Trade Liberalization, Foreign Direct Investment, and Productivity of Russian Firms*

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The paper studies the effects of liberalization of imports and foreign direct investment on Russian firms. Using the firm-level data from 1995-2001, this paper finds that competition with imports and with FDI exerts a positive effect on domestic firms. This effect is weaker in the case of firms located in complex industries. Increased availability of imported inputs help to improve productivity of domestic firms in the mid-1990s, although the devaluation of the ruble in 1998 temporarily made firms that relied on foreign-produced inputs less competitive. Finally, entry of foreign-owned firms in post-crisis period leads to improvement in TFP of their Russian suppliers.

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The issue of the effect of trade liberalization on economic growth remains controversial in both theoretical and empirical literature. While traditional international trade literature makes clear predictions about the static effect of trade on welfare level (Helpman and Krugman (1985)), the dynamic effects are much less clear. In the case of infant industries (see, for example, Krugman (1997)), protection from international trade flows results in higher growth rates than trade liberalization. On the contrary, in the world, where firm output depends on variety of intermediate inputs, such as in Grossman and Helpman (1991), trade liberalization will speed up growth.

Import substitution was a popular paradigm of development in 1960-70, when the success of Japan and other East-Asian economies was attributed mainly to well-designed protectionist policies. However, failure of Latin American and Asian countries, such as India, to reach high growth rates using import substitution policy, undermined belief in import substitution strategies. Nowadays, creating opportunities for economies of scale and learning-by-doing is considered less important than creating correct incentives for firms to develop and to improve productivity (Krueger (1997)). Trade liberalization became a popular recommendation to countries struggling to increase their growth rates. The empirical evidence of the success of such policies is still mixed, though (at least on the macro side). The results of studies such as Sachs and Warner (1995) or Edwards(1998), who claimed that trade openness had a positive effect on growth, were recently questioned by Rodriquez and Rodrik (1999), who showed that trade liberalization and trade openness, when considered in isolation from other structural policies, have no or even negative effect on growth.

More convincing evidence of the importance of creating correct incentives comes from studies, which use micro data. A number of plant-level and industry-level studies, which uses data from for various countries (Tybout et. al (1995), Harrison (1994), Krishna and Mitra (1998), Pavcnik (1999), Lawrence(1999), etc), demonstrates that protection has a negative effect or no effect on plants' productivity, while competition with imports and trade liberalization have a positive effect. Lawrence and Weinstein (1999) question the effectiveness of protectionism and industrial policies even in such countries as Japan and Korea, which are usually considered as the most successful cases of infant-industry protectionism. Their paper provides evidence that high growth rates in these countries were mainly caused by competition with imports and availability of imported inputs.

This paper studies the effects of trade liberalization and competition with imports and foreign direct investment on the productivity of Russian firms. A number of previous studies, including Brown and Earle (2000), and Yudaeva et al. (2003), demonstrated the positive effect of competition with imports and foreign direct investment on Russian firms. In contrast to these previous studies, this paper makes an attempt to decompose this effect into the effects of competition, and the effect of availability of foreign-produced inputs. In the case of foreign direct investment, we also look at the effects from foreign-owned consumers and suppliers on domestic firms. There are a number of case studies, which demonstrate that these effects can be substantial in Russia and other transition countries.[1] Almonte and Resmini (2001) find evidence of them in Poland, but we failed to find these effects in Russia in mid-1990s in an earlier paper by Yudaeva et al (2003).

Trade liberalization and the opening- up the economy for the foreign direct investment were among the most important features of the transition policy reforms package, which was begun in Russia in the early-mid 1990s. In the Soviet Union, international trade was monopolized by the state. Export contracts were signed by the state, and state committees decided upon purchases of imported goods. Due to deficits of most consumer goods, illegal imports were not considered a significant problem. Rather, the federal and the local governments were primary concerned with the prevention of illegal exports, which worsened the deficit problem. In the early 1990s, the situation changed dramatically. Firms, most of which were privatized, received full freedom in regards to their export and import activities.[2] The so-called shuttle trade flourished: thousands of individuals and small firms became importers of consumer goods from Poland, Turkey, China and other East Asian countries. After the breakdown of CMEA trade, Russian exports of machinery declined, and primary goods started to occupy a more and more important position among Russian exports. Import penetration ratios increased to almost 50% in some consumer goods industries.[3]

It is well known that the decline of production at the start of the Russian transition was particularly long lasting and severe even for a CIS country. Since trade

[1] Smirnova (2002) studies the relationships of IKEA with its Russian suppliers. Earlier, the evidence of vertical spillovers from MacDonald's in Russia and Volkswagen in the Czech Republic were reported in Keren and Ofer (2001).

[2] The government retained control functions over export of armaments, goods which can be used both in civilian and military purposes, and some other goods.

liberalization in Russia was quite pronounced, a number of economists and a large share of the population strongly believe that trade liberalization was one of the most important (if not the most important) reasons for output decline. With the prospect of the future WTO accession, such beliefs strengthen the position of protectionists, who claim that Russia is not ready for accession, and that accession in the current situation would bring a new wave of output decline and a dramatic increase in unemployment.

Both Russian economists and policymakers agree that the modernization of Russian industry requires substantial investment. The underdeveloped financial sector does not allow firms to finance investment from the financial market. Therefore, it is often claimed that further trade liberalization would preserve and probably increase the non-competitiveness of the Russian industry, while increased protection would allow firms to accumulate necessary funds and to prepare themselves for WTO accession. The productivity study by the McKinsey Global Institute (1999) questioned this argument, and demonstrated that important productivity gains in Russia can be achieved with very modest investment. The McKinsey study also shows that, due to a lack of competition, Russian firms do not have proper incentives to implement the changes necessary to increase productivity.

Our paper provides further evidence in this direction. Using industrial firms Registry data we estimate production function in 83 industries. We then tested whether or not certain factors have positive or negative effects on total factor productivity in domestic firms. These factors include competition with foreign trade and foreign direct investment; the availability of imported materials; and the presence of foreign direct investments in vertically related sectors. Our results show that in the industries exposed to higher competition from imports and foreign direct investment, total productivity grew faster (or declined slower) than in other industries. We interpret this result as suggesting that competition with foreign goods forces domestic firms to restructure more quickly.

An additional explanation is based on the notion of a demonstration effect. In the Soviet Union, the central planning agencies considered industries which produced consumer goods to be unimportant; therefore, such industries were underdeveloped and produced goods of low quality. After trade liberalization, some of these industries experienced a particularly high inflow of imports. In order to survive in the new

[3] Strictly speaking, the overall volumes of both export and import declined in Russia in mid-1990s in comparison to late 1980s. This decline can be fully attributed to the decline in output.

situation, Russian firms started copying foreign products. This mode of development was especially successful in the food industry. We call this source of increase in firms' productivity the demonstration effect.

In addition to effects from competition in the same industry, we observe positive vertical effects. In the first part of the sample (1996-1998), firms using many imported components were more productive than other firms. In the 1999-2000 we observed a negative effect on the efficiency from using imported inputs. Given that in mid-1998 the ruble depreciated by about 50%, a negative effect of foreign produced components is not surprising. Depreciation boosted the costs of foreign produced inputs and, therefore, made firms relied on these inputs non-competitive for a while. In the 2000-2001 the negative effect had already become insignificant.

Case study evidence suggests that FDI can have a positive effect on domestic suppliers. Competition among domestic firms to become a supplier of foreign-owned firms forces domestic firms to restructure. Also there are cases of a direct influence: IKEA, for example, invested in some of its suppliers in Russia (Smirnova (2002)). We constructed a test to detect the presence of this effect in the case of Russian manufacturing firms. The results confirm the hypothesis of a positive effect in the overall sample and in before- and after-crisis sub-samples.

The paper finds that productivity growth in response to competition with imports is less pronounced in industries with more complex technologies. The breaking down of inter-firm relationships and the lack of coordination among vertically related firms, as well as search problems, can account for this result.[4] At the same time we find that industries with complex technologies started to catch up with others after the 1998 crisis.

This paper is organized as follows: section 1 begins with a description of the data; section 2 discusses the methodology, the results of the estimation of production function and the computation of firm-level total factor productivity growth (TFP); section 3 evaluates the effect of competition with imports and foreign direct investment (FDI) in TFP; section 4 concludes.

[4] Blanchard and Kremer (1997) and Roland and Verdier (1999) noticed that decline in more complex industries in Russia was deeper, and attributed this phenomenon to disorganization problems in the Russian economy.

