Does Services Liberalization Benefit Manufacturing Firms?
Evidence from the Czech Republic

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Abstract

While there is considerable empirical evidence on the impact of liberalizing trade in goods, the effects of services liberalization have not been empirically established. This study examines the link between services sector reforms and the productivity of manufacturing industries relying on services inputs. Several aspects of services liberalization are considered, namely, the presence of foreign providers, privatization and the level of competition. The results, based on firm-level data from the Czech Republic, show a positive relationship between services sector reform and the performance of domestic firms in downstream manufacturing sectors. Allowing foreign entry into services industries appears to be the key channel through which services liberalization contributes to improved performance of manufacturing sectors. This finding is supported by evidence that foreign acquisitions of Czech services providers result in profound changes in the labor productivity and sales of acquired firms. As most barriers to foreign investment today are not in goods but in services sectors, the findings of this study may strengthen the argument for reform in this area.

Keywords: services liberalization, productivity, foreign direct investment, privatizations, foreign acquisitions
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1 Introduction

Services liberalization is a controversial subject, as is evident from recent policy debates in the European Union and the World Trade Organization. The scope for controversy is great because—in contrast to the large body of empirical research on the impact of trade liberalization in goods—little is known about the effects of allowing greater foreign entry in services industries. Since a wide range of manufacturing and services industries rely on services inputs, it seems reasonable to presume that large gains could be achieved through the liberalization of services sectors.

To the best of our knowledge, this is the first study that provides empirical evidence on the link between reforms in services sectors and the performance of downstream manufacturing industries.[1] Our analysis focuses on the Czech Republic which introduced far reaching reforms of services industries during the 1990s, including opening services sectors to foreign investors, in the context of its accession to the European Union (EU). The results, based on firm-level data for the period 1998–2003, suggest a positive association between liberalization in services industries and the productivity of manufacturing firms using services inputs. Allowing entry of foreign services providers appears to be the key channel through which services liberalization benefits the manufacturing sector.

Liberalization of services industries can involve the abolition of monopolies, the privatization of state-owned enterprises and the elimination of barriers to entry. As a result, new domestic and foreign providers are likely to enter the market and hence increase the choice of providers for downstream users of services. Greater choice of services providers may in turn affect the performance of manufacturing sectors in three ways.

[1] The most closely related studies by Rajan and Zingales (1998) and Fernald (1999) are discussed in the next section. Recent efforts to estimate the economy-wide benefits of services reform using computable general equilibrium models (Rutherford and Tarr 2008) assume downstream productivity effects of foreign entry into services markets. This paper is seeking to establish the existence of these effects.

First, new services may become available through the entry of more technologically advanced services providers. Examples include new financial instruments and cash flow management tools, multi-modal transport services, or digital value-added services in telecommunications. Availability of such services may allow manufacturers to introduce productivity enhancing changes to their operations, such as receiving production orders on line or setting up on-line bidding systems for suppliers. Ethier (1982) provides theoretical and Amiti and Konings (2007) provide empirical support for the argument that access to a greater variety of inputs can result in higher productivity of downstream industries. This argument in favor of liberalization of trade in goods is equally valid in the context of services liberalization.

Second, services liberalization may also lead to a wider availability of services that were formerly restricted to certain groups of users, such as internet coverage in rural areas or an improved availability of business consulting services to smaller firms. The improved access may lead to enhanced performance of smaller or remotely located enterprises.[2]

Third, the reliability of existing services may improve as a result of privatization, competition and the entry of internationally successful players. For instance, telephone communications or electricity provision may become more reliable due to investments in infrastructure by new domestic or foreign owners, or credit decisions may be made faster as competition among banks increases. These improvements will in turn limit disruptions to production and reduce operating costs in downstream manufacturing sectors.

The entry of foreign providers may play a particularly important role in realizing these benefits. Foreign providers may bring know-how and knowledge about new products and

[2] In a case study of Mexican detergent industry, Javorcik, Keller and Tybout (2008) find that the entry of Wal-Mart reduced the distribution cost for detergent manufacturers. While in the past manufacturers used to deliver their products to individual supermarkets, Wal-Mart instituted a system of deliveries to a central warehouse. Moreover, the expansion of Wal-Mart into many regions of the country gave producers an opportunity to expand the reach of their products without having to engage in costly transactions with small wholesalers and retailers. This was particularly valuable for smaller producers whose reach into other regions had been hindered by prohibitive transport and transaction costs.

international best practices into the country. By setting a higher standard and introducing new products, they may also put pressure on domestic suppliers to make similar improvements.[3] Given the limited scope for cross-border trade in services inputs, we would expect the performance of downstream sectors to be tied more closely to the quality and availability of services supplied by providers operating domestically than is the case for physical intermediate inputs.

To examine the link between services sector reforms and the performance of services users, we rely on firm-level data from Amadeus, a commercial data base including financial statements and ownership information for approximately ten thousand Czech companies for the 1998-2003 period. We regress the total factor productivity of manufacturing firms on the state of liberalization in services sectors weighted by the respective manufacturing sector's reliance on inputs from each services sector. To take into account the possible simultaneity between productivity shocks and input selection, we estimate the total factor productivity using the methodology proposed by Olley and Pakes (2003). Our identifying assumption is that the effect of services reform should be more pronounced in manufacturing sectors relying more heavily on services inputs. Our measures of the state of liberalization in services sectors are time varying. The reliance of manufacturing sectors on services inputs is assessed based on the national input-output matrix. We control for other aspects of openness, namely tariffs both on output and on intermediate inputs, and the presence of foreign direct investment (FDI) both in the same sector as well as in industries supplying intermediates. All explanatory variables are lagged one period. The estimated model also includes firm and year fixed effects. Standard errors are clustered on industry-year combinations.

[3] Javorcik, Keller and Tybout (2008) report that the centralized system of deliveries instituted by Wal-Mart in Mexico was later adopted by national supermarket chains.

Identifying the impact of a policy reform, such as increasing openness of services sectors to new domestic and foreign entrants, is often complicated by the fact that exogeneity of such a reform is difficult to establish. If a policy is endogenous to changes in the overall economic conditions or to developments in politically influential parts of the economy, the causality between the policy and performance may run in both directions. This paper argues that the Czech Republic's efforts to join the EU and the close supervision of reform progress by Brussels bureaucrats present a rare example of a largely exogenous policy reform leading to profound changes in the structure of services industries and large FDI inflows into services.

Several measures are used to capture the extent of reform in services sectors. The first is a set of policy reform indices published by the European Bank for Reconstruction and Development (EBRD). Sector-specific time-varying indices are available for banking, telecommunications, electric power, railway transport, road transport, and water distribution. The indices reflect the overall state of policy reform in a given services industry. Three additional measures capture a particular aspect of liberalization: (i) the extent to which foreign investors have entered Czech services industries, which is proxied by the share of an industry's output produced by foreign-owned companies; (ii) the progress of privatization in services industries, which is captured by the share of an industry's output produced by private companies; (iii) the level of competition in services industries, which is measured by the market share of the four largest providers.

Our main finding is a positive correlation between liberalization in services sectors and the productivity of downstream manufacturing firms. When each measure of reform is considered in isolation, a positive and statistically significant relationship is found for the overall progress in policy reform, the presence of foreign providers in services sectors and the extent of privatization in services industries. No statistically significant relationship is detected for the

level of competition in services sectors. When multiple measures are entered jointly, the effect of privatization loses its statistical significance.

These results are consistent with services sector liberalization, particularly FDI inflows into the sector, being associated with improved availability, range and reliability of services, which in turn contribute to improved performance of manufacturing firms using services as inputs. The magnitude of the effect is economically meaningful: a one-standard-deviation increase in foreign presence in services industries is associated with a 7.7% increase in the productivity of manufacturing firms relying on services inputs.

Although the political setting of the reform process in preparation for EU accession makes the Czech Republic a rare case of a largely externally dictated reform, we nonetheless address any remaining concerns about the possible endogeneity of services liberalization. Taking advantage of the fact that neighboring countries, such as Slovakia and Hungary were also preparing for the EU accession, we use their progress in services reform to instrument for foreign presence and the extent of privatization in services industries in the Czech Republic. We find that our conclusions with respect to foreign presence in services remain unchanged.

In a final robustness check, we follow the methodology of Harrison (1994) and demonstrate that our conclusions about the positive link between foreign presence in services and the performance of downstream manufacturing firms are robust to controlling for the response of markups to services liberalization.

To strengthen our argument that foreign services providers are quite different from their Czech competitors, we provide three types of evidence. First, anecdotal evidence, presented in section 6.1, documents several cases of foreign services provides being at the forefront of innovation in their sectors in the Czech Republic. Second, the benefits of foreign entry into services are confirmed by the results of a firm survey conducted by the World Bank in the Czech

Republic in 2004. A majority of the 350 Czech enterprises interviewed believed that allowing FDI inflows into services industries contributed to improvements in the range, quality and availability of services inputs in their country. Finally, an analysis combining the difference-in-differences approach with propensity score matching finds that foreign acquisitions of Czech services providers have led to increases in labor productivity and boosted the volume of sales the in the acquired firms. These findings are consistent with foreign services providers bringing new technologies and know-how to the Czech Republic and providing services with greater appeal to Czech consumers.

This paper is structured as follows. Section 2 reviews the relevant literature. Section 3 briefly discusses the liberalization of services industries in the Czech Republic. Section 4 describes the data and the empirical strategy, while section 5 contains the empirical results. Section 6 presents additional evidence on the implications of FDI inflows for the performance of services sectors. The last section presents the conclusion of the study.

