1	14.5	10.0	0.1	12.0
Singapore	***70-80***	10.3	12.3	8.6	-0.9	11.2
Turkey	***70-80***	0.6	10.0	4.4	-7.9	8.5
Turkey (Priv.)	***70-80***	1.2	13.8	4.5	-9.5	10.7
Korea	***80-90***	11.2	11.1	4.4	3.0	8.3
Taiwan	***80-90***	7.2	7.8	1.2	2.8	4.4
Singapore	***80-90***	6.7	9.0	2.1	-1.1	7.8
Turkey	***80-90***	9.4	5.2	2.6	4.8	4.7
Turkey (Priv.)	***80-90***	10.1	3.6	4.3	6.2	3.9

Figures for East Asian manufacturing industries are taken from Young (1995). Priv. refers to private manufacturing industry.

Table 2: Annual growth rates of real value-added employment and productivity

Period	Value Added	Employment	TFP
1970-1996	6.35	3.85	-0.82
1970-1980	1.22	4.48	-9.48
1980-1996	9.55	3.45	4.59
1970-1976	7.13	5.34	-7.00
1976-1980	-7.64	3.17	-13.19
1980-1988	9.77	4.91	6.27
1988-1996	9.33	1.99	2.90

4.1. Growth Performance

Table 2 provides annual growth rates of value added, employment and total factor productivity for the sample period 1970-1996 as well as for the four sub-periods. Value added in Turkish private manufacturing industry grew 6.4% per annum on average throughout the sample. Given that manufacturing industry is 'the engine of development', the observed growth rate is too slow. However, the source of low growth rate lies in years before 1980, the value-added growth after trade liberalization reached an annual rate of 9.6%, as opposed to 1.2% prior to liberalization. In fact, it is the years of balance of payment crisis during which the economy observed a dismal growth rate of –7.6% per annum. Otherwise, the growth rate between 1970 and 1976 was a decent 7.1%.

The second column of the table provides annual growth rates of employment. Considering high population growth rates and mass migration from rural areas to urban centers[7], the observed employment growth of 3.9% should be considered relatively low. Earlier research reports that opening the economy to free trade had a negative impact on employment. Indeed, employment growth dropped to 3.5% per annum from 4.5% after liberalization. However, it is after 1988, when real wages increased sharply and capital account is liberalized, that employment growth fell rapidly to 2.0% per annum from 4.9% in the early years of liberalization. Therefore, unsatisfactory employment creation

[7] The population growth rate is 2.6% per annum and the rate of migration is 1.3% per annum between 1970 and 1997.

is due to changes in factor markets rather than being a consequence of opening the economy to free trade.

In sum, relatively slow value-added growth in Turkish manufacturing industry through out the sample period is as a result of severe balance of payment crisis at the end of 1970s. Excluding those years from the calculation, the removal of barriers in front of trade provides a smaller yet significant improvement in growth rate of value added. The suppression of wages at the early phase of liberalization helped the economy to sustain employment growth. Once real wages increased, employment growth slowed considerably.

In the last column of the table, growth rates of total factor productivity, defined as in Equation (3), are provided. The average growth rate for the entire manufacturing industry for the whole sample period is –0.8%. TFP growth was negative throughout the entire 1970s. The 13.2% decline in TFP during the payment crisis years was preceded by a –7.0% annual growth rate in the first half of the 1970s. The continuing bad performance led first to a balance of payment crisis and then to the end of import-substituting industrialization despite high growth rates of output and employment prior to the crisis. TFP growth recovered after 1980, reaching the level as high as 6.3% per annum in the first phase of liberalization and dropping to 2.9% thereafter.

Dismal growth rates for productivity, especially total factor productivity, throughout the 1970s shows the demise of import-substituting industrialization in Turkey. There is very strong recovery after 1980 until 1994 when another major crisis hit the economy. Despite bad performance of the last three years of the sample, the post-1980 performance is still superior.