Data

Our data come from three major sources. The firm-level information on output, employment, capital, costs of production, and wages are taken from the statistical information dataset, which was collected by Goskomstat at the Russian Industrial Firms Registry. Further, some of the data are taken from the Alba dataset and the Gnosis dataset, which have similar origins but cover different areas. The Alba data set also contains the balance sheets of the firms. The Gnosis data set includes major rows of the balance sheets, in addition to a standard set of variables of the Russian Industrial Firms Registry. In principle, all firms with more than 100 employees, as well as smaller firms with 75% of individual ownership are supposed to submit the corresponding forms to Goskomstat. Unfortunately, Goskomstat does not have enough enforcement power to compel all the firms to supply the data.[5] As a result, many firms do not provide information to the Goskomstat. New firms are particularly underrepresented in the dataset, although old firms are more frequently dropping out of it. The largest firms are also not in the dataset; information on them was either not included in the original dataset or it was dropped, due to the fact that they seemed to be outliers. The data we have are for 1995-2001. The number of firms differs from year to year; many firms that were in the sample in the early years dropped out of the dataset by the end of the period. It is unclear, though, whether firms dropped from the sample because they closed or because they simply ceased reporting information to Goskomstat. Since closure of medium and large old firms was a rare phenomenon in Russia in the 1990s, we believe that in most cases firms just stopped reporting to the Goskomstat.

Due to this problem with our dataset, we are unable to make any correction for firms exit, as in Pavcnik (1999). This means that our sample may be biased, but the direction of this bias is unclear. While exiting firms are most likely less productive than those continuing to operate, it is difficult to assess the quality of firms that stopped reporting. We can assume that the productivity of the firms remaining in the dataset is higher than that of exiting firms. It seems natural that younger and more successful management can decide to stop reporting to the Goskomstat, while old management will continue doing so by habit.

[5] Currently, Goskomstat considers switching of firm-level statistics collection from Census form to a survey form.

Another problem with this dataset is underreporting of output. In an attempt to hide profits, firms tend to underreport sales and to report costs that are higher than they are in reality. After several interactions with tax inspectors, some corrections for this underreporting can be made. However Goskomstat's report includes the first draft of firms' reports; hence, underreporting could be substantial in our dataset as a result. Unfortunately, nothing can be done to correct for this underreporting. We have to assume that underreporting is randomly distributed among all types of firms, which may be not a very good assumption.

Overall, the dataset seems to be biased toward old and non-restructured firms. In Figure 3, we report the real value added to the firms from the sample. While countrywide official statistics report high growth rates from 1999-2001, most of our firms do not demonstrate output growth in 2000.

Information on foreign-owned firms, including information on the size of the foreign stake and country of origin of the foreign investor, comes from the Registry of Joint Ventures for 1995-2000, which was also collected by Goskomstat. Before 1998, all foreign firms were present in this census, but since 1998 only firms with more than 100 employees remained in the dataset.

The main source of data on foreign trade volumes and prices of imported goods is the State Customs Committee Yearbook. This Yearbook contains information on goods imports and exports, both in value terms and in physical quantities by country of origin and destination. In many cases, information on prices is also available. Since 1995, these data have been compiled from customs declarations. In the case of imports, price and in some cases volume information, is not particularly reliable, even in the later years. Customs in Russia are corrupt, and Russian importers tend to bribe corrupt officials and underestimate the value of their imports in order to save on import duties and value added tax. In the mid-1990s, a very common way of cheating was to assign goods to a category, which fell into a smaller tariff rate (turkey instead of chicken, for example). Tariff rates were recently unified, by and large, and the nature of cheating changed. At present, Russian customs publish minimum prices at which goods can be imported. Anecdotal evidence suggests that these minimum prices are mainly used in customs declarations as prices of purchase. Due to cheating, price information in State Customs Committee data often has little relation to reality, and import volumes are severely underreported. The size of underreporting is estimated to be anywhere between 20 (in the mirror

statistics) to 80 (according to anecdotal evidence) percent.[6] As in the case of production, we cannot correct for underreporting, and we must assume that it does not seriously depend on goods characteristics. We mainly use trade statistics to compute import ratio to production volumes. Since both the numerator and the denominator suffer from underreporting, the resulting ratios may not be far from the true ratios.

For most goods, import and export data are available in 4-digit HS classification, and for a large number of goods we have 6 (or even 9) digit HS data. One of the most complicated data problems for this paper was matching trade and firm-level data. Firm data contain the code of the industry, to which the firm belongs, which is assigned according to the Soviet-Developed OKONH industry classification. These codes were sometimes assigned in the beginning of 90s and may not reflect actual production structure of the firms. Therefore, we had to use firm-level data on the range of goods produced in each firm to construct the correspondence code between the two databases and to construct the shares of imports in industry production. Information on prices is often not reliable; hence, we used physical volumes whenever possible to construct the shares of imports in production. The appendix describes the matching procedure in more detail. Since both trade statistics and firm level statistics on the range of goods produced contain several missing variables, we had to fill in some of the missing variables with the numbers for neighboring years. Without this procedure, the range of goods on which ratios of import to production are computed would have been very unstable from year to year. We use the ratios of import to production with filled missing values in our computations.

Input-output matrices, price data, regional characteristics, industrial production and other data were obtained from various Goskomstat publications.

Production Function Estimation

Following the literature, we obtained firm-level TFP data by estimating production function. We computed value added using data on sales, total costs of production, and wage bill. In the Alba and Gnosis datasets we have information on costs of production that are reported as a proportion of output. Unfortunately, this information for 1998 is absent from all datasets we used. We constructed the cost data for 1998 using the cost data for 1997 and information on the share of imported components from the input-

[6] Kozlov (2002) describes functioning of Russian customs, and presents different estimates of underreporting.

output matrix for 1995. Since the devaluation of the ruble happened in the second half of 1998, we assume that most of the firms did not have time to adjust inputs structure, i.e. to replace imported inputs with domestic inputs, by the end of the year. The value of imported inputs in 1997 was obtained by multiplying 1997 costs of inputs by the shares of imported inputs, which were taken from the 1995 input-output matrix for the corresponding industry. Domestic inputs were computed as a difference between total material inputs and imported inputs. To compute the costs of production in 1998, we multiplied the domestic part of intermediate inputs by the 1998 industrial-producer price index, and we multiplied the imported part by the 1998 year-average exchange rate.

All information in the Industrial firms' census dataset is in current rubles. To make the data comparable across years we constructed deflators for each 5-digit OKONH industry.[7] Yearly deflators were constructed by weighting monthly PPIs by monthly industrial production, as reported by Goskomstat. Capital deflators were obtained in a different manner. The value of a firm's capital stock is subject to revaluation as of the 1st of January. Hence, the reported figures on the end-of-year and beginning-of-year value of capital stocks differ by the revaluation coefficient. We computed these revaluation coefficients and used them as deflators for the capital stock.

The production functions are estimated separately in each of the 83 industries. The list of industries and the number of firms are reported in Table 1. Production function coefficients can differ across these groups of industries. We chose a translog production function specification because it allows for non-linearities of factor inputs, which are likely to be present on the industry level. The estimated equation has the following form:

$$\ln VA_t = \alpha_0 + \alpha_L \ln L_t + \alpha_K \ln K_t + \alpha_t t + \alpha_{KK} (\ln K_t)^2 + \alpha_{LL} (\ln L_t)^2 + \alpha_{tt} t^2 + \\ + \alpha_{LK} \ln L_t \ln K_t + \alpha_{Lt} \ln L_t \cdot t + \alpha_{Kt} \ln K_t \cdot t$$

Where: *VA* refers to value added, *L* stands for the year average employment, *K* is the year average level of capital. We estimated the equations using OLS, fixed and random effect specifications. We dropped outliers (1% of observations from each side) from the estimation sample. As we mentioned before, we cannot control for selection bias due to exit of firms from business and from the dataset due to non-reporting. However, there are arguments for assuming that all types of firms (both

more and less productive than the average ones) may drop out from the dataset, so we hope that the bias due to non-correction is not large.

In Figure 1 we report changes in the marginal products of labor and capital; elasticities of the value added over labor and capital ($\eta_{L,t}, \eta_{K,t}$) averaged over 2-digit OKONH industries. We used random effect estimation results to construct the graph, although the results of other estimation methods are very similar to this. As shown in the graph, our estimated coefficients of the production function are quite plausible. Capital elasticity is usually quite low, while labor elasticity is quite high. The elasticities are more or less stable across years.