2 Related Literature

As Hoekman (2006) notes, "research on services trade constitutes only a very small share of the total output of international economics" and "the share of rigorous empirical studies [on services] is particularly small, reflecting the scarcity of data on both policies and flows." The small existing literature encompasses a theoretical contribution by Francois (1990) who argues that the growth of intermediation services is an important determinant of overall economic growth and a handful of econometric studies based on aggregate data. Rajan and Zingales (1998) examine the impact of financial sector development on growth in downstream industries and find that more finance-dependent sectors grow faster in countries with well-developed financial markets. Fernald (1999) finds that changes in road growth are associated with larger changes in

productivity growth in US industries that are more vehicle intensive. Eschenbach and Hoekman (2006) document a positive correlation between the extent of services liberalization and economic growth in transition countries during the 1990-2004 period.[4]

To the best of our knowledge, the relationship between services reform and downstream productivity has not been examined in the empirical literature. The absence of evidence is particularly surprising considering the well-developed empirical literature on other channels through which openness may affect firm performance.

The first channel, which has received a lot of attention, is the effect of goods trade liberalization on indigenous producers in import-competing sectors and indigenous producers relying on imported inputs. In both cases, goods trade liberalization has been found to have a positive effect. Pavcnik (2002), who considers the Chilean trade liberalization, shows that plants in import-competing sectors grew by 3 to 10% more than those in sectors which were not exposed to foreign competition. She also finds that aggregate productivity improvements stemmed from the reshuffling of resources and output from less to more efficient producers. Trefler (2004) and Lileeva (2008) demonstrate similar patterns in Canada, as do Fernandes (2007) in Colombia, Krishna and Mitra (1998) in India, and Goh and Javorcik (2007) in Poland. Analyzing the effects of trade liberalization in upstream manufacturing sectors, Amiti and Konings (2007) find a strong positive relationship between trade liberalization in intermediate inputs and firm productivity in downstream manufacturing sectors. Using a novel approach relying on plant-specific tariff changes as instruments, Lileeva and Trefler (2010) show that the improved access to US intermediate inputs resulting from the Canada-US Free Trade Agreement (FTA) raised the overall labor productivity in the Canadian manufacturing sector by 0.005 log

[4] A related literature considers the importance of services reform for goods trade. Fink, Mattoo and Neagu (2005) show that communication costs affect the pattern of trade, and Freund and Weinhold (2004) find a trade-enhancing effect of internet connectivity.

points. Finally, Goldberg et al. (2009) show that trade liberalization gave Indian firms access to new imported inputs and hence increased their ability to manufacture new products.[5]

The second channel, which has also been extensively investigated, is the impact of FDI on indigenous firms. A large number of studies consider the effect of foreign entry on indigenous producers operating in the same sector, postulating that foreign entry may result in knowledge spillovers to local firms (which would have a positive effect on the performance of the latter) as well as in local producers losing part of their market share to foreign entrants (which would have a negative effect as local producers would have to spread their fixed cost over a smaller scale of production). Empirical analyses based on firm-level panel data produce mixed results. Aitken and Harrison (1999), Javorcik (2004) and Javorcik and Spatareanu (2008, 2010) find that the overall effect of these two forces is either negative or statistically insignificant, while Haskel, Pereira and Slaughter (2002) and Keller and Yeaple (2009) find a positive effect. More recently researchers have also analyzed inter-industry effects of foreign entry. Javorcik (2004) finds a positive effect of FDI on local producers in upstream industries in Lithuania. Blalock and Gertler (2008) find a similar pattern in Indonesia and Javorcik and Spatareanu (2008, 2010) in Romania. Kugler (2006) documents a positive effect of FDI inflows on Colombian producers in other sectors, i.e. sectors other than the sector receiving FDI. He considers the pairwise effects between sectors without distinguishing between the effects on downstream versus upstream sectors.

While the focus of this paper is on the relationship between the performance of domestic firms in manufacturing sectors and upstream services liberalization, we will also examine the impact of goods trade liberalization and foreign presence in both firms' own and in upstream

[5] For a discussion of various mechanisms through which bilateral trade liberalization affects firm productivity see Lileeva and Trefler (2010, section IVC).

manufacturing sectors. First, however, we turn to the developments in services sectors in the Czech Republic.

3 Services Liberalization in the Czech Republic

Having made substantial progress in liberalizing services sectors and opening its economy to FDI, the Czech Republic is a suitable choice for our study. Within a few years after the end of the communist regime in 1989, the government of the former Czechoslovakia privatized many state-owned enterprises, liberalized prices and wage-setting and began to open the country to foreign trade and FDI (Hanousek, Kocenda and Lizal 2004). In 1998, Czech policy makers adopted an even more welcoming approach to FDI, particularly in services industries, and FDI inflows saw a steep rise. A summary of the reform measures undertaken in the banking, telecommunications and energy sectors is presented here.[6]

In the telecommunications sector, the monopoly fixed line operator was majority public-owned in 1998, and there was no independent regulator for the sector. In early 2000, the Telecommunications Act established an independent regulator and determined that the fixed line monopoly of the incumbent would end on January 1, 2001. Yet, as interconnection prices remained above comparable prices in the EU and certain other reform-related issues had not been addressed, the EU called for immediate remedial action. A third mobile operator entered the market in 2000 with 100% foreign ownership, and in 2001 the foreign private investor in one of the two mobile companies operating since 1996 increased its shares to 60%. In August 2002, the government decided to privatize the state's majority stake in the incumbent fixed line operator. Now there is a choice of operators in all segments of the market, and according to WTO (2001)

[6] The on-line Appendix A contains a more detailed description.

there has been “strong growth in both size and quality of services, and prices of some services have fallen.”

In the banking sector, the privatization of the four large state-controlled banks began in March 1998. Foreign investors were given national treatment as of 1998, and the supervisory powers of the central bank were strengthened. In 1999, the government published a precise and ambitious timetable for the remaining privatizations in banking and by 2001, 90% of banking assets were in foreign-controlled banks, with 27 out of 40 commercial banks being foreign owned. In 2002, after another legal reform, the EU deemed the banking sector in the Czech Republic to be in compliance with the *Acquis Communautaire*.

In the energy sector, a regulatory administration was established in 1998, although its independence was still limited. On 1 January 2001, a new Energy Act came into force providing for a gradual liberalization of the electricity and gas markets, including third party access starting in 2002. The privatization of the Czech monopoly gas importer and owner of the transit network, together with the transfer to a German utility firm of a majority of shares in seven out of eight regional gas monopoly distributors, was concluded in May 2002. In 2002, the European Commission found that the privatization of major players in the gas market, the restructuring of electricity utilities and broadly cost-reflective electricity prices had prepared the Czech gas and electricity sectors for the competitive EU-internal energy market.

In response to changes in the policy environment, the Czech Republic has received large inflows of FDI into services sectors. The aggregate FDI inflows (encompassing both services and other sectors) in 1998 were twice as large as in the preceding year and doubled again in 1999. In fact, the Czech Republic is one of the most successful Central and Eastern European countries in terms of the stock of FDI per capita. Many of the world’s most prominent multinational companies have established themselves in the Czech market. A majority of recent FDI inflows

into the Czech Republic have been directed into services rather than manufacturing sectors, and almost all services industries have attracted foreign investors.

The progress of the liberalization of the Czech economy with respect to both domestic regulation and openness to foreign entry was closely monitored by the EU in preparation for the country's accession in 2004.[7] The fact that a substantial liberalization of services was required to attain one of the country's major overall policy goals suggests that the liberalization and openness to foreign entry were exogenous developments rather than a response to domestic lobbying.

4 Data and Empirical Strategy

4.1 Data

The source of firm-level information is the Amadeus data base published by Bureau van Dijk. It contains annual balance sheets and income statements of firms operating in the Czech Republic. The data base includes all firms that either had total assets of more than 20 million Czech Crowns (CZK) or a turnover of more than 40 million CZK. The firm records contain annual figures on volume of sales, labor, intermediate inputs, stock of tangible fixed assets and ownership structure. The data set forms an unbalanced panel spanning the period 1998–2003.[8]

The data set includes information on firms in 21 manufacturing industries.[9] As our measure of firm performance, we estimate the total factor productivity (TFP) for manufacturing firms. The TFP is estimated as the residual of sector-specific three-factor Cobb-Douglas production functions, with deflated values of labor, capital and material/services inputs as

[7] The European Commission published extensive yearly reports on "Progress towards Accession" on its website at http://europa.eu.int/comm/enlargement.

[8] In some cases, figures reported in Amadeus appeared to be key punch errors, and we developed several rules to clean the data by excluding firms with unlikely patterns from our sample. We excluded a firm from our sample if it reported negative values of labor payments, intermediate inputs or capital stock, and wherever intermediate inputs exceeded the value of output.

[9] The petroleum sector (NACE 23) was excluded from the analysis because of a very small number of observations.

production factors. Nominal values of output are deflated using wholesale deflators specific to 3-digit NACE sectors, obtained from the Czech Statistical Office (CSO). Labor costs are deflated using the consumer price index from IMF's *International Financial Statistics*. For capital, a deflator for tangible fixed assets, obtained from the CSO, is used.

As our objective is to assess the effect of services liberalization on firm performance, it is important to properly account for the usage of services inputs. While services inputs are not directly reported in the Amadeus data base, consultations with foreign accounting firms operating in the Czech Republic suggested that the data on the (combined) use of services and material inputs could be obtained by subtracting value added and extraordinary profit/loss[10] from the operating revenue. All three variables are reported in the Amadeus data base. In accounting terms, the material and services usage derived in this way is equal to the sum of (i) the cost of goods sold excluding wages,[11] (ii) other operating expenses excluding depreciation,[12] and (iii) financial revenues less financial costs excluding interest payments.[13] The value of material and services inputs is deflated using wholesale deflators specific to 2-digit NACE sectors (both manufacturing and services industries) weighted by the share of each sector in the provision of inputs taken from the input-output matrix.