4.2 Growth Accounting

This section engages in a simple accounting exercise. The growth in value added is decomposed into its components obtained by re-arranging Equation (3). The purpose of the growth accounting exercise is to determine whether the source of growth is factor accumulation or technological improvement, as measured by TFP. Table 3 presents time averaged growth rates of value added and of each factor. It is apparent that growth in value added is only due to factor accumulation for the entire sample. Indeed, the contribution of TFP to value added growth is negative. The picture, however, differs when the exercise is broken down in sub-periods.

As shown in Table 3, the only source of growth throughout the 1970s was factor accumulation. It was more so for the 1970-1976 period than the following sub-period when severe balance of payment crisis made it impossible for firms to import capital goods from abroad. Lack of foreign currency interrupted production process and

sharpened the decline in TFP. If the TFP growth rate were simply zero during the first half of the 1970s, the output growth would have reached 14.5%. It should also be noted that it is mostly growth in capital stock that generated output growth; the contribution of labor is rather minimal.

Table 3: Growth accounting, 1970-1996

Period	*Value Added Growth*	*Contribution of (%)*		
		Labor	*Capital*	*TFP*
1970-1996	6.35	15.68	98.18	-13.86
1970-1980	1.22	117.94	744.87	-762.82
1980-1996	9.55	7.50	44.47	48.04
1970-1976	7.13	24.24	180.26	-104.50
1976-1980	-7.64	13.26	45.66	-158.92
1980-1988	9.77	11.83	24.01	64.16
1988-1996	9.33	2.95	65.91	31.14

After the reforms significant gains in productivity boosted output growth, in spite of further deceleration of factor accumulation until 1988. The contribution of TFP to value added growth in 16 years after liberalization is around 50%. If the sample is limited to the years prior to the 1994 crisis, TFP contributes two thirds of the output growth. The crisis disrupted a spectacular productivity growth, observed especially after 1988: TFP growth is 9.8% between 1988 and 1993 and its contribution to value added growth is around 65%. The major distinction between the two sub-periods, pre- and post-financial liberalization, is that the contribution of factor accumulation is drastically different. The 1988-1989 financial liberalization coincided with populism; real wages increased sharply in 1988 and firms responded by replacing capital for labor. Consequently, capital accumulation accounts for around two thirds of growth in the latter sub-period whereas labor's contribution is limited to a mere 3%.

The growth accounting exercise formalizes that factor accumulation was the main source of growth in the last phase of import-substitution in Turkey. The gloomy performance in terms of productivity, and the slowing down of capital accumulation due to the payments crisis towards the end of the 1970s forced a major change in policy orientation. Productivity recovered and contributed significantly to the growth of value

added in the early years of liberalization while factor accumulation slowed down. Financial liberalization that eased the transfer of currency abroad and populism in politics that increased real wages drastically caused substitution of labor with capital. A further negative effect of populism revealed itself in reduced TFP growth after the 1994 crisis and political and macroeconomic instability thereafter.

5. Trade and Productivity Growth

The analysis in the previous section is focused on the dynamics before and after reforms in Turkish manufacturing industry. The significant changes in the productivity levels and growth rates, as well as in the source of value-added growth are quite apparent. Nevertheless, the analysis does not show how much of the observed improvement is caused independently by increasing share of trade in total production. This section is investigating the effects of "openness to trade" on productivity growth.

Since the trade measures available for the analysis are subject to endogeneity, that is, higher (lower) productivity growth may cause increasing exports (imports), contemporaneous correlations would be misleading. Therefore, Granger-causality tests are chosen as the appropriate econometric methodology. However, since the data has limited time series observations for trade variables, from 1981 to 1996, the data is pooled as a panel of individual industries. To overcome inconsistency of the estimates due to the dynamic structure of the estimation equation, short time dimension of the panel, and weakly exogenous regressors, the Arellano and Bond (1991) GMM estimator is applied.