The TFP growth rates were then calculated using the following procedure, suggested in Jorgenson (1995):

$$\ln(A_{t+1}/A_t) = \ln(VA_{t+1}/VA_t) - \overline{\eta}_K \ln(K_{t+1}/K_t) - \overline{\eta}_L \ln(L_{t+1}/L_t)$$

where $\overline{\eta}_K = (\eta_{K,t+1} + \eta_{K,t})/2$, $\overline{\eta}_L = (\eta_{L,t+1} + \eta_{L,t})/2$,

$$\eta_{K,t} = \frac{\partial \ln VA_t}{\partial \ln K_t} = \alpha_K + 2\alpha_{KK} \ln K_t + \alpha_{LK} \ln L_t + \alpha_{Kt} t,$$

$$\eta_{L,t} = \frac{\partial \ln VA_t}{\partial \ln L_t} = \alpha_L + 2\alpha_{LL} \ln L_t + \alpha_{LK} \ln K_t + \alpha_{Lt} t.$$

The estimates of TFP produced from fixed effect, random effect and OLS estimations of production function are quite similar. The correlation coefficient between TFP growth rates obtained from different methods is above 96%.

TFP declined across all firms and industries from 1996 to 1998 (see Figure 2). In 1999, TFP increased sharply in almost all industries with the exception of the food industry. This trend was followed by a decline in the year 2000 of TFP in metallurgy, chemical and petrochemical, timber and paper, and food industries (i.e. in industries with a high proportion of export-oriented production). This trend was also followed by a reduction of growth rates in electricity and fuel, machinery, and light industries. This result seems to be at odds with the official statistics, which report very high growth rates in 2000 in all sectors, including in export-oriented sectors. We mentioned above that the largest firms were not included in the sample. It is possible that, while the largest, restructured exporting firms were growing in 1999, the middle-sized firms, included in our sample, were not yet able to adjust to real appreciation, which started in that year. For 2001, we observed TFP growth in almost all industries.

[7] Some of the industries correspond to 4-digit, rather than 5-digit industries.

With the exception of 2000, TFP dynamics that we report are similar to those obtained in the studies based on macro data (Dolinskaya (2001)).

Effects of foreign trade and FDI on Russian firms.

The abolition of the state monopoly in trade in the early 1990s resulted in a significant increase in foreign competition for most Russian manufacturing firms. As our computations (see Table 2.1) show, by the mid 1990s, the ratio of import to production was particularly high in industries producing consumer goods (textile, furniture, electronics and some machine-building industries), where the quality of the goods produced by Russian firms was seriously lagging behind international standards. Domestic production of some consumer goods declined dramatically, and in some cases firms changed their specialization or closed down.[8] At the same time, in many cases, the increase in foreign competition was accompanied by massive improvements in the quality of goods produced by domestic firms, and the appearance of new domestic firms, which were able to successfully compete with foreign producers.[9]

The main question is, of course, which of these two processes dominated, i.e. whether most import competing firms had to close down, or were able to restructure. Another interesting problem is to find factors, which influence firms' ability to adjust to foreign competition.

We begin answering these two questions by presenting some simple graphical evidence. We divided all sectors into five groups according to the level of their exposure to foreign trade:

- export oriented (with export share more than 30%, import share less than 30% and a low intra-industry trade index),
- import competing (with import share more than 30%, export share less than 30% and a low intra-industry trade index),
- import competing with high import shares (a subgroup of import competing industries with import share more than 80%),
- with high intra-industry trade (IIT index more than 50%), and
- non-traded.

[8] Russian classification of industries OKONH failed to trace the changes in firms' specialization. We found a lot of cases in our dataset, when firms were mainly producing goods others, than the one, which are included in the definition of their OKONH industry. Relatively small ratios of import to production in such industries as electronics can be explain by this fact.

[9] Food processing is a good example of such an industry.

Figure 3 shows cumulative changes in value added, total factor productivity, labor, and capital in the 5 groups of firms. Import-competing firms, particularly those located in the sectors with very high import/production ratios, experienced one of the highest TFP growth rates among all groups of industries. They tend to outperform both exporting and intra-industry trade industries. Industries producing non-traded goods outperformed all other industries in 1999, the year following the devaluation, but their TFP growth slowed down afterwards, when the real exchange rate started to appreciate. This asymmetry between non-traded goods production and import-competing industries can be explained by the fact that import competing sectors often rely heavily on imported inputs. As we report in Table 2.2, our measure of imported inputs is twice as high in the case of import-competing sectors than in the case of non-traded sectors.

In addition to liberalization of imports, inflows of foreign direct investment in Russia were allowed in the late 1980s. It is well known that Russia is lagging behind other transition economies in terms of attracting FDI. Nonetheless, the share of production by foreign-owned firms has reached significant amounts, particularly in recent years (see Table 2.3). As Yudaeva et al (2003) show, competition with FDI plays an important role in improving domestic firms' productivity, particularly in regions with high human capital. Below, we use regression analysis to more formally evaluate the effect of increased access to foreign goods on productivity of domestic firms.

Finally, it is often believed, that exporting firms are more efficient, because they directly compete in the international market. It is unclear, though whether such firm are expected to restructure faster than other firms. Since they are already more efficient, they may need smaller improvements in the future.

Regression results

To get more precise evidence on the effect of trade openness and liberalization of FDI on Russian firms, we used regression analysis. We tested for the effect of the following variables:

1. Competition with imports, measured by the ratio of import to production of the same good. The effect of competition can be both positive and negative. The former result is possible, when competition forces domestic firms to

restructure, and the latter result implies that competition mainly leads to driving domestic firms out of the market.

2. Competition with FDI, measured by the share of production of foreign-owned firms in the total production of the industries, in a breakdown available in input-output matrix. As in the case with the effect of import competition, this effect can be both positive and negative.
3. The availability of imported inputs. For each firm, we compute a proxy of this effect using the following formula: $imi_i = \sum_j shi_j * io_{i,j}$

   where imi_i is the share of imported inputs in total inputs, used in production of industry i, shi_j is the import/production ratio in industry j, $io_{i,j}$ is the share of industry j in the total inputs, used in industry i. The $io_{i,j}$ coefficients are taken from the input-output matrix.[10]
4. The presence of foreign-owned firms in the industries, producing inputs for the domestic firm. As in the case of imported inputs, we expect this effect to be positive: the better the inputs, the better is the quality of the final product, and, therefore, the higher is the TFP of the firm. The proxy for this effect is computed using a formula similar to the one for the availability of imported inputs proxy.
5. The presence of foreign-owned firms in the industries, which consume products of the firm (consuming industries). Several case studies (Smirnova (2002), Keren and Ofer (2000)) demonstrated that entry of foreign-owned firms leads to improvements in the quality of suppliers. The effect can be indirect: in order to supply goods to the foreign firm, domestic producers attempt to increase the quality of their products. The direct influence, when a foreign producer invests in its suppliers or helps them with improvements of the design of their products, has also been observed in Russia. We computed a proxy for this effect using the following formula: $fdic_i = \sum_j shfdi_j * ioc_{i,j}$,

   where $fdic_i$ is the proxy for FDI in the industries, which use products of industry i as inputs, $shfdi_j$ is the share of production by foreign-owned firms in

[10] Earlier on, we mentioned that input-output matrix contain information on the share of imported inputs. Unfortunately, this information exists only in a very aggregated form, i.e. for 2 digit industries. In addition, input-output matrixes are not computed every year. Therefore, we prefer to include in regression equation indirect measure of imported inputs

industry j, and ioc_{ij} is the share of production of industry i , used as inputs in industry j.

Unfortunately, we were able to compute this proxy only for the industrial foreign-owned firms. It would be extremely interesting exercise to do it for the service sector, if the corresponding data on domestic firms were available.

6. Exporting activities of the firm. We use firm export/output ratio to measure the intensity of foreign trade operations. Unfortunately, this variable may suffer from severe underestimation. Firm level data have information on exporting activities only for 1996-97. In the later years, we used custom declaration statistics to obtain the value of exports. Many, or even most of Russian firms rely on intermediaries in their exporting activities. Custom statistics does not trace goods to the producer, and, therefore, export data we use suffer from underreporting.

Other control variables were included in the regression equation because of the following consideration. It may be more difficult for large firms to improve their TFP (or they may face higher pressure from the local government to not decrease labor), and we tried to measure this effect by including log of employment in the regression. In the case of capital-intensive production processes, improvements in TFP may require higher investment in capital, and this effect is controlled for by including the capital-labor ratio. Industry structure can have an effect on firm's incentives to restructure (Brown Earle (2000), Djankov and Murrell (2001)). In particular, monopolies or firms facing less domestic competition can have weaker incentives to restructure. There are two proxies for this effect in our regressions: a 5-digit industry Herfindahl-Hirschman index and the share of the firm in total sales of its 5-digit industry and region. Both measures could be included in the regressions since the correlation between them is quite low (around 0.3). We used the coefficient of variance of PPI in the industry as a measure of uncertainty. Finally, we included PPI in the industry with a combination of year dummies for controlling for exchange rate changes. Sectoral dummies are also included in all specifications.