We estimate the production function separately for each of 14 manufacturing sectors, using both ordinary least squares (OLS) and the semi-parametric estimation technique suggested by Olley and Pakes (1996) which controls for the selection problem induced by firm exit and a simultaneity bias arising from the endogeneity of a firm's input choices.[14] Because both

[10] Extraordinary profit/loss pertains to items related to natural disasters and insurance claims.
[11] Cost of goods sold is defined as a specific or direct cost of material and labor entering in the production of finished goods. In the Czech Republic, it also includes energy costs.
[12] Other operating expenses include insurance costs, depreciation, donations and penalties.
[13] Financial costs include bank fees, interest paid and costs related exchange rate differences.
[14] We group similar 2-digit industries together into 14 sectors to get a larger number of observations. See the on-line Appendix B for a list of groupings. For a description of the Olley-Pakes procedure see Pavcnik (2002) and Javorcik (2004). In the Olley-Pakes procedure, firm survival is conditioned on the services linkages measure based on the EBRD index.

approaches lead to the same conclusions, in the paper we present only the results based on the latter approach.[15]

Liberalization of services industries is measured in several ways. The first measure comes from the European Bank for Reconstruction and Development publication, Transition Report 2004. The EBRD publishes indices of policy reform for banking, telecommunications, electric power, railway transport, road transport, and water distribution as well as an overall index for services sectors. We use the overall index for those services industries where sector-specific information is not available. All of the indices are available for 1998–2002. According to the EBRD, the scores "reflect the judgment of the EBRD's Office of the Chief Economist about country-specific progress in transition." The advantage of using these measures is that they are in principle designed to encompass all policy aspects of liberalization, both with respect to domestic and foreign providers.[16] However, this broad coverage comes at the cost of a limited precision, particularly with respect to the time variation of the indicators.

Therefore, we employ alternative measures aiming to capture particular aspects of services reform, namely (i) the extent to which foreign investors have entered Czech services industries; (ii) the progress of privatization in services industries; and (iii) the level of competition in services industries. These proxies offer several advantages. First, they can be measured precisely. Second, allowing foreign entry or privatizing state owned enterprises is a good indicator of a serious commitment to reform. Third, all these measures are outcomes rather than policy variables, which means that they encompass implementation as well as policies. Fourth, comparing the results for individual measures can offer insights into the relative importance of different aspects of services liberalization.

[15] For a full set of results see the working paper version of this study.
[16] The indices are described in more detail in the on-line Appendix C.

The extent of foreign presence in services sectors is measured by the share of foreign-owned providers in sectoral sales. Firm-level ownership information is available in Amadeus in the form of records on shareholders, their nationalities and their ownership shares, including the dates as of which the information is valid. The date records pertain to the latest available information in each release of Amadeus, i.e. they are not time-varying within one version of the data base. Therefore, we combine the information from four different releases of Amadeus (1998, October 2001, January 2005 and March 2005) and construct a panel of foreign ownership shares for each firm.[17] In cases where the date of foreign entry was ambiguous, we looked up information on the owners from other publicly available sources.[18]

To calculate the share of foreign-owned providers in sectoral sales we weight a firm's output by the foreign ownership share and only this fraction is considered as foreign output. We calculate the share of foreign output at the level of 2-digit services sectors of the NACE classification for the years 1998 to 2002.[19] In what follows, we will refer to the foreign output share variables as *foreign share*.[20]

We construct the *foreign share* variables for the following services sectors: other business activities (includes legal, accounting, consulting, advertising services) (NACE code 74), computer and related activities (72), renting of machinery and equipment (71), real estate activities (70), financial intermediation (65), post and telecommunications (64), supporting and auxiliary transport activities (63), land transport (60), retail trade and repair of personal and household goods (52), wholesale trade and commission trade (51), sale, maintenance and repair

[17] Note that in contrast to other releases, the January 2005 release contained ownership information relating to earlier dates which proved invaluable in constructing ownership changes taking place during the 2002-04 period.
[18] For the top five companies in each sector and year, we additionally verified any available information about foreign owners and their date of entry by looking at annual reports and information on the company websites.
[19] For more information on how this variable was constructed, see the on-line Appendix D.
[20] In an earlier version of this paper, we also employed an alternative definition where a firm's entire output was counted as foreign if the sum of the shares held by foreign entities exceeded 10% (the standard threshold for defining FDI). Using the alternative definition led to very similar results.

of motor vehicles and retail sale of automotive fuel (50), construction (45), collection, purification and distribution of water (41), electricity, gas and hot water supply (40).[21] Foreign engagement in these sectors varies substantially. While in the electricity sector almost 76% of sales in 2002 came from foreign-owned firms, this ratio reached only 8% in land transport. There is also significant variation across time. The average of foreign output shares more than doubled between 1998 and 2002.

The progress of privatization in services industries is measured by the share of output provided by firms with private owners. The determination of whether a particular owner is a private entity or a state or municipal government or agency is made based on the shareholder name and description in the Amadeus data base. To calculate the share of private/privatized entities in the industry output, we follow the same approach as in the case of FDI.

The level of competition in each services industry is proxied by two indices of concentration: the market share of the four largest providers and the Herfindahl index which is defined as the sum of squared market shares of all providers in the sector. As our results show no qualitative difference between the findings based on the two indices, we present the estimation results only for the former index.

4.2 Empirical Strategy

Our empirical strategy relies on the assumption that manufacturing sectors that are more dependent on services inputs should be affected to a greater extent by the reform in services industries. To measure inter-sectoral linkages between services and manufacturing industries, we weight the extent of liberalization in each services sector by the reliance of manufacturing firms on each services input. To do so, we use information from a national input-output matrix to

[21] The following services sector had to be excluded due to a small number of observations in the data: hotels and restaurants (55), water transport (61), air transport (62), insurance and pension funding (66), activities auxiliary to financial intermediation (67).

evaluate the dependence of each manufacturing sector on the different services sectors.[22] An advantage of using the industry-level information (rather than firm-level information which is in any case not available to us) is that there is less need to be concerned about correlation between the performance of an individual firm and its services usage. We calculate the following measures for each manufacturing industry *j* at time *t*:

$$services\_linkage_{jt} = \sum_k a_{jk} \cdot liberalization\_index_{kt} \qquad (1)$$

where a_{jk} is the amount of inputs sourced from services sector *k*, expressed as a fraction of the overall inputs used by manufacturing sector *j*. $Liberalization\_index_{kt}$ is one of the four measures discussed above: the EBRD index of reform in services sector *k* at time *t*, $foreign\ share_{kt}$ in services sector *k* at time *t*, the share of output provided by private companies in services sector *k* at time *t* or the concentration index for services sector *k* at time *t*. Put differently, the *services_linkage* variable is obtained by multiplying the matrix of sectoral reform indicators for services sectors with a matrix of input-output coefficients.[23]

To establish whether there exists a link between the performance of Czech firms and liberalization of upstream services sectors, we regress the productivity of manufacturing firms on the *services_linkage* measures:

$$\ln TFP_{it} = \alpha_i + \beta\ services\_linkage_{jt-1} + X_{jt-1}\Pi + \delta_t + \eta_{it} \qquad (2)$$

where TFP_{it} is the total factor productivity of a Czech manufacturing firm *i* operating at time *t* estimated at the industry level using the Olley and Pakes method.

There are two advantages of analyzing productivity at the firm-level, as opposed to conducting the exercise at the industry level. First, we can include firm fixed effects (α_i) to

[22] We employ the use table of the input-output matrix for the year 2000, obtained from the CSO. Annual information is not available. Note, however, that the year 2000 lies approximately in the middle of the time period covered by our sample.
[23] This way of measuring cross-sector effects was used by, for instance, Javorcik (2004).

capture unobserved firm heterogeneity related to firm location, size, the subindustry of operation, manager's characteristics, etc. Second, firm-level data allow us to isolate the effect on domestic firms, which is the outcome likely to be of highest interest to national policy makers. For this reason, only firms in manufacturing sectors (NACE codes 15 to 36) that have less than 10% of foreign ownership at all times are included in the regressions.[24]

The empirical specification takes into account other aspects of the increasing integration of the Czech economy with the outside world by including a vector of control variables X_{jt-1}. As the effects of services liberalization and other aspects of international integration may take time to materialize, these variables are lagged one period. X_{jt-1} includes a sector-specific measure of foreign presence in upstream manufacturing sectors, constructed in the same way as the *services_linkage* variables. Foreign entry into manufacturing industries may affect the sourcing options for manufacturing inputs by increasing the range of products available. To account for the sourcing options offered by imported inputs, X_{jt-1} also includes the level of tariff protection in upstream manufacturing sectors, again weighted by the input-output coefficients.

To take into account the level of competition in the sector where the firm is operating, we control for the level of tariff protection and the share of output produced by multinational enterprises operating in the Czech Republic. The former variable captures competition from imports, while the latter controls for competition from foreign firms and/or potential knowledge spillovers.[25] We also experimented with controlling for concentration levels in the same manufacturing sector, but these controls turned out to have no systematic effect so we excluded

[24] Note that including foreign firms in the sample leads to very similar results.

[25] In preparation for accession to the European Union, Czech tariffs vis-à-vis the EU were governed by a bilateral accession agreement of 1992, which established a schedule for phasing out tariffs on most manufacturing products by the end of 2000. In practice, this means that for the time frame we are investigating, EU preferential tariffs outside the food and tobacco sectors were already very low, with an average tariff of less than half a percent. In the presence of virtual free trade with the EU, it does not seem sensible to exploit the minimal variation in this protection before 2001, and indeed our data show little evidence that this aspect of trade protection matters. Instead we focus on MFN tariffs, which will capture protection vis-à-vis imports from non-EU countries, such as the United States, China and other developing countries. However, the results are robust to including both EU preferential and MFN tariff rates.

them from the model. Finally, to take into account macroeconomic shocks that improve business prospects in both services and manufacturing in a specific year, we include year fixed effects.