Table 4 provides the regression results. Three different measures of openness measure, trade share, export-output ratio and import-sales ratios are considered in estimation. Holtz-Eakin, Newey and Rosen (1988) emphasize the importance of testing for the appropriate lag length before testing for causality in dynamic panel data models with a short time dimension. The estimation results reported are obtained after such tests have been performed on different choices of lag length specifications.

The first three columns show the effect of lagged trade measures on total factor productivity. Both trade share and import-sales ratios are found to Granger-cause total factor productivity at all conventional significance levels. On the other hand, the coefficients of export-output ratio are insignificant though positive and joint tests also reject the null of Granger-causality. The results indicate that two of the three openness measures Granger-cause productivity, and hence opening the economy to free trade improved total factor productivity in Turkish manufacturing. However, the impact of trade in Turkey is mostly through imports either as inputs to production or indirectly through reverse-engineering. The results support the finding of Pavcnik (2002) for Chile in that productivity in import substituting industries is positively affected by trade liberalization. Lack of evidence in favor of a positive impact of increased exports on

productivity is consistent with the conclusion by Clerides et al. (1998) and Bernard and Jensen (1999).

Table 4: Testing Causality: Trade Share and Productivity

Dependent Variable	***TFP***	***TFP***	***TFP***
Explanatory Variable	***Trade Share***	***Export/Output***	***Import/Sales***
Prod(t-1)	-0.0042	-0.0886	-0.0545
	(0.0707)	(0.0722)	(0.0721)
Prod(t-2)	-0.0138	-0.0535	-0.0834
	(0.0767)	(0.0919)	(0.0738)
Pro(t-3)			
Open(t-1)	0.0002	0.0009	-0.0011
	(0.0003)	(0.0007)	(0.0019)
Open(t-2)	0.0034*	0.0023	0.0103*
	(0.0006)	(0.0014)	(0.0024)
Open(t-3)			
Signif. Level of Rest.	0.000	0.242	0.000

All equations include individual effects and a time trend (the coefficients of which are not shown here).
* indicates significance at 1%, ** indicates significance at 5% level.

Table 4 (Cont'd.): Testing Causality: Trade Share and Productivity

Dependent Variable	***Trade Share***	***Export/Output***	***Import/Sales***
Explanatory Variable	***TFP***	***TFP***	***TFP***
Prod(t-1)	-4.1592*	-0.2010	-1.7973*
	(0.8471)	(0.6266)	(0.2155)
Prod(t-2)	-3.5093*	3.2976*	-1.8091*
	(0.7724)	(0.3277)	(0.1437)
Pro(t-3)	-4.1409	2.4563*	
	(2.7030)	(0.5732)	
Open(t-1)	-0.1780*	-0.3715*	-0.1862*
	(0.0144)	(0.0079)	(0.0103)
Open(t-2)	-0.1048*	-0.1323*	-0.1193*
	(0.0137)	(0.0069)	(0.0187)
Open(t-3)	-0.2224*	-0.1673*	
	(0.0251)	(0.0052)	
Signif. Level of Rest.	0.000	0.000	0.000

All equations include individual effects and a time trend (the coefficients of which are not shown here).
* indicates significance at 1%, ** indicates significance at 5% level

The regression results about whether TFP growth causes openness measures are provided in the last three columns of Table 4. Growth in TFP was found to have a positive effect on export-output ratio and negative effect on import-sales ratio and the coefficients in both regressions are significant at usual significance levels. TFP in regression of trade share has significant and negative coefficients. That is probably due to the high level of imports throughout the sample period relative to exports.

Finally, productivity growth has been found to increase the competitiveness of domestic industries, as expected. The positive impact of lagged productivity growth on export-output ratio and negative impact on imports-sales ratio show that improvement in productivity reduces imports and increases exports.