As a dependent variable, we used TFP estimates, obtained using a random effects estimation procedure. Equations are estimated using random effects and instrumental variables random effects estimation methods. As instruments for import competition, quality of intermediate inputs and export to output ratio, we used their lags. Tables 3-4 report the results. Since we do not have FDI data for 2001, we report

separately results for 1996-2001 without controls for FDI, and for 1996-2000 with controls for FDI. In the overall sample 1996-2001, all import-related effects are positive and significant in both specifications (Table 4, columns 1-2). However, the results of estimation of this equation in sub-samples for 1994-1998 and 1999-2001 are somewhat different. In the sub-sample for the earlier period, most of which precedes the 1998 financial crisis in Russia, competition with imports is insignificant, while the imported inputs variable is positive and highly significant. In the post-crisis period, import competition became positive and significant, while the effects of imported components became negative and significant. This later result can be easily explained by the devaluation of the ruble, which happened in 1998: foreign-produced inputs became too expensive, and firms that relied on such inputs lost some of their competitiveness in comparison to firms relying on domestic inputs only. This negative effect tends to disappear quickly, though. In the sample for 2000-2001, the coefficients at imported inputs are much smaller than in the 1999-2001 sample, and they are insignificant.[11] Interestingly, the export/output variable is insignificant, and in some specifications it is negative, such as in the 1999-2001 sub-period. This may be related to the construction of the variable: as we mentioned above, it suffers from underreporting. Alternatively, our results may suggest that average-sized exporting firms benefited from devaluation less then the larger ones.

In Table 4 we report the results for 1996-2000, where we included proxies for competition and vertical relationships with foreign-owned firms. In the overall period, spillovers from FDI in the same industry were positive and significant at the 10% level. In the first sub-period, spillovers were positive, highly significant, and larger in the absolute values than in the overall period. In the second sub-period spillovers remained positive, but became insignificant. This finding is difficult to explain; it may be related to the fact that some foreign-owned firms closed after the 1998 crisis. Spillovers from foreign-owned firms to import-competing firms were negative but insignificant in the first sub-period, while they became positive, but still insignificant, in the second sub-period. Surprisingly, the coefficient at the share of FDI among suppliers is always negative and significant. At the same time, FDI in consumers is positive and significant in all specifications and sub-periods. This result corresponds to anecdotal evidence on the positive effect of FDI on downstream industries in transition countries.

[11] Results of this estimation are not reported in the paper, but available upon request.

For firms in import-competing industries the coefficient at FDI share among consumers was negative and significant in the before-crisis sub-sample and became positive and significant in 1999-2001, which could be easily explained by the fact that foreign-owned firms switched to inputs produced by Russian firms after the ruble devaluation.

In all regressions, the coefficients at the control variables almost always coincide with our intuition. Productivity growth in larger firms and firms with higher capital/labor ratios was smaller than in other firms. Firms in the sectors with larger market shares experienced higher growth of productivity, while in most of cases the concentration ratio is negatively related to productivity. For some reason, higher variance of PPI corresponds to higher productivity growth.

Complexity and reaction to competition

It is well known that during the transition period Russian specialization was increasingly shifting towards primary goods production and away from production of more complex products. Blanchard and Kremer (1997) attributed this relatively deeper decline in more complex industries to the disorganization of the Russian economy. They claim that in more complex industries, the breaking down of relationships between firms had a more detrimental effect on growth than in the less complex ones. Roland and Verdier (1999) suggest that search problems are more complicated in more complex industries, which can also affect their output pattern. Additionally, we can claim that in more complex industries, restructuring can be slower because it requires the coordination of restructuring efforts of many firms.

We tested whether restructuring in response to import and FDI competition was slower in more complex industries. The level of complexity was computed from input-output matrixes using methodology, suggested by Blanchard and Kremer (1997). We included in the regression the complexity variable itself and its cross-term with other dependent variables. Interestingly, the complexity index itself is positive, and almost always significant in all specifications and sub-periods (Table 5). The only exception is instrumental variables regression for the first sub-period, when this variable is negative, but insignificant, and negative and close to significance in the import competing sub-sample. Thus, we found weak evidence that complex industries were indeed restructuring slower prior to the 1998 crisis, while afterwards they started to catch up. The coefficient at the cross-term between complexity index and import output ratio is negative and sometimes significant, or positive and insignificant in all

specifications. This finding suggests that, indeed, for complex industries it is more difficult to coordinate and to restructure in the presence of import competition.

Conclusions

In view of the forthcoming Russian accession to the WTO, the issue of the effects of trade liberalization on the Russian economy became a common topic of discussion. A number of economists, politicians, and businessmen claim that only strengthening protection, instead of further liberalization of foreign trade, will help to restructure the Russian economy. This paper provides evidence to the contrary: increased competition with foreign goods or goods produced by foreign firms leads to faster restructuring of domestic firms, either because of improved incentives or because of better opportunities for reverse engineering, or both. Unfortunately, this effect is not yet true in the case of complex industries. However, other things equal, industries with more complex technological processes started to grow faster than other sectors after 1998 crisis.

There are a number of other factors, which help to increase the benefits of trade and FDI liberalization. The list of such policies includes improvements in the financial sector, regional bureaucracy, and labor mobility. More research is needed to reveal the influence of these factors on the ability of firms to restructure.

The 1998 crisis weakened the position of firms that relied on foreign-produced inputs or worked for foreign-owned companies. This factor did not allow us to give a decisive answer on the question of how important these two channels are for improvements in Russian firms' TFP. Evidence from the later periods will help to shed light on this issue.

References

Almonte, C. and L. Resmini (2001)"Multinational corporations as catalyst for industrial development: the case of Poland," ISLA-Bocconi University, Milan, Working paper 368.

Blanchard, O., Kremer, M. (1997), "Disorganization", Quarterly Journal of Economics, 112 (4), 1091-1126

Brown, D., and Earl, J. (2000a) Competition and Firm Performance: Lessons from Russia, CEPR Discussion Paper No.2444

Djankov, S. and P. Murrell (2002) "Enterprise Restructuring in Transition: A Quantitative Survey" Journal of Economic Literature, forthcoming.

Dolinskaya, I., (2001) Explaining Russia's Output Collapse: Aggregate Sources and Regional Evidence, IMF Working Paper

Edwards, S. (1998), "Openness, Productivity and Growth: What Do We Really Know?" Economic Journal 108, pp. 383-398.

Grossman, G. and E. Helpman (1991) *Innovation and Growth in the Global Economy*. Cambridge, The MIT Press.

Harrison, Ann E. (1994). "Productivity, imperfect competition and trade reform," *Journal of International Economics* 36, pp.53-73

Helpman, E. and P. Krugman (1985) *Market Structure and Foreign Trade.* The MIT Press, Cambridge, Massachusetts, London, England.

Jorgenson, D. (1995) *Productivity. Volume 1. Postwar U.S. economic growth.* Cambridge and London: MIT Press

Keren, M. and G. Ofer (2001), "FDI and the restructuring of trade and supply networks," Department of Economics, Hebrew University of Jerusalem, paper presented at the annual meeting of ACES, New Orleans, January 4-7, 2001.

Kozlov, K. (2002). "Russian customs", *mimeo,* CEFIR

Krishna, P. and D. Mitra (1998) "Trade liberalization, market discipline and productivity growth: new evidence from India." *Journal of Development Economics,* 56(2) pp.447-62.

Krugman, P. (1987) "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies," Journal of Development Economics 27, pp. 41-55.

Krueger, Anne (1997) "Trade Policy and Economic Development: How We Learn," American Economic Review, Vol. 87, no. 1 (March 1997): 1-22.

Lawrence, R.(1999) "Does a kick in the pants get you going or does it just hurt? The impact of international competition on technological change in US manufacturing" in Robert Feenstra (ed.) *Globalization and Wages*, Chicago: University of Chicago Press.

Lawrence, R. and D. Weinstein (1999)"Trade and growth: import-led or export-led? Evidence from Japan and Korea," NBER Working Paper 7264.

McKinsey Global Institute, (1999) Russian Economy: Growth is Possible. Moscow, October 1999

Pavcnik, N. (1999) "Trade liberalization, exit, and productivity improvements: evidence from Chilean plants", NBER Working paper 7852.