In our second specification, we estimate the model in first differences rather than in levels. Differencing takes out all observable and unobservable time-invariant characteristics at the level of the firm as well as at the level of the industry and region. By including region and year fixed effects in the model in first differences, we additionally control for differences in trends (rather than in levels) that are specific to a particular region or for factors affecting the whole economy in a particular period.[26] Our second specification takes the following form:

$$\Delta \ln TFP_{it} = \alpha + \gamma \, \Delta services\_linkage_{jt-1} + \Delta X_{jt-1}\Theta + \alpha_t + \alpha_{reg} + \varepsilon_{it} \qquad (3)$$

As the variables of interest are at the industry level while the dependent variable is at the firm-level, we adjust standard errors to allow for correlation between observations belonging to the same industry in the same year. We do so in both specification (2) and (3).[27]

The summary statistics for all variables are presented in the on-line Appendix E.

5 Results

The results from the estimation of equation 2 are presented in table 1. When we enter the measures of *services_linkages* into the model one by one, we find a positive and statistically significant correlation between firm performance in downstream manufacturing and the overall liberalization of services (EBRD measure, column I), the presence of foreign providers of services (the measure labeled FDI in column II) and the extent of privatization in services industries (column IV). The first two estimates are statistically significant at the 1% level, the latter at the 5% level. These results support our hypothesis that services liberalization affects the

[26] For example, differences in regional public spending on infrastructure or economy wide shocks would be picked up by these fixed effects in the differenced equation and would not bias our coefficient estimate of the services linkage variable.
[27] Our results are robust to clustering on industry rather than industry-year.

performance of domestic manufacturing firms relying on services inputs. The extent of competition in services, proxied by the concentration ratio (or the Herfindahl index, not reported to save space), does not have a statistically significant effect. When the three aspects of services reform (foreign presence, privatization and competition) enter the model jointly in column V, only the presence of foreign providers is statistically significant. This suggests that allowing foreign entry into services industries may be the key channel through which services liberalization contributes to improved performance of downstream manufacturing sectors.[28]

Our results do not provide strong evidence that other aspects of openness affect firm performance. We do not find a significant relationship between tariffs on foreign-produced material inputs and firm productivity, nor do we find evidence suggesting that access to material inputs produced by foreign investors affects the performance of domestic producers.[29] Moving on to within-industry effects, our results reveal no evidence of positive spillovers from foreign presence in the same sector. Regarding tariff protection in the same sector, one out of five specifications suggests a positive correlation with firm performance, significant at the 10% level. While this finding contrasts with the results in the existing literature on the effect of import competition on productivity, it is important to mention that our result is not directly comparable to those found in other analyses, due to the specific situation of the Czech Republic. Imports of manufacturing products from the EU and its accession countries were entering the Czech Republic practically duty free throughout most of the period under study, and our tariff measure captures the residual competition offered by imports from non-EU countries.[30]

[28] We also explored whether ownership status (foreign versus domestic), firm size, or the distance to the productivity frontier affected the firm's ability to benefit from services liberalization. We did not find any evidence that these characteristics of firms influenced the extent of benefits of services liberalization.
We also experimented with interacting the EBRD and the FDI measures with biennial dummies. The results suggest that the benefits of services reform increase over time.
[29] The latter finding is consistent with the results of Javorcik (2004).
[30] Imports from the EU accounted on average for 62.5% of all Czech imports during the period under study.

In order to interpret the size of our estimated coefficients, we undertake the following hypothetical exercises on the basis of models I and II in table 1. Assume that the level of services liberalization in the Czech Republic at the end of our time frame, as measured by the EBRD indices, were to drop to the level of Romania, which has made considerably less progress in liberalizing its services sectors according to the EBRD. In this case, our model would predict an average decrease in the productivity of downstream manufacturing sectors of 7.7%. Simulating a one-standard-deviation increase in foreign presence in services industries in the Czech Republic would lead to a 7.7% increase in the productivity of downstream manufacturing firms.[31] To put these results into perspective, recall that Pavcnik (2002) showed that productivity of plants in import-competing sectors grew by 3 to 10% more than those in sectors which were not exposed to foreign competition. Trefler (2004) and Lileeva (2008) found that the fall in Canadian tariffs against the US resulting from the Canada-US FTA led to a substantial amount of contraction and exit of the least productive import-competing plants which raised the average manufacturing labor productivity by 4.5%. Lileeva and Trefler (2010) found that the improved access to US intermediate inputs resulting from the FTA increased *within-plant* labor productivity in the Canadian manufacturing sector by about 0.5%.

Next we estimate our model in first differences as specified in equation 3. In this more demanding specification, the differencing removes all influences that are fixed at the level of the firm, industry or region, as did the firm fixed effects before. In addition, regional dummy variables in the differenced equation now purge all differences in trends that are specific to the region of operation. The estimates, presented in table 2, confirm our earlier conclusions. We find a positive and statistically significant correlation between the presence of foreign providers of

[31] In a robustness check, presented in the on-line Appendix F, we control for possible changes in markups. For the manufacturing sector as a whole, the magnitude of the estimated productivity effect of FDI entry into services is about a quarter of the effect presented in table 1. The sector-specific coefficients obtained from the exercise in Appendix F are in most cases smaller than the aggregate coefficient in table 1.

services and the productivity of Czech manufacturing firms. As before, statistically significant effects are also found for the index of policy changes and the extent of privatization. When foreign presence, privatization and competition in services are entered jointly in column V, the only variable that remains significant is once again the presence of foreign providers.

Given the tight supervision of progress in policy reform by the European Commission in preparation for EU accession, services policy choices can be considered largely exogenous. Nevertheless, in order to ensure that endogeneity is not a concern for our FDI and privatization variables, we also employ an instrumental variable approach. The instrumental variable approach alleviates the possibility that our measures of service sector liberalization are correlated with some other sector-specific aspects of the EU accession path, even though it does not eliminate it completely. We take advantage of the fact that two neighboring countries, Slovakia and Hungary, were also expected to liberalize services industries in preparation for their EU accession, which took place on May 1, 2004. We use the EBRD index capturing progress in their reforms, weighted by the Czech input-output coefficients, to instrument for foreign presence and privatization in Czech services industries:

$$\begin{aligned} services\_linkage\_IV_{jt}^{Slovakia} &= \sum_k a_{jk}^{Czech} \cdot liberalization\_index_{kt}^{Slovakia} \\ services\_linkage\_IV_{jt}^{Hungary} &= \sum_k a_{jk}^{Czech} \cdot liberalization\_index_{kt}^{Hungary} \end{aligned} \qquad (4)$$

The estimation results, presented in table 3, suggest that these instruments are good predictors of FDI and privatization in services industries. The Shea partial R^2 of 0.35 and 0.44, respectively, indicate that our instruments are highly relevant. This conclusion is confirmed by the Kleibergen-Paap (2006) underidentification test and the test of excluded instruments. The Hansen test does not reject the validity of the instruments in the specification with FDI, though

unfortunately this is not the case for the specification with the privatization measure where the p-value is equal to 0.06.

The results from the instrumental variable approach confirm our earlier findings on the positive relationship between foreign presence in services and the performance of Czech manufacturing firms. The coefficient on the FDI measure is positive and statistically significant at the 5% level in both specifications. The privatization measure itself does not appear to be statistically significant in either model.

In a final exercise reported in the on-line Appendix F, we follow the methodology of Harrison (1994) and demonstrate that our conclusions about the positive link between foreign presence in services and the performance of Czech downstream firms are robust to controlling for the response of markups to services liberalization. When we consider each manufacturing sector separately, we find a positive and significant –although smaller– effect of foreign presence in services in 10 of 14 sectors, as well as in a pooled sample. These findings suggest that our conclusions cannot be attributed to changes in markups.

To summarize, our findings of a positive relationship between liberalization of services sectors, in particular opening of services sectors to foreign providers, and downstream manufacturing performance are robust to controlling for unobservable firm characteristics, for changes in other aspects of openness and for systematic differences in performance across regions and time periods. They are also robust to instrumenting for foreign presence in services industries and taking into account changes in markups.

6 Developments in Services Industries

To strengthen our argument that foreign services providers are quite different from their Czech competitors, we provide three types of evidence. First, we present anecdotal evidence

documenting several cases of foreign services providers being at the forefront of innovation in their sectors in the Czech Republic. Second, we present survey results indicating that Czech entrepreneurs had a favorable view of the impact of foreign services providers. Third, we combine the difference-in-differences approach with propensity score matching to show that foreign acquisitions of Czech services firms have led to increases in labor productivity and in the volume of sales in the acquired firms. These findings are consistent with foreign services providers bringing new technologies and know-how to the Czech Republic and providing services with greater appeal to Czech consumers.

6.1 Anecdotal Evidence on the Effects of Services Reform

There is considerable anecdotal evidence suggesting that the introduction of new services in the Czech Republic has been related to the liberalization of services industries and the presence of foreign providers. For example, banking is a sector where foreign firms have introduced innovative services in the Czech market. Ceska Sporitelna, a large Austrian-owned bank, was the first bank to offer transaction ATMs, at which customers could pay their bills or make transfers. By early 2005, it had installed 1,080 ATMs across the country and issued 2.7 million payment cards. Moreover, it has become the market leader in remote banking, offering services via phone, cell phone or internet. When Ceska Sporitelna introduced a new internet banking service in 2002, 70,000 Czech customers signed up for the new service during the first 2 months. By now, the service has about 800,000 users.