6. Summary and Further Research

This paper studies the effects of trade liberalization on productivity in Turkey by analyzing the performance of manufacturing industry before and after trade reform. The results show that after the economy is opened to free trade there are significant improvements in productivity growth. However, the initial productivity growth right after reform declines somewhat in later years of liberalization when relative macroeconomic stability and discipline of the early years is replaced by populism. The analysis here implies that the benefits of trade reform cannot be realized unless a stable environment is not established. The results also show that factor accumulation was faster during the import-substituting industrialization period. The speculated outcome of free trade, that Turkey will specialize in relatively more labor-intensive sectors and thus employment will grow faster, is not actualized. Moreover, there is no evidence for faster capital accumulation, despite financial liberalization. The causes of these failures are left for further research.

Furthermore, increasing share of trade is found to contribute significantly and positively to the performance of the economy primarily through the imports channel rather than exports. This is yet another evidence that protectionism is not the solution to developing economy problems. The results, however, fail out to provide evidence in favor of export promotion.

A few other questions remain unanswered. The analysis here is restricted to the aggregate level. There is evidence that the growth performance of the Turkish manufacturing industry has been very volatile over time. Even year-to-year growth rates show significant variation across industries and across time, generating massive uncertainty about the future forecasts of the growth performance. A detailed analysis of the relationship between trade and the change in the distribution of productivity performance of industries is left for further research. A second question is related to the role played by the state-owned enterprises in Turkish manufacturing before and after trade reform. While their share declined drastically in total output and employment after 1980, public firms kept providing cheap inputs to private firms.

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Appendix: Data and classification of industries

Annual Surveys of Manufacturing Industry define 20 industries until 1973, the classification system has changed afterwards to have 29 industries. To be consistent throughout the entire sample, 29 industries after 1974 are collapsed to matching 20 industries of earlier classification. The surveys also differentiate public enterprises from private ones. It has been noted in early studies on Turkish manufacturing that the performance of public sector differs considerably from the private sector. Thus this paper focuses only on private manufacturing industries.

Real value added is calculated by dividing the nominal value added by sectoral price deflators. Sectoral price deflators exist for 1982-1997 period at a monthly frequency with 1981 being the base year. For each industry the sectoral deflator is extrapolated for the early years using the relation between each deflator and consumer price index, oil prices and a set of time related variables after 1982.

Labor input is total number of persons engaged. Man-hour data is available only after 1980. None of the results related to post-1980 do change qualitatively if man-hour data is used instead of persons engaged. The skill level of workers is not available for this study. Noting that average education level in Turkey rose from 3.3 years in 1975 to 5.0 years in 1990, the lack of information of human capital shall be taken into account when the results are interpreted.

The surveys report current value investment figures for each industry. The finer distinction for newly purchased goods are not available. The nominal investment figures are deflated by an aggregate investment deflator. The deflator values for post-1980 period is taken from Treasury Department. Data on earlier years are reported in OECD National Accounts. Treasury deflator is extrapolated using OECD data for years prior to 1980.

Given the series of real investment, the capital stock is a function of past investment flows. The choice of function is somewhat arbitrary, since information about asset types, asset lives and depreciation patterns across industries are not available. Two different functions are entertained in this paper, both yielding very close estimates. First one is the perpetual inventory method. The initial level of capital stock is approximated by taking the ratio of investment value added in 1950 to the sum of investment value added ratio in the next ten years. Given positive depreciation rates and long investment series prior to the initial date the perpetual inventory approach is fairly robust to the choice of capital stock estimate for the first year. Then investments are added to the capital stock by adjusting for depreciation in the existing stock.

The second approach is to construct capital stock as a delayed linear scrapping rule. This method adds newly purchased capital good to the capital stock and after a period of *s* years a constant proportion, *1/(m+1)*, is scrapped every year.

$$K_{it} = \sum_{n=1}^{s} I_{it-n} + \sum_{n=s+1}^{s+m} I_{it-n}\left[1 - \frac{n-s}{m+1}\right]$$

where K_{it} is the capital stock of industry *i* at time *t*, *I* is real investment. This is the formula used by the OECD in it's Intersectoral Database for international comparisons (OECD,1996). Following Harrigan (1999) *s* is chosen as 3 years and *m* as 7 years and capital stock is calculated from 1960 onward. The capital stock estimates reported in this paper uses the delayed scrapping approach.