Roland, G., Verdier, Th., 1999, "Transition and the Output Fall", *Economics of Transition*, 7 (1)

Rodriquez, F. and D. Rodrik (1999), "Trade policy and economic growth: a skeptic's guide to the cross-national evidence," NBER Working Paper 7081.

Sachs J. D., Warner A. M., (1995), Economic reform and the process of global integration," Brookings Paper on Economic Activity, Vol.1, pp.1-118.

Smirnova, A. (2002) "The spillover effect of FDI on the productivity of Russian firms", master thesis, New Economic School, Moscow, Russia

Tybout, James, R. and M. Daniel Westbrook (1995). "Trade Liberalization and the Dimensions of Efficiency Change in Mexican Manufacturing Industries," *Journal of International Economics* 39, pp.53-78.

Yudaeva, K., Kozlov, K., Melentieva, N., Ponomareva N., (2003), Does Foreign Ownership Matter? Russian Experience, *Economics of Transition, Volume 11(3).*

Appendix: Construction of import/output ratios.

We used firm level data on the physical volumes and values of production of each commodity to construct firm-specific import/production ratios. By comparing commodity names, we constructed correspondence between domestic production and HS classification of import for each good. Then individual I/P ratios were computed separately for each good. For homogeneous commodities physical volumes were used. When information on physical volumes was not available, I/P ratios were computed in monetary terms (if available).

At the next step we computed firm-level I/P ratio by weighting individual commodity ratios by the degree of presence of particular commodities in enterprise's output. This weighting procedure can suffer from endogeneity problem, if enterprises change their production pattern in response to changing import pressure. The only change in variability of I/P ratio should be the change in individual I/P ratios of each commodity. To overcome endogeneity problem, weights should not change from year to year. Hence, we summed up production of each good over all years for every firm, and then computed weights of each good produced using this aggregate production levels. We used 1999 export prices to sum up commodities reported in real terms with those in monetary terms.

I/P ratios for industries were constructed in a similar way to I/P ratios of firms. In this case, volumes of goods produced were summed up for the entire industry.

Table 1
Industry List and Number of Firms in the Sample[1]

Code	Industry Name	1995	1996	1997	1998	1999	2000	2001
	Energy and Fuel							
1	Electricity	429	398	292	377	733	345	672
2	Oil and gas	89	80	56	68	166	68	137
3	Coal	168	116	87	79	161	85	147
4	Peat	77	47	35	29	57	36	41
	Metallurgy							
5	Ferrous	234	190	121	116	217	151	210
6	Non-ferrous	103	67	43	0	85	48	66
	Chemical and petrochemical							
7	Chemical	403	280	179	180	381	224	333
8	Petrochemical	136	94	75	66	118	81	110
	Machinery							
9	Equipment for energy sector and metallurgy	77	61	44	47	90	51	80
10	Mining equipment	40	39	30	29	41	33	48
11	Lifting and transportation machinery	75	61	26	32	74	57	76
12	Railroads machinery	51	46	29	44	57	38	55
13	Electro-technical equipment	385	305	195	223	367	258	429
14	Equipment for chemical and oil machinery	130	114	74	75	124	102	139
15	Machine-tool construction	136	92	61	70	104	81	117
16	Tool-making industry	114	84	54	70	130	62	136
17	Equipment for inter-industry production activities	84	60	33	36	87	40	98
18	Instrument-making industry and computer engineering	246	194	119	131	223	146	222
19	Automobile and bearings industries	234	179	128	118	256	154	297
20	Tractors and agricultural machinery	202	122	104	76	178	131	182
21	Equipment for road construction and public utilities sectors	186	129	85	79	155	118	163
22	Textiles equipment	60	44	21	29	46	25	51
23	Equipment for food industry and mixed fodder industry	82	64	35	35	67	49	66
24	Other technological equipment and household devices and machines	77	50	35	32	64	30	72
25	Sanitary and gas equipment	88	62	37	40	80	42	86
26	Aircraft industry	82	68	41	8	0	2	8
27	Defense industry	129	115	74	3	0	7	20
28	Shipbuilding industry	87	72	47	2	0	3	5
29	Radio industry	86	70	39	2	0	0	4
30	Communication means industry	75	58	29	4	0	2	8
31	Electronic industry	185	139	80	4	0	21	30
32	Other machinery industries	69	46	28	1	0	8	7
33	Production of metal constructions	177	127	72	48	129	87	150
34	Production of assembled buildings and metal goods	258	164	111	97	217	140	239
35	Metal goods for non-production use	81	46	22	34	59	36	56
36	Repair of machinery and equipment	1,723	1,206	785	787	1,536	882	1,286
	Timber, paper and woodworking industry							
37	Timber cutting industry	1,064	702	424	414	875	370	584
38	Timber (sawing) industry	255	145	97	90	220	86	222
39	Timber processing industry (not incl. sawing)	294	177	114	126	253	123	249
40	Production of furniture	523	291	179	170	348	206	320
41	Other timber processing industries	87	50	35	36	66	40	63
42	Cellulose paper, and timber-chemical industry	175	122	81	76	152	106	142

[1] In most cases, industry in this list correspond to a 5-digit OKONH industries. Although, if the number of firms in a 5-gidit industry was too small, several 5-digit industries were combined into one industry.

Table 1 (continued)

Code	Industry Name	1995	1996	1997	1998	1999	2000	2001
	Construction materials industry							
43	Cement, asbestos-cement goods and soft roofing and hydro-isolating materials industry	83	65	46	51	77	67	80
44	Assembled reinforced concrete and concrete constructions and products industry	799	554	345	291	537	373	564
45	Wall materials industry	566	368	252	276	412	223	411
46	Construction ceramics and polymeric materials industry	49	43	16	25	62	26	69
47	Non-ore construction materials industry	235	158	118	136	196	125	201
48	Facing materials, porous fillers, lime and gyps materials industry	135	94	59	75	108	59	112
49	Heat-isolating materials, asbestos, materials from non-metal ores industry	139	106	59	68	123	59	132
50	Glassware, chinaware, faience industry	133	92	69	80	120	78	105
	Light industry							
51	Primary processing of flax and wool	127	57	42	25	86	76	92
52	Cotton, linen, wool and silk industries	288	186	121	93	241	175	264
53	Non-woven materials, hemp, net-making industry	49	40	17	16	37	32	38
54	Fancy goods textile	46	36	14	21	38	33	36
55	Knitted wear industry	266	149	86	72	193	109	182
56	Felting industry	49	28	25	27	39	24	37
57	Sewing industry	1,302	876	611	468	1,168	635	1,075
58	Leather industry	118	79	51	32	85	59	89
59	Fur industry	56	36	36	21	56	26	50
60	Footwear industry	253	166	106	72	226	105	211
61	Other textiles	48	31	24	19	42	32	41
	Food industry							
62	Sugar industry	85	44	28	39	71	57	73
63	Baking industry	1,502	1,086	787	672	1,172	765	1,015
64	Confectionery industry	290	186	118	187	204	120	175
65	Pasta making	58	41	28	34	49	31	50
66	Oil and fat industry	78	54	37	44	69	52	79
67	Fragrance and cosmetics	26	14	6	9	25	20	26
68	Spirits industry	90	75	42	43	81	61	99
69	Liqueur and vodka industry	105	85	72	92	163	79	162
70	Wine industry	91	58	41	36	94	54	82
71	Beer industry	185	120	93	109	158	96	157
72	Non-alcohol beverages industry	80	40	25	27	84	32	92
73	Fruit and vegetable industry	172	94	80	76	153	87	127
74	Other food industries	122	94	60	61	118	81	118
75	Meat and poultry industry	524	353	223	127	363	202	383
76	Butter, cheese and milk industry	1,283	698	561	422	903	661	860
77	Fish industry	288	187	100	72	211	80	172
	Other							
78	Microbiology industry	25	24	19	17	27	25	26
79	Flour-grinding and cereals industry	257	226	150	105	257	178	246
80	Mixed fodder industry	147	114	56	50	139	98	119
81	Medical industry	143	130	87	122	175	99	161
82	Polygraphic industry	886	748	514	686	779	611	683
83	Other industrial productions	486	380	242	292	516	277	456
	Total	20,920	14,591	9,722	9,173	17,573	10,656	16,576