Foreign banks were also the first to speed up processing of loan applications. For instance, at the US-owned GE Capital Bank, decisions about loans to small and medium enterprises are made within 2 days. Ceska Sporitelna guarantees the issuance of any debit card within 6 days from the filing of the application. HVB Bank, another foreign-owned bank, offers

its corporate clients a software package that allows internet banking with multiple banks, domestic and international transactions, and multiple approval procedures of transactions within the company via electronic signatures, even if one of the approvers is located abroad.

6.2 Firms' Perceptions of the Effects of Services Reform

Consistent with the anecdotal evidence, Czech managers exhibit positive views of services sector reforms in their country. In 2004, the World Bank surveyed 350 Czech firms about their perceptions regarding different aspects of the services reform. Managers were asked whether they felt that the changes had a positive or a negative impact in terms of quality, prices, the range of services on offer and the availability of these services. The results of the survey portrayed a generally positive view of services reform. The share of positive perceptions ranged from 55% of the respondents when asked about the quality of accounting and auditing services to 82% for telecommunications. With regards to the variety of products offered, the positive views of liberalization varied between 56% of respondents evaluating accounting and auditing services to 87% of respondents asked about telecommunications. The corresponding figures for the effect on services availability ranged from 47% in accounting and auditing to 80% in telecommunications.[32]

6.3 Effects of Foreign Acquisitions on the Performance of Services Firms

Finally, we provide rigorous evidence on the causal effect of foreign acquisitions on the performance of services providers. Our empirical strategy relies on three elements. First, we focus on changes from domestic to foreign ownership taking place within the same firm. Second, we use a difference-in-differences method to compare the performance of acquired providers with the performance of providers remaining in domestic hands. In this way, we eliminate the

[32] For more details on the survey, see the working paper version of this paper.

influence of all observable and unobservable non-random elements of the acquisition decision that are constant or strongly persistent over time. This comparison, however, is still vulnerable to problems of non-random sample selection. To address the selection issue, we combine the difference-in-differences approach with propensity score matching, which constitutes the third element of our empirical strategy.

The propensity score matching technique controls for the selection bias by restricting the comparison to differences within carefully selected pairs of firms with similar observable pre-acquisition characteristics. Its purpose is to construct the missing counterfactual of how the acquired firms would have behaved had they not been acquired. The underlying assumption for the validity of the procedure is that conditional on the observable characteristics that are relevant for the acquisition decision, potential outcomes for the treated (acquired) and non-treated (those remaining in domestic hands) firms are orthogonal to the treatment status.[33]

In the context of our study, the propensity score is the predicted probability of a firm being partially or fully acquired by a foreign investor in a given time period. A foreign acquisition is defined as a situation where the foreign ownership share increases to above 10% of equity (the IMF threshold for distinguishing between FDI and portfolio investment). We estimate the probability of a foreign acquisition using a probit specification where the explanatory variables include the firm size (measured in terms of employment), labor productivity (defined as the value added per worker) normalized by the industry average in that year, capital intensity (measured as the capital-labor ratio), skill intensity (proxied with the average wage paid by the firm), investment outlays and a time trend. All the explanatory variables are expressed in real terms and in the log form, and enter as one period lags (see the on-line Appendix E for summary

[33] The combination of propensity score matching and the difference-in-differences approach has been used to study the effects of foreign acquisitions by Girma and Gorg (2007) and Arnold and Javorcik (2009).

statistics). We expect that larger and more efficient firms in terms of labor productivity, capital and skill intensity are more attractive acquisition targets.[34]

The estimated equation (not reported to save space) suggests that larger, more productive and more skill-intensive services firms are more likely to be acquired by foreign investors. The other factors do not appear to play a significant role in foreign investors' decisions. To assess the quality of the matching procedure, we conduct the balancing hypothesis test. We consider the difference between the treated and the control group in terms of each of the above variables and run simple t-tests on the differences within 8 bands of the propensity score. All of the differences are found to be small and statistically insignificant. This gives us confidence that our approach is capable of grouping together relatively homogeneous firms.[35]

In constructing the pairs of observations matched on the propensity score, we impose a restriction that the matched control observations are assigned only from the same sector as the acquired firm. This eliminates the possibility that industry characteristics would influence our estimated effects. We use one-to-one nearest-neighbor matching on the propensity score, which expresses the estimated probability of a firm becoming acquired by a foreign investor.

The combination of matching and a difference-in-differences approach means that we look for divergence in the paths of performance between the acquired firms and the matched control firms that had similar characteristics in the pre-acquisition year. The performance analysis begins in the pre-acquisition period and focuses on the (cumulative) change in

[34] To estimate the propensity score we use all the available data on services firms which gives us 11,133 observations and 245 cases of foreign acquisitions. Foreign acquisitions take place in all years considered. They are observed in a variety of industries: electricity, gas and hot water supply (NACE 40), collection, purification and distribution of water (41), construction (45), sale, maintenance and repair of motor vehicles and retail sale of automotive fuel (50), wholesale trade and commission trade (51), retail trade and repair of personal and household goods (52), hotels and restaurants (55), land transport (60), air transport (62), supporting and auxiliary transport activities (63), post and telecommunications (64), financial intermediation (65), real estate activities (70), renting of machinery and equipment (71), computer and related activities (72), other business activities (includes legal, accounting, consulting, advertising services) (74), sewage and refuse disposal (90), recreational and cultural activities (92) and other services (93).

[35] In our matching procedure we also exclude observations outside the common support. The common support is bound by the lowest propensity score of a treatment observation and the highest propensity score of a control observation.

performance over the following year and then each of the subsequent two periods. We use bootstrapping to assess the significance of the results.

We focus on three outcome variables: labor productivity, sales, and capital intensity (all expressed in real terms). If foreign providers bring in new technology, know-how and/or management skills, we would anticipate that foreign acquisitions lead to increases in labor productivity in acquired firms.[36] If foreign acquisitions increase the appeal of the range of services on offer, we would expect to observe an increase in the volume of sales in the post-acquisition period. Finally, to check whether the anticipated improvements in labor productivity are driven by increases in capital intensity, we include it among our outcome variables.

We are also interested in the timing of the changes. We focus on the developments in the acquired firms in the three years following a foreign acquisition. To make comparisons within exactly the same group of acquired firms, we restrict our attention to firms reporting each outcome variable for all three years following the acquisition. Unfortunately, this means that our sample shrinks to between 81 and 98 acquisition cases depending on the outcome considered. Fortunately, the acquisitions are still spread across a wide range of industries.

The results, presented in table 4, confirm that foreign acquisitions lead to profound changes in the acquired firms. The average labor productivity observed in the treated and control groups in the period when matches are assigned is 1.54 and 1.44, respectively. While the matched pairs start with almost identical labor productivity levels, their performance diverges quickly. During the first year under foreign ownership, the acquired firms exhibit a labor productivity level equal to 1.71 as opposed to 1.42 for the control observations. In the third year under foreign ownership, the figures increase to 2.24 and 1.78, respectively.

[36] Note that we are not using the normalized labor productivity here, as all our comparisons are performed within the same sector. We opted for using labor productivity rather than the TFP because the Olley-Pakes TFP estimation procedure assumes a fixed sector-specific technology. Given the extensive reform and restructuring of services industries, this assumption does not seem appropriate for services sectors. Other studies using labor productivity as the performance measure include Trefler (2004) and Lileeva and Trefler (2010).

Both groups increase their labor productivity levels, but the increase is substantially higher for the acquired firms. This is clearly visible when we consider the average difference in labor productivity in the matched pairs, net of the average initial difference in the pre-acquisition period. This difference is reported in table 4 as the average treatment effect on the treated (ATT). In the year of acquisition, the ATT is equal to 0.194, i.e., after taking into account the initial difference between the two groups, acquired firms have 21.4% higher labor productivity.[37] In the second year under foreign ownership, the productivity advantage of acquired firms increases to 37.9%. By the third year it reaches 43.6%. In all cases, the effect is statistically significant.[38]

Moving on to the effects of foreign acquisitions on sales, we again find that the ownership change has strong implications for the acquired firms. The acquired firms and the control group start with a similar level of sales in the pre-acquisition period (7.87 and 7.32, respectively), but their performance quickly diverges. While the acquired firms increase their sales over time, the opposite is true of the control group. The ATT gradually increases over time. It is not statistically significant in the year of acquisition, but it reaches the 10% significance level a year later and the 5% significance level in the subsequent year. By the third year under foreign ownership, the acquired firms increase their sales 33% faster than the control group.

The final outcome of interest is the capital intensity. Although we observe an increase in capital intensity of the acquired services providers and a decrease among the control group, the ATT never reaches conventional significance levels. Thus we conclude that increases in labor productivity do not appear to be driven by increased investment in fixed assets.

[37] The magnitude is calculated as exp(0.194) -1 = 0.214.

[38] These magnitudes are in line with the effects found for foreign acquisitions of manufacturing plants in Indonesia. Arnold and Javorcik (2009) showed that in the year of acquisition, the acquired plants had a 32% advantage over the control group. By the third year under foreign ownership the labor productivity advantage increases to 63%.

7 Conclusions

In this paper, we created measures of reform in services sectors and combined them with information on the degree to which manufacturing firms rely on intermediate inputs from services industries. This allowed us to analyze the relationship between services liberalization and downstream manufacturing performance. Our results lead to two conclusions. First, we find that services policy matters for manufacturing performance as manifested in the positive strong relationship between services sector reform and the productivity of local producers relying on services as intermediate inputs. This finding is robust to several different econometric specifications, including controlling for unobservable firm heterogeneity and for other aspects of openness. Second, we find evidence suggesting that opening services sectors to foreign providers is a key channel through which services reforms affect downstream productivity in manufacturing. This finding is robust to instrumenting for the extent of foreign presence in services industries.