Figure A.1: Value added vs. gross output based total factor productivity.

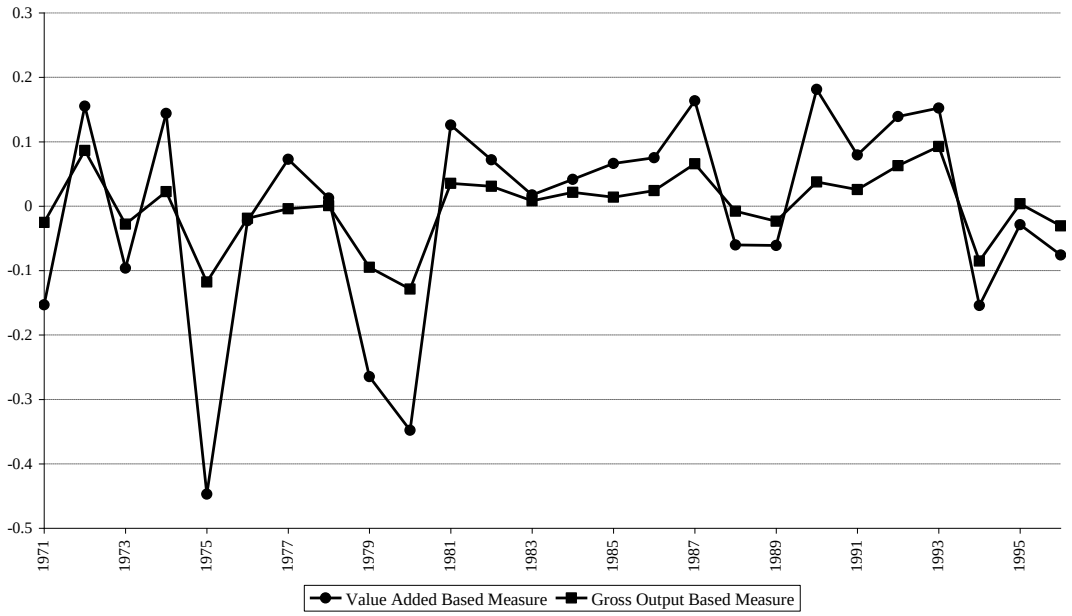

Table A.1: Industry list

ISIC3 Code	Industry	Name used in the paper
311 + 312	Food Manufacturing and Other food manufacturing	Food
313	Beverage industries	Beverage
314	Tobacco manufactures	Tobacco
321	Textiles	Textiles
322 + 324	Manufacture of wearing apparel and footwear	Clothing incl. Footwear
323	Manufacture of leather and products of leather	Leather
331	Manufacture of wood and wood and cork products except furniture	Wood
332	Manufacture of furniture and fixtures, except primarily of metal	Furniture
341	Manufacture of paper and paper products	Paper
342	Printing, publishing and allied industries	Printing
351 + 352	Manufacture of industrial chemicals and other chemical products	Chemicals
353 + 354	Petroleum refineries and miscellaneous products of petroleum and coal*	Misc. Prod. of Petroleum
355	Manufacture of rubber products	Rubber
361 + 362 + 369	Manufacture of non-metallic mineral products except products of petroleum and coal	Pottery, Glass & Minerals
371 + 372	Basic metal industry	Iron&steel,Nonferr. Metals
381	Manufacture of fabricated metal products, except machinery and equipment	Fabricated Metal
382	Manufacture of machinery except electrical machinery	Machinery
383	Manufacture of electrical machinery	Electrical Machinery
384	Manufacture of transport equipment	Motor Vehicles
356 + 385 + 390	Manufacture of plastic products not elsewhere classified, manufacture of professional and scientific equipment and other manufacturing industries	Other Manufacturing

** There are no private refineries.*