Table 2.1
Ratios of Import to Output by Firm

		1995	1996	1997	1998	1999	2000	2001
Import Competing	**mean**	0.20	0.24	0.27	0.24	0.21	0.20	0.28
	st. dev.	0.14	0.15	0.17	0.16	0.17	0.16	0.19
Export Oriented	**mean**	0.10	0.11	0.13	0.12	0.11	0.11	0.14
	st. dev.	0.16	0.18	0.18	0.18	0.17	0.16	0.18
High Intra-Industry Trade	**mean**	0.16	0.19	0.22	0.22	0.25	0.28	0.29
	st. dev.	0.20	0.20	0.22	0.21	0.20	0.21	0.23
Non Traded	**mean**	0.10	0.12	0.13	0.13	0.11	0.11	0.13
	st. dev.	0.18	0.20	0.21	0.21	0.19	0.19	0.21
Import Competing with High Import Share	**mean**	0.33	0.44	0.44	0.41	0.36	0.34	0.42
	st. dev.	0.23	0.28	0.26	0.26	0.27	0.24	0.27
Total	**mean**	0.16	0.19	0.21	0.19	0.17	0.17	0.21
	st. dev.	0.19	0.22	0.23	0.22	0.21	0.20	0.23

Table2.2
Share of Imported Inputs by Industry

		1995	1996	1997	1998	1999	2000	2001
Import Competing	**mean**	0.11	0.16	0.18	0.17	0.15	0.15	0.17
	st. dev.	0.04	0.06	0.07	0.06	0.05	0.05	0.05
Export Oriented	**mean**	0.07	0.09	0.10	0.08	0.07	0.08	0.10
	st. dev.	0.04	0.05	0.06	0.05	0.04	0.05	0.06
High Intra-Industry Trade	**mean**	0.10	0.14	0.15	0.13	0.13	0.13	0.17
	st. dev.	0.05	0.05	0.07	0.07	0.07	0.06	0.06
Non Traded	**mean**	0.08	0.11	0.12	0.10	0.09	0.09	0.12
	st. dev.	0.04	0.05	0.05	0.05	0.05	0.04	0.05
Import Competing with High Import Share	**mean**	0.14	0.20	0.21	0.19	0.17	0.16	0.21
	st. dev.	0.07	0.09	0.09	0.08	0.07	0.06	0.07
Total	**mean**	0.09	0.13	0.15	0.13	0.11	0.11	0.14
	st. dev.	0.05	0.07	0.07	0.07	0.06	0.06	0.07

Table 2.3
Share of Foreign-Owned Firms Production in the Total Production by Industry

		1996	1997	1998	1999	2000
Import Competing	**mean**	0.06	0.07	0.07	0.11	0.17
	st. dev.	0.09	0.11	0.11	0.12	0.16
Export Oriented	**mean**	0.13	0.13	0.18	0.20	0.34
	st. dev.	0.12	0.10	0.14	0.13	0.15
High Intra-Industry Trade	**mean**	0.05	0.05	0.15	0.23	0.19
	st. dev.	0.06	0.06	0.15	0.24	0.19
Non Traded	**mean**	0.03	0.04	0.06	0.10	0.14
	st. dev.	0.09	0.10	0.09	0.15	0.17
Import Competing with High Import Share	**mean**	0.07	0.09	0.12	0.15	0.21
	st. dev.	0.08	0.10	0.13	0.14	0.17
Total	**mean**	0.05	0.06	0.08	0.12	0.17
	st. dev.	0.10	0.10	0.11	0.14	0.17

Table2.4
Complexity

Import Competing	**mean**	0.73
	st. dev.	0.19
Export Oriented	**mean**	0.72
	st. dev.	0.10
High Intra-Industry Trade	**mean**	0.81
	st. dev.	0.09
Non Traded	**mean**	0.77
	st. dev.	0.13
Import Competing with High Import Share	**mean**	0.82
	st. dev.	0.12
Total	**mean**	0.76
	st. dev.	0.15

Table 3
Total Factor Productivity Growth Regressions. Panel random effects.

	All Industries						Import Competing Industries					
	1996-2001		1996-1998		1999-2001		1996-2001		1996-1998		1999-2001	
Variables	**[1]**	**[2] IV**	**[3]**	**[4] IV**	**[5]**	**[6] IV**	**[7]**	**[8] IV**	**[9]**	**[10] IV**	**[11]**	**[12] IV**
log employment	-0.023 [5.84]**	-0.022 [5.89]**	-0.033 [5.98]**	-0.046 [3.41]**	-0.015 [2.52]*	-0.013 [2.49]*	-0.018 [2.82]**	-0.016 [2.48]*	-0.023 [2.43]*	-0.017 [0.23]	-0.007 [0.74]	-0.003 [0.29]
capital/output ratio	-0.039 [16.94]**	-0.036 [16.11]**	-0.043 [15.30]**	-0.037 [13.78]**	-0.033 [7.42]**	-0.027 [6.64]**	-0.036 [9.97]**	-0.036 [9.96]**	-0.045 [9.80]**	-0.043 [6.74]**	-0.019 [2.80]**	-0.016 [2.47]*
lagged market share by region and industry	-0.063 [4.37]**	0.164 [2.42]*	-0.087 [4.12]**	0.184 [1.50]	-0.046 [2.17]*	0.108 [1.25]	-0.042 [2.11]*	0.187 [1.63]	-0.123 [3.93]**	0.320 [1.62]	0.030 [0.99]	-0.031 [0.21]
national Herfindalh index	0.185 [2.58]**	-0.054 [3.95]**	0.316 [2.67]**	-0.071 [3.40]**	0.147 [1.54]	-0.025 [1.32]	0.189 [1.66]	-0.042 [2.10]*	0.347 [1.77]	-0.127 [3.19]**	-0.013 [0.09]	0.046 [1.66]
coefficient of variance of PPI	0.122 [3.52]**	0.120 [3.48]**	2.076 [4.34]**	1.895 [3.72]**	0.094 [2.68]**	0.099 [2.86]**	0.114 [3.00]**	0.115 [3.02]**	3.447 [3.74]**	3.277 [1.62]	0.071 [1.85]	0.083 [2.17]*
PPI by industry	0.096 [4.30]**	0.086 [3.87]**	0.177 [3.58]**	0.141 [2.89]**	-0.100 [3.34]**	-0.110 [3.65]**	0.142 [4.12]**	0.144 [4.15]**	0.119 [1.37]	0.110 [0.85]	-0.240 [4.75]**	-0.237 [4.68]**
import shares by firm		0.081 [2.98]**		-0.002 [0.06]		0.210 [5.15]**		0.021 [0.49]		-0.122 [1.80]		0.241 [3.95]**
lagged import shares by firm	0.076 [2.77]**		0.029 [0.74]		0.155 [3.70]**		0.018 [0.45]		-0.063 [1.00]		0.189 [3.08]**	
imported inputs	0.200 [2.21]*	0.193 [2.03]*	0.576 [4.80]**	1.011 [6.12]**	-1.126 [7.14]**	-1.385 [8.97]**	0.039 [0.32]	0.016 [0.12]	0.245 [1.47]	0.604 [1.06]	-1.127 [5.10]**	-1.436 [6.32]**
export/output ratio	0.043 [2.72]**	0.101 [2.58]**	0.260 [7.76]**	0.857 [1.69]	-0.025 [1.35]	0.031 [1.07]	0.066 [2.82]**	0.035 [0.54]	0.186 [4.13]**	-0.084 [0.03]	0.013 [0.45]	0.001 [0.04]
constant	-0.422 [11.52]**	-0.424 [11.57]**	-0.454 [7.05]**	-0.424 [6.13]**	0.441 [7.18]**	-0.424 [6.13]**	-0.409 [6.30]**	-0.415 [6.22]**	-0.275 [2.23]*	-0.335 [0.92]	0.615 [5.71]**	0.612 [5.87]**
year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
sectoral dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	47951	47951	25737	25737	22214	25737	19902	19902	10500	10500	9402	9402
Number of firms	14161	14161	12286	12286	10378	12286	6084	6084	5148	5148	4474	4474

IV – instrumental variable estimation. Import shares by firm, imported inputs, export/output ratio instrumented by their first lags.
Absolute value of t-statistics in brackets; * significant at 5% level; ** significant at 1% level

Table 4
Total Factor Productivity Growth Regressions. FDI. Panel Random Effects.