Our second conclusion is further supported by the finding that foreign acquisitions of Czech services providers resulted in profound changes in the acquired firms. Foreign acquisitions led to substantial increases in labor productivity and sales. Acquired firms enjoyed a labor productivity boost of 43.6% and a 33% increase in sales when compared to the control group.

As most barriers to foreign investment today are not in goods but in services, our findings strengthen the case for further liberalization of services industries and opening of services sectors to foreign providers.

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TABLE 1. Estimation with firm fixed effects using Olley-Pakes productivities

Dependent Variable: ln(TFP)		I	II	III	IV	V
Services input Linkages	EBRD	1.601***				
		(0.531)				
	FDI		7.984***			6.194***
			(2.117)			(2.286)
	Concentration			-2.238		2.457
				(3.669)		(3.358)
	Privatization				16.901**	11.402
					(7.059)	(7.853)
Manufacturing input linkages	FDI	-0.259	0.095	-0.541	-0.318	0.009
		(0.553)	(0.555)	(0.551)	(0.480)	(0.559)
	MFN Tariff	-0.067	-0.22	0.081	-0.002	-0.211
		(0.148)	(0.142)	(0.150)	(0.129)	(0.152)
Within sector Effects	FDI	0.134	-0.041	0.299	0.254	0.047
		(0.223)	(0.215)	(0.218)	(0.198)	(0.223)
	MFN Tariff	0.064	0.129*	-0.009	0.014	0.117
		(0.074)	(0.07)	(0.076)	(0.067)	(0.078)
	No. of obs.	7155	7155	7155	7155	7155
	R^2	0.066	0.066	0.064	0.066	0.067
	Test of joint significance of all policy variables (p-value)					0.006

The input linkage variables are weighted by the respective I/O coefficient. All regressors are lagged one year. All models include firm and year fixed effects. Robust standard errors clustered on industry-year combinations are presented in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level.

TABLE 2. Estimation in first differences using Olley-Pakes productivities

Dependent Variable: Δln(TFP)		I	II	III	IV	V
Services input Linkages	EBRD	1.630**				
		(0.692)				
	FDI		9.593***			7.840*
			(3.233)			(4.127)
	Concentration			0.815		3.789
				(3.918)		(3.532)
	Privatization				19.098**	12.393
					(9.156)	(10.874)
Manufacturing input linkages	FDI	0.348	0.829	0.116	0.304	0.623
		(0.726)	(0.786)	(0.746)	(0.686)	(0.785)
	MFN Tariff	-0.131	-0.327*	-0.045	-0.112	-0.320*
		(0.145)	(0.195)	(0.163)	(0.171)	(0.187)
Within sector Effects	FDI	-0.224	-0.46	-0.092	-0.158	-0.351
		(0.286)	(0.312)	(0.303)	(0.285)	(0.324)
	MFN Tariff	0.06	0.143*	0.017	0.036	0.139*
		(0.065)	(0.086)	(0.074)	(0.075)	(0.083)
	No. of obs.	4197	4197	4197	4197	4197
	R^2	0.017	0.017	0.015	0.016	0.017
	Test of joint significance of all policy variables (p-value)					0.011

The input linkage variables are weighted by the respective I/O coefficient. All regressors are differenced one year and then lagged one year. All models include region and year fixed effects. Robust standard errors clustered on industry-year combinations are presented in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level.

TABLE 3. Instrumenting for foreign presence and privatization in services industries

Stage II	**Dependent variable: ln(TFP)**	I	III	III
Services input linkages	FDI	11.171**		12.119**
		(5.207)		(5.994)
	Privatization		15.976	19.770
			(15.833)	(17.833)
Stage I	**Dependent variable:**	**FDI**	**Privatization**	**FDI** **Privatization**
	Weighted EBRD index for Slovakia	0.111***	0.011	0.111*** 0.011
		(0.027)	(0.013)	(0.027) (0.013)
	Weighted EBRD index for Hungary	0.048	-0.264***	0.048 -0.264***
		(0.233)	(0.092)	(0.233) (0.092)
	Underidentification test	226.5	194.9	75.05 194.9
	p-value	0.00	0.00	0.00 0.00
	Shea R^2 (IV 1)	0.35	0.44	0.35 0.44
	F-stat (IV 1)	13.78	7.44	13.78 7.44
	p-value	0.00	0.00	0.00 0.00
	Hansen J statistic	1.73	3.51	n.a.
	p-value	0.19	0.06	n.a.
	Observations	6875	6875	6875

The input linkage and other services variables are weighted by the respective I/O coefficient. All regressors are lagged one year. All models include in both stages the same controls as those listed in table 1. Firm and year fixed effects are includd in all specification. Robust standard errors clustered on industry are presented in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level.

TABLE 4. Matching results for foreign acquisitions

	Pre-acquisition Year	Acquisition year[(a)]	One year later[(b)]	Two years later[(c)]
		ln(Labor productivity)		
Treatment group	1.54	1.71	2.02	2.24
Control group	1.44	1.42	1.60	1.78
ATT		0.194*	0.321*	0.362*
		(0.110)	(0.190)	(0.214)
No. of matched pairs		81	81	81
Mean difference in propensity score		0.0023	0.0023	0.0023
		ln(Sales)		
Treatment group	7.87	7.94	8.00	8.00
Control group	7.32	7.35	7.26	7.16
ATT		0.040	0.180*	0.283**
		(0.060)	(0.095)	(0.112)
No. of matched pairs		98	98	98
Mean difference in propensity score		0.0017	0.0017	0.0017
		ln(Capital-labor ratio)		
Treatment group	1.44	1.51	1.61	1.56
Control group	0.90	0.88	0.85	0.87
ATT		0.102	0.222	0.165
		(0.086)	(0.147)	(0.153)
No. of matched pairs		84	84	84
Mean difference in propensity score		0.0021	0.0021	0.0021

ATT stands for the average treatment effect on the treated. Bootstrapped standard errors are reported in parentheses.
*, **, *** indicate statistical significance at the 10, 5 and 1% level.

(a) $\text{ATT} = \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{acquisition year}} - \ln Y^{\text{control}}_{\text{acquisition year}}\right) - \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{pre-acquisition year}} - \ln Y^{\text{control}}_{\text{pre-acquisition year}}\right)$

(b) $\text{ATT} = \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{acquisition year+1}} - \ln Y^{\text{control}}_{\text{acquisition year+1}}\right) - \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{pre-acquisition year}} - \ln Y^{\text{control}}_{\text{pre-acquisition year}}\right)$

((c) $\text{ATT} = \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{acquisition year+2}} - \ln Y^{\text{control}}_{\text{acquisition year+2}}\right) - \frac{1}{n}\sum_{1}^{n}\left(\ln Y^{\text{treated}}_{\text{pre-acquisition year}} - \ln Y^{\text{control}}_{\text{pre-acquisition year}}\right)$

where Y is the outcome of interest.

ON-LINE APPENDICES [NOT FOR PUBLICATION]

Appendix A. Services policy reform in the Czech Republic, 1998-2003

In order to give some examples of the profound changes that have taken place in Czech services sectors during the period covered by our study (1998-2003), we present a detailed description of the regulatory reforms in the banking, telecommunications and energy sectors. The information below draws largely on the yearly Accession Protocols of the European Commission and the WTO Trade Policy Review for the Czech Republic (2001).

In the banking sector, the privatization of the remaining four large state-controlled banks began with the sale of IPB in March 1998 and the call for expression of interest for CSOB in July 1998. Regulatory improvements were enacted in the same year to separate banks' engagement in the enterprise sector, which was perceived as one of the reasons for banks' soft stance vis-à-vis bad debtors.[39] Foreign investors were treated on equal terms with domestic ones as of 1998, and the supervisory powers of the central bank were strengthened. In 1999, the government published a precise and ambitious timetable for the remaining privatizations in banking. In June, a majority stake in CSOB was sold to foreign investors. Another bank, CS, with a public share of 45%, was completely privatized in March 2000. In preparation for privatization, many historic debt positions were moved into a public fund, with the state covering the cost of the write-offs. This was particularly relevant for CS and even more so KB, the last remaining public bank awaiting privatization. By 2000, two thirds of banking assets were foreign owned. In 2001, KB was privatized after a massive bailout by the state. This completed the banking privatizations, and left 90% of banking assets in foreign-controlled banks, with 27 out of 40 commercial banks being foreign owned. In 2002, after another legal reform, the EU deemed the banking sector in the Czech Republic to be in compliance with the *Acquis Communautaire.*

In the telecommunications sector, the monopoly fixed line operator was majority public-owned in 1998, and there was no independent regulator for the sector. The two ministries in charge of regulation faced a conflict of interest by simultaneously exercising the state's controlling property rights in several operating companies. In mobile services, there were two providers with 51% public ownership and the remaining capital held mostly by foreign investors. In early 2000, the Telecommunications Act established an independent regulator and determined that January 1, 2001 would be the end of the fixed line monopoly of the incumbent. New licenses were issued in advance of the market opening in 2001, and the regulator made a number of crucial decisions regarding interconnection. Yet, as interconnection prices were above comparable prices in the EU and the provision of carrier selection facilities had not been addressed, the EU called for immediate action. A third mobile operator entered the market in 2000, with 100% foreign ownership, and in 2001 the foreign private investor in one of the two mobile companies operating since 1996 increased its shares to 60%. Carrier selection on a call-by-call basis was introduced in July 2002. The developments, combined with reduced interconnection charges, notably increased the level of competition. However, the fixed line market was still largely

[39] Nollen, Kudrna and Pazdernik (2005) describe the conflict of interest stemming from the fact that banks' investment funds owned a sizeable stake in industrial companies. As lenders, the banks were expected to apply prudent lending criteria based on the credit-worthiness of the borrower. However, as owners via investment funds, the banks had an incentive to look for short-term returns and to stave off losses and bankruptcy and therefore preferred to lend than to foreclose or force default. Another unusual characteristic of the Czech banking system was that managers of bank investment funds were in the awkward position of representing their owners in a competing bank.

controlled by a single operator in which the State held a majority stake and which was not fully commercialized. For these reasons, it had been difficult for alternative operators to compete even though the market had legally been open. In August 2002, the government decided to privatize the state's majority stake in the incumbent fixed line operator. Meanwhile, strong competition has evolved in mobile services, which have become a direct competitor to fixed line services.