	All Industries						Import Competing Industries					
	1996-2001		1996-1998		1999-2000		1996-2001		1996-1998		1999-2000	
Variables	**[1]**	**[2] IV**	**[3]**	**[4] IV**	**[5]**	**[6] IV**	**[7]**	**[8] IV**	**[9]**	**[10] IV**	**[11]**	**[12] IV**
log employment	-0.020 [4.83]**	-0.020 [4.59]**	-0.033 [5.90]**	-0.047 [3.35]**	0.004 [0.52]	0.004 [0.53]	-0.011 [1.54]	-0.010 [1.27]	-0.024 [2.59]**	-0.024 [0.29]	0.018 [1.54]	0.017 [1.42]
capital/output ratio	-0.038 [16.1]**	-0.038 [16.0]**	-0.044 [15.4]**	-0.037 [13.9]**	-0.031 [6.04]**	-0.031 [6.02]**	-0.040 [10.2]**	-0.040 [10.2]**	-0.044 [9.62]**	-0.045 [6.97]**	-0.026 [3.13]**	-0.026 [3.22]**
lagged market share by region and industry	0.220 [2.78]**	0.210 [2.67]**	0.283 [2.36]*	0.169 [1.41]	0.119 [1.02]	0.110 [0.97]	0.313 [2.38]*	0.309 [2.34]*	0.408 [2.05]*	0.404 [2.00]*	-0.062 [0.32]	-0.056 [0.30]
national Herfindalh index	-0.067 [4.27]**	-0.065 [4.18]**	-0.091 [4.29]**	-0.074 [3.44]**	-0.041 [1.52]	-0.033 [1.29]	-0.046 [2.01]*	-0.047 [2.04]*	-0.120 [3.82]**	-0.124 [2.85]**	0.076 [2.01]*	0.080 [2.14]*
coefficient of variance of PPI	0.147 [4.16]**	0.152 [4.30]**	2.236 [4.65]**	2.014 [3.85]**	0.127 [3.44]**	0.140 [3.78]**	0.140 [3.53]**	0.142 [3.58]**	2.750 [2.91]**	2.717 [1.76]	0.139 [3.36]**	0.148 [3.59]**
PPI by industry	0.108 [4.64]**	0.107 [4.52]**	0.169 [3.39]**	0.137 [2.77]**	-0.106 [3.21]**	-0.108 [3.23]**	0.148 [4.12]**	0.147 [4.09]**	0.154 [1.75]	0.151 [1.17]	-0.323 [5.82]**	-0.332 [5.96]**
import shares by firm		0.141 [4.49]**		0.015 [0.39]		0.317 [5.52]**		0.012 [0.24]		-0.108 [1.51]		0.250 [2.90]**
lagged import shares by firm	0.134 [4.48]**		0.046 [1.13]		0.275 [5.30]**		0.022 [0.48]		-0.047 [0.74]		0.255 [3.41]**	
share of FDI	0.084 [1.84]	0.088 [1.91]	0.153 [1.98]*	0.082 [0.97]	0.069 [1.08]	0.047 [0.76]	-0.069 [1.07]	-0.076 [1.15]	-0.086 [0.84]	-0.146 [1.28]	0.159 [1.67]	0.116 [1.23]
share of FDI among suppliers	-0.824 [8.55]**	-0.810 [8.45]**	-0.486 [3.03]**	-0.407 [2.21]*	-0.464 [3.06]**	-0.508 [3.44]**	-1.382 [5.66]**	-1.408 [5.61]**	0.967 [1.75]	0.608 [0.21]	-1.158 [3.33]**	-1.127 [3.24]**
share of FDI among consumers	0.365 [4.45]**	0.360 [4.40]**	0.469 [3.18]**	0.191 [0.93]	0.391 [3.63]**	0.408 [3.89]**	0.004 [0.03]	0.022 [0.16]	-1.337 [5.08]**	-1.299 [4.83]**	1.150 [6.10]**	1.224 [6.49]**
imported inputs	0.257 [2.65]**	0.246 [2.27]*	0.518 [4.21]**	0.994 [5.54]**	-1.755 [8.62]**	-1.715 [8.28]**	0.185 [1.32]	0.266 [1.63]	0.145 [0.83]	0.556 [1.34]	-1.049 [3.52]**	-0.689 [2.16]*
export/output ratio	0.065 [3.62]**	0.083 [1.53]	0.248 [7.39]**	0.844 [1.64]	-0.023 [1.00]	-0.022 [0.66]	0.086 [3.19]**	0.038 [0.45]	0.194 [4.30]**	0.068 [0.02]	0.025 [0.61]	-0.005 [0.10]
constant	-0.407 [10.4]**	-0.414 [10.2]**	-0.432 [6.57]**	-0.403 [5.82]**	0.428 [5.29]**	0.431 [5.32]**	-0.402 [5.59]**	-0.418 [5.66]**	-0.238 [1.89]	-0.272 [0.83]	0.554 [3.93]**	0.502 [3.55]**
year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
sectoral dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	40334	40334	25737	25737	14597	14597	16611	16611	10500	10500	6111	6111
Number of firms	13859	13859	12286	12286	9818	9818	5930	5930	5148	5148	4195	4195

IV – instrumental variable estimation. Import shares by firm, imported inputs, export/output ratio instrumented by their first lags.
Absolute value of t-statistics in brackets; * significant at 5% level; ** significant at 1% level

Table 5
Total Factor Productivity. Complexity and Competition. Panel Random Effects.

	All Industries						Import Competing Industries					
	1996-2001		1996-1998		1999-2001		1996-2001		1996-1998		1999-2001	
Variables	**[1]**	**[2] IV**	**[3]**	**[4] IV**	**[5]**	**[6] IV**	**[7]**	**[8] IV**	**[9]**	**[10] IV**	**[11]**	**[12] IV**
import shares by firm		0.040 [0.31]		0.296 [1.26]		0.122 [0.64]		-0.155 [0.73]		-0.357 [0.81]		0.982 [3.36]**
lagged import shares by firm	0.136 [2.23]*		0.248 [2.78]**		0.111 [1.26]		0.198 [2.40]*		0.116 [1.02]		0.578 [4.38]**	
imported inputs	0.088 [0.89]	0.072 [0.62]	0.431 [3.33]**	0.876 [4.63]**	-1.171 [6.64]**	-1.476 [7.64]**	0.017 [0.14]	-0.008 [0.05]	0.236 [1.37]	0.912 [1.42]	-1.245 [5.37]**	-1.855 [7.18]**
export/output ratio	-0.106 [1.75]	0.230 [2.13]*	-0.105 [0.31]	10.088 [2.11]*	-0.090 [1.34]	0.100 [1.07]	-0.145 [0.47]	3.669 [2.38]*	-0.756 [1.11]	28.761 [1.90]	-0.014 [0.04]	0.694 [1.12]
complexity index	0.459 [3.20]**	0.312 [2.15]*	0.593 [2.94]**	-0.514 [0.98]	0.422 [1.86]	0.373 [1.71]	0.503 [2.53]*	0.170 [0.73]	0.273 [0.94]	-1.852 [1.90]	1.088 [3.39]**	1.327 [4.21]**
complexity index multiplied by log employment	-0.073 [2.83]**	-0.046 [1.85]	-0.080 [2.20]*	0.148 [1.26]	-0.090 [2.23]*	-0.068 [1.84]	-0.086 [2.39]*	-0.031 [0.71]	-0.036 [0.67]	0.371 [1.75]	-0.179 [3.12]**	-0.183 [3.39]**
complexity index multiplied by lagged market share	0.233 [2.36]*	0.210 [2.24]*	0.243 [1.68]	0.398 [2.37]*	0.292 [1.99]*	0.272 [2.06]*	0.245 [2.01]*	0.220 [1.79]	0.291 [1.54]	0.282 [1.28]	0.195 [1.06]	0.138 [0.81]
complexity index multiplied by capital/output ratio	-0.002 [0.14]	-0.001 [0.05]	0.024 [1.18]	0.073 [2.47]*	-0.008 [0.25]	-0.015 [0.48]	0.023 [1.03]	0.029 [1.27]	0.063 [2.23]*	0.172 [2.73]**	-0.009 [0.19]	-0.028 [0.65]
complexity index multiplied by import shares	-0.059 [0.81]	0.072 [0.46]	-0.262 [2.47]*	-0.351 [1.20]	0.075 [0.70]	0.129 [0.57]	-0.236 [2.38]*	0.257 [0.99]	-0.249 [1.88]	0.486 [0.95]	-0.510 [3.20]**	-0.871 [2.49]*
complexity index multiplied by export/output ratio	0.213 [2.57]*	-0.176 [1.11]	0.462 [1.09]	-11.751 [1.94]	0.093 [1.00]	-0.094 [0.74]	0.264 [0.68]	-4.504 [2.36]*	1.167 [1.39]	-36.082 [1.97]*	0.037 [0.08]	-0.856 [1.10]
constant	-0.744 [6.82]**	-0.637 [5.79]**	-0.832 [5.27]**	-0.056 [0.15]	0.137 [0.78]	0.192 [1.14]	-0.776 [4.71]**	-0.571 [3.07]**	-0.399 [1.60]	0.820 [1.38]	-0.186 [0.69]	-0.347 [1.34]
year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
sectoral dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	47951	47951	25737	25737	22214	22214	19902	19902	10500	10500	9402	9402
Number of firms	14161	14161	12286	12286	10378	10378	6084	6084	5148	5148	4474	4474

IV – instrumental variable estimation. Import shares by firm, imported inputs, export/output ratio, and their crossterms with complexity index instrumented by their first lags. Other control variables are log employment, capital/output ratio, lagged market share by region and industry, national Herfindalh index, coefficient of variance of PPI, PPI by industry

Absolute value of t-statistics in brackets; * significant at 5% level; ** significant at 1% level

Figure 1.
Marginal Products of Capital and Labor and Capital and Labor Elasticity of Output (Random Effects Estimations)

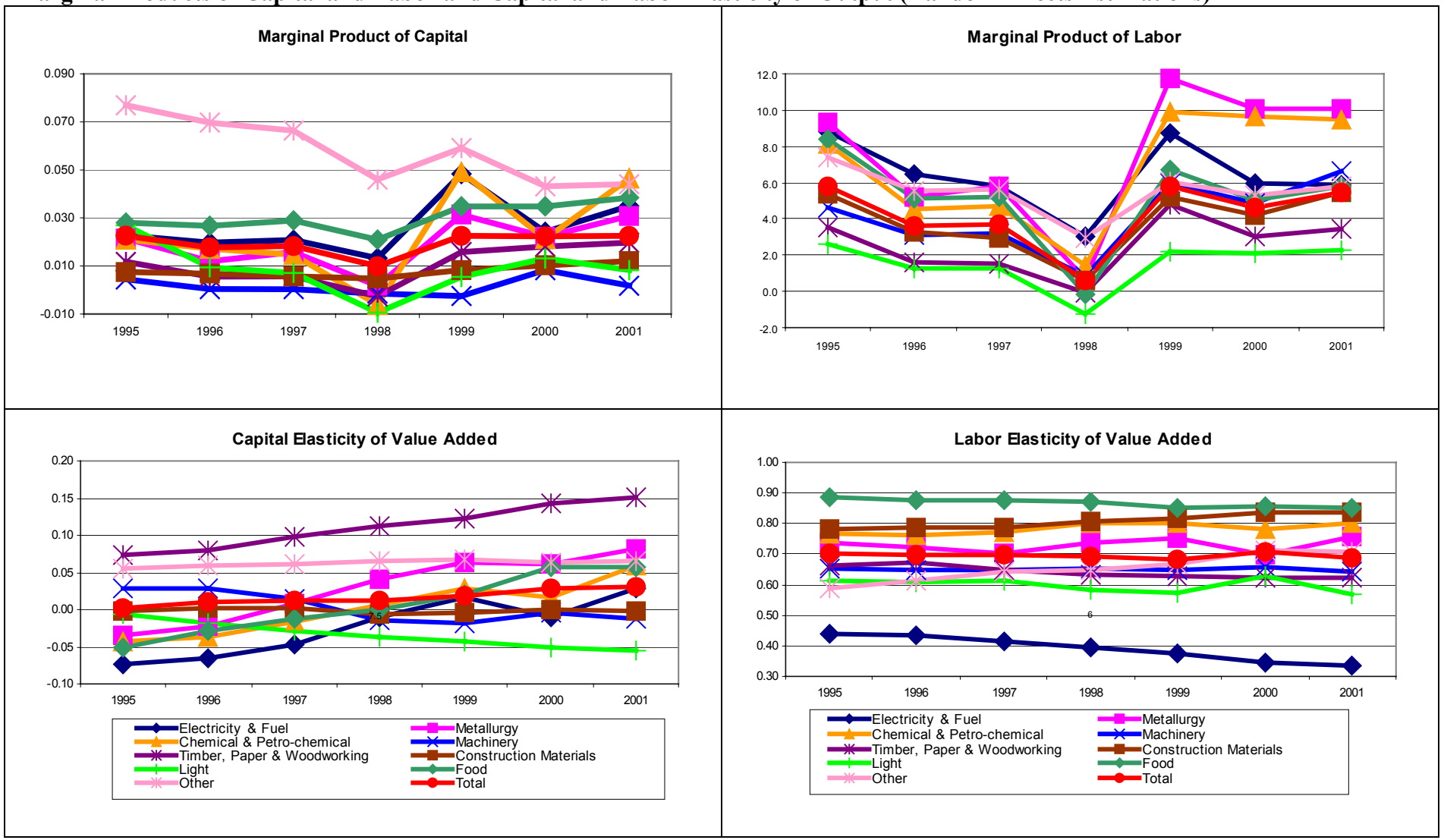

Figure 2.
Total Factor Productivity Growth

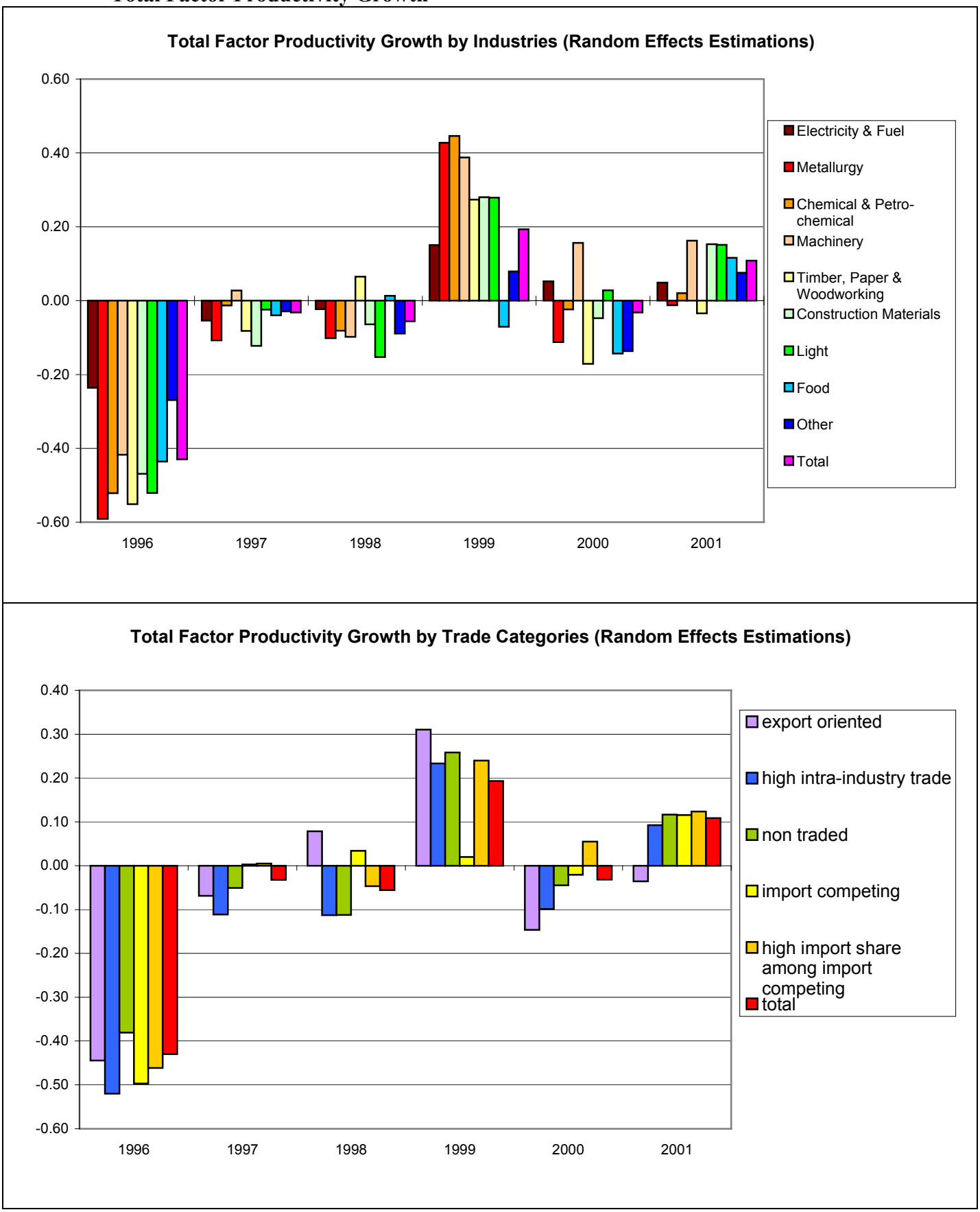

Figure 3
Total Factor Productivity, Real Output, Real Capital and Labor Cumulative Growth by Trade Categories (1996 = 100%)