In the energy sector, a regulatory administration was established in 1998, although its independence was still limited. In January 1999, a transmission system operator for electricity was set up as a 100% subsidiary of the national electricity company, separating the production and transmission accounts as required by the EU Electricity Directive. However, the dominant producer still held a monopoly for transmission, transit, import and export of electricity. Tariffs, which had traditionally been set below costs, were revised in 1999, which implied an increase in the maximum prices for gas and power for households effective in early 2000. Two regional energy distributors in South Bohemia were privatized in 2000, and authorities embarked on a gradual process of price liberalization, which aimed at eliminating cross-subsidies. On 1 January 2001, a new Energy Act came into force providing for a gradual liberalization of the electricity and gas markets, including third party access starting in 2002. Following further price liberalization in both segments, the EU Commission concluded that the alignment of prices for private households with cost recovery levels was achieved for electricity and was near completion for gas by 2001. The same year saw the establishment of an independent regulator, the Energy Regulatory Office (ERO). It is funded from a separate chapter of the state budget, with its principle responsibility being the promotion of competition. The regulator can pass secondary legislation, grant market licenses and set market rules. In 2002, the ERO issued decrees regulating the construction of and access to the electricity and gas network infrastructure, the cost and revenue calculation for utilities and licensing rules. In January 2002, the market for entities consuming over 40GWh of electricity annually became fully liberalized. This led to a reduction in electricity prices for this market segment, which has 65 eligible customers representing approximately 30% of the Czech market. The privatization of the Czech monopoly gas importer and owner of the transit network, together with the transfer to a German utility firm of a majority of shares in seven out of eight regional gas monopoly distributors, was concluded in May 2002. In the electricity segment, the incumbent operator CEZ was restructured in 2002 and sold its majority stake in the electricity transmission system operator. Thanks to the privatization of major players in the gas market, the restructuring of electricity utilities and the broadly cost-reflective electricity prices, in 2002 the European Commission was able to deem the Czech gas and electricity sectors to be well prepared for the competitive EU-internal energy market.

Appendix B. Production function estimation

Table B1. Estimated production function coefficients

	OLS estimation			Olley-Pakes estimation		
Sector	Labor	Material and services inputs	Capital	Labor	Material and services inputs	Capital
Food and beverages	0.42	0.46	0.05	0.40	0.40	0.10
Textiles	0.22	0.66	0.06	0.16	0.64	0.07
Wearing apparel	0.32	0.49	0.06	0.36	0.48	0.06
Leather, luggage	0.29	0.37	0.10	0.50	0.25	0.16
Wood and wood products; paper and paper products; furniture; manufacturing n.e.c.	0.32	0.49	0.07	0.24	0.55	0.13
Printing and publishing	0.72	0.26	-0.03	0.75	0.26	0.04
Chemical, rubber and plastic products	0.36	0.44	0.10	0.37	0.37	-0.03
Other non-metallic mineral products	0.29	0.54	0.11	0.24	0.49	0.08
Basic metal products	0.20	0.58	0.16	0.22	0.58	0.09
Fabricated metal products	0.33	0.47	0.05	0.26	0.48	0.02
Machinery and equipment	0.35	0.52	0.01	0.32	0.53	0.11
Office and computing machinery; electrical machinery and apparatus	0.37	0.37	0.07	0.32	0.36	0.05
Radio, TV, communications equipment; medical, precision and optical instruments	0.34	0.35	0.10	0.42	0.36	0.27
Motor vehicles; other transport equipment	0.16	0.60	0.12	0.34	0.52	0.02

Appendix C. A description of the EBRD indicators of services sector reforms

The EBRD indicators of services sector reform come from the publication "Transition Report 2004". Sector-specific time-varying indices are available for banking, telecommunications, electric power, railway transport, road transport, and water and waste water. In addition, the publication constructs an aggregate index of infrastructure reform, and an index for financial institutions. For those sectors where no specific sector index was available, we used an overall services index, created as the average of the infrastructure and financial institutions indices. Below we reproduce a description of the indices, as outlined in pages 199-204 of EBRD (2004).

> "The transition indicator scores […] reflect the judgment of the EBRD's Office of the Chief Economist about country-specific progress in transition. The scores are based on the following classification system, which was originally developed in the 1994 Transition Report, but has been refined and amended in subsequent Reports.
> "+" and "--" ratings are treated by adding 0.33 and subtracting 0.33 from the full value. The average is obtained by rounding down, e.g. a score of 2.6 is treated as 2+, but a score of 2.8 is treated as 3 --.
>
> **Infrastructure reform**
> The ratings are calculated as the average of five infrastructure reform indicators covering electric power, roads, railways, telecommunications, water and waste water. The classification system used for these five indicators is detailed below.
>
> **Banking reform and interest rate liberalization**
> 1 Little progress beyond establishment of a two-tier system.
> 2 Significant liberalization of interest rates and credit allocation; limited use of directed credit or interest rate ceilings.
> 3 Substantial progress in establishment of bank solvency and of a framework for prudential supervision and regulation; full interest rate liberalization with little preferential access to cheap refinancing; significant lending to private enterprises and significant presence of private banks.
> 4 Significant movement of banking laws and regulations towards BIS standards; well-functioning banking competition and effective prudential supervision; significant term lending to private enterprises; substantial financial deepening.
> 4+ Standards and performance norms of advanced industrial economies: full convergence of banking laws and regulations with BIS standards; provision of full set of competitive banking services.
>
> **Electric power**
> 1 Power sector operates as government department with few commercial freedoms or pressures. Average prices well below costs, with extensive cross-subsidies. Monolithic structure, with no separation of different parts of the business.
> 2 Power company distanced from government, but there is still political interference. Some attempt to harden budget constraints, but effective tariffs are low. Weak management incentives for efficient performance. Little institutional reform and minimal, if any, private sector involvement.

3 Law passed providing for full-scale restructuring of industry, including vertical unbundling through account separation and set-up of regulator. Some tariff reform and improvements in revenue collection. Some private sector involvement.
4 Separation of generation, transmission and distribution. Independent regulator set up. Rules for cost-reflective tariff-setting formulated and implemented. Substantial private sector involvement in distribution and/or generation. Some degree of liberalization.
4+ Tariffs cost-reflective and provide adequate incentives for efficiency improvements. Large-scale private sector involvement in the unbundled and well-regulated sector. Fully liberalized sector with well-functioning arrangements for network access and full competition in generation.

Railways
1 Monolithic structure operated as government department, with few commercial freedoms. No private sector involvement and extensive cross-subsidization.
2 Rail operations distanced from state, but weak commercial objectives. Some business planning, but targets are general and tentative. No budgetary funding of public service obligations. Ancillary businesses separated, but little divestment. Minimal private sector involvement.
3 Commercial orientation in rail operations. Freight and passenger services separated and some ancillary businesses divested. Some budgetary compensation available for passenger services. Improved business planning with clear investment and rehabilitation targets, but funding unsecured. Some private sector involvement in rehabilitation and/or maintenance.
4 Railways fully commercialized, with separate internal profit centers for passenger and freight. Extensive market freedoms to set tariffs and investments. Implementation of medium-term business plans. Ancillary industries divested. Private sector participation in freight operation, ancillary services and track maintenance.
4+ Separation of infrastructure from operations and freight from passenger operations. Full divestment and transfer of asset ownership implemented or planned, including infrastructure and rolling stock. Rail regulator established and access pricing implemented.

Roads
1 Minimal degree of decentralization and no commercialization. All regulatory, road management and resource allocation functions centralized at ministerial level. New investments and road maintenance financing dependent on central budget allocations. Road user charges not based on the cost of road use. Road construction and maintenance undertaken by public construction units. No public consultation in the preparation of road projects.
2 Moderate degree of decentralization and initial steps in commercialization. Road/highway agency created. Improvements in resource allocation and public procurement. Road user charges based on vehicle and fuel taxes, but not linked to road use. Road fund established, but dependent on central budget. Road construction and maintenance undertaken primarily by corporatized public entities, with some private sector participation. Minimal public consultation/participation on road projects.

3 Fair degree of decentralization and commercialization. Regulation and resource allocation functions separated from road maintenance and operations. Level of vehicle and fuel taxes related to road use. Private companies able to provide and operate roads under negotiated commercial contracts. Private sector participation in road maintenance and/or through concessions to finance, operate and maintain parts of highway network. Limited public consultation/participation and accountability on road projects.
4 Large degree of decentralization. Transparent methodology used to allocate road expenditures. Track record in competitive procurement for road design, construction, maintenance and operations. Large-scale private sector participation in construction, operations and maintenance directly and through public-private partnerships. Substantial public consultation/ participation and accountability on road projects.
4+ Fully decentralized road administration. Commercialized road maintenance operations competitively awarded to private companies. Road user charges reflect the full costs of road use and associated factors, such as congestion, accidents and pollution. Widespread private sector participation in all aspects of road provision. Full public consultation on new road projects.

Telecommunications
1 Little progress in commercialization and regulation. Minimal private sector involvement and strong political interference in management decisions. Low tariffs, with extensive crosssubsidization. Liberalization not envisaged, even for mobile telephony and value-added services.
2 Modest progress in commercialization. Corporatization of dominant operator and some separation from public sector governance, but tariffs are still politically set.
3 Substantial progress in commercialization and regulation. Telecommunications and postal services fully separated, and cross-subsidies reduced. Considerable liberalization in the mobile segment and in value-added services.
4 Complete commercialization, including privatization of the dominant operator, and comprehensive regulatory and institutional reforms. Extensive liberalization of entry.
4+ Effective regulation through an independent entity. Coherent regulatory and institutional framework to deal with tariffs, interconnection rules, licensing, concession fees and spectrum allocation. Consumer ombudsman function.

Water and waste water
1 Minimal degree of decentralization; no commercialization. Services operated as vertically integrated natural monopolies by a government ministry or municipal departments. No financial autonomy and/or management capacity at municipal level. Low tariffs, low cash collection rates and high cross-subsidies.
2 Moderate degree of decentralization; initial steps towards commercialization. Services provided by municipally owned companies. Partial cost recovery through tariffs, and initial steps to reduce cross-subsidies. General public guidelines exist regarding tariff-setting and service quality but both under ministerial control. Some private sector participation through service or management contacts, or competition to provide ancillary services.
3 Fair degree of decentralization and commercialization. Water utilities operate with managerial and accounting independence from municipalities, using international

accounting standards and management information systems. Operating costs recovered through tariffs, with a minimum level of cross-subsidies. More detailed rules drawn up in contract documents, specifying tariff review formulae and performance standards. Private sector participation through the full concession of a major service in at least one city.
4 Large degree of decentralization and commercialization. Water utilities managerially independent, with cash flows – net of municipal budget transfers – that ensure financial viability. No cross-subsidies. Semi-autonomous regulatory agency has power to advise and enforce tariffs and service quality. Substantial private sector participation through build-operator-transfer concessions, management contacts or asset sales in several cities.
4+ Water utilities fully decentralized and commercialized. Fully autonomous regulator exists with complete authority to review and enforce tariff levels and quality standards. Widespread private sector participation via service/ management/lease contracts. High-powered incentives, full concessions and/or divestiture of water and waste-water services in major urban areas. “

Appendix D. Data cleaning procedure

All the variables in our data set are subject to missing values. Missing values in firm output created a particular problem when calculating the foreign output shares at the sector level. A large firm with a missing value for output in a given year can lead to bumps in the foreign output share of the respective industry if no correction is made. Hence rather than taking a missing value as a zero, we used linear interpolation to estimate the firm output in a year in which it was missing and we could not obtain the information from the company website. Although imperfect, the interpolated output is most likely a better approximation of the true value than a value of zero. Interpolated values, however, were used only for the construction of the foreign output shares at the sector level, not in our estimation of firm performance.

We also encountered cases of missing information on the country of origin of the firm owner. In these cases, we looked up information on the owners from other publicly available sources and tried to determine whether they were Czech or foreign. This usually allowed us to eliminate any residual doubts. For the top 5 companies in each sector and year, we additionally verified any available information about foreign owners and their date of entry by looking at annual reports and information on the company websites. For smaller firms, we replaced missing values of the record date with the release date of the Amadeus version from which the record originated. In the cases where owners were not physical persons, we used information about the ultimate owners (that is, shareholders in the owner company) and were thus able to account for cases of indirect foreign ownership. We also allowed for the possibility of a firm becoming foreign through a change in shareholders of a possible intermediate owner.

Appendix E. Summary statistics

Table E1. Summary statistics

		Obs	Mean	Std. Dev
Manufacturing				
Firm specific variables	ln(output)	7155	6.96	1.26
	ln(capital)	7155	5.22	1.99
	ln(labor cost)	7155	4.94	1.24
	ln(material and service inputs)	7155	6.20	1.60
	ln(Olley-Pakes TFP)	7155	1.79	0.87
Services input linkages	EBRD	7155	0.43	0.10
	FDI	7155	0.02	0.01
	Concentration	7155	0.06	0.01
	Privatization	7155	0.02	0.01
Manufacturing input linkages	FDI	7155	0.13	0.07
	MFN tariff	7155	4.41	1.31
	EU tariff	7155	1.08	1.61
Within sector effects	FDI	7155	0.17	0.13
	MFN Tariff	7155	5.83	2.58
	EU tariff	7155	1.71	3.09
Services				
	log (employment)	11133	3.93	1.45
	log (output)	11132	6.81	1.38
	log (labor productivity)	11133	1.51	1.31
	log (capital intensity)	11133	0.82	1.94
	log (investment)	11133	2.89	2.85
	log (skill intensity)	11133	0.55	0.70

Appendix F. Controlling for markups

Foreign entry or simply the threat thereof may enhance the degree of competition, and this in turn may affect productivity. Aghion et al. (2009) argue that technologically advanced competition enhances innovation incentives in sectors close to the technological frontier, while discouraging it in laggard sectors. New entry at the intermediate stage could also affect markups at the final stage by influencing the nature of vertical restraints on competition, such as resale price maintenance (Mathewson and Winter, 1984, 1998), although these arrangements may be less relevant to the types of intermediate services we consider in this paper.

Harrison (1994) argues that the relationship between policy reforms and changes in productivity may be mismeasured if policy reforms also affect the nature of competition. If price-cost margins for a given firm exceed one due to market power, then the value of the firm's marginal product will exceed the factor costs by some markup $\mu > 1$. As a result, both the observed rate of productivity growth and the change of this rate will be different from changes to `true' productivity. To illustrate this point, consider the equation (6) from Harrison (1994):

$$\Delta\ln(Y/K) - \alpha_l\Delta\ln(L/K) - \alpha_m\Delta\ln(M/K) = (\mu-1)\,[\alpha_l\Delta\ln(L/K) + \alpha_m\Delta\ln(M/K)] + \Delta A/A$$

where α_l and α_m represent the cost shares of labor and materials and μ is the markup. The left hand side in this equation represents observed productivity growth, while the term dA/A represents the true change of the Solow residual from a production function of the form Y=A G(L, K, M). Observed and `true' productivity growth coincide under perfect competition when $\mu=1$, but not in the presence of market power.

In order to estimate the productivity change associated with a policy reform while correcting for possible changes in markups, Harrison estimates for each industry j an equation of the form:

$$\begin{aligned}\Delta\ln(Y_{it}/K_{it}) = {} & B_{0j} + B_{1j}\,[\alpha_{l\,it}\,\Delta\ln(L_{it}/K_{it}) - \alpha_{m\,it}\,\Delta\ln(M_{it}/K_{it})] \\ & + B_{2j}\,policy_{jt}*[\alpha_{l\,it}\Delta\ln(L_{it}/K_{it}) - \alpha_{m\,it}\Delta\ln(M_{it}/K_{it})] + B_{3j}\,policy_{jt} + g_i + u_{it} \qquad (A1)\end{aligned}$$

where $policy_{jt}$ is the policy reform measure and g_i is a fixed effect for firm i.

In order to ensure that our estimated productivity changes during the period of services sector reform in the Czech Republic are not driven by changes in price-cost margins, we implement this procedure by substituting $policy_{jt}$ with the *services_linkage* measure defined in equation (1), using the *foreign share* in upstream services sectors. The coefficient B_1 is an estimate of an industry's markup μ_j. B_2 measures the effect of changes in markups associated with the policy reform, while B_3 is an estimate of the change to `true' productivity, purged of the effect of markup changes due to services FDI. Table F1 presents the results from estimating equation (A1) for 14 manufacturing sectors. As in Harrison (1994), the equation is estimated using an within-estimator by expressing all variables in deviations from individual firm averages.

We observe markups exceeding one in a number of sectors, although among these sectors markups are significantly larger than one only in food and beverages, wood products, electrical machinery and radio and TV equipment. The change in markups associated with services

liberalization in the Czech Republic is ambiguous, with significant negative coefficient estimates on B_2 for 7 of 14 sectors and significant positive estimates for two.

Most importantly, we find that services reform is associated with significant increases in the `true' Solow residual in 10 of 14 sectors, as well as in the pooled sample of manufacturing firms. These results suggest that the productivity changes we document in this paper are robust to considering changes to the nature of competition over the same period.

Table F1. Controlling for markups following Harrison (1994)

	Food and beverages	Textiles	Wearing apparel	Leather	Wood products
Markup	1.31***	1.13***	0.40*	0.69***	1.27***
	(0.08)	(0.08)	(0.21)	(0.24)	(0.06)
Markup* FDI services input linkage	-21.4***	-2.96	25.83***	1.6	-13.4***
	(3.67)	(2.84)	(8.69)	(15.73)	(2.44)
FDI services input linkage	1.81*	2.62***	4.14**	7.99*	3.49***
	(0.97)	(0.83)	(1.9)	(4.32)	(0.78)
No. of obs.	839	302	99	48	664
R^2	0.73	0.85	0.91	0.84	0.78

	Printing and publishing	Chemical, rubber and plastic products	Non-metallic mineral products	Basic metal products	Fabricated metal products
Markup	1.01***	1.03***	1.00***	1.18***	1.05***
	(0.12)	(0.07)	(0.11)	(0.11)	(0.06)
Markup* FDI services input linkage	1.41	-1.42	-6.5***	-5.33*	-0.41
	(4.19)	(2.65)	(2.48)	(3.26)	(2.20)
FDI services input linkage	-1.11	-0.12	1.32**	0.04	3.02***
	(1.73)	(0.88)	(0.63)	(0.84)	(0.67)
No. of obs.	332	690	411	220	1283
R^2	0.83	0.83	0.72	0.82	0.81

	Machinery and equipment	Electrical machinery	Radio, TV equip.	Motor vehicles	All manufacturing
Markup	1.02***	1.19***	1.31***	1.04***	1.13***
	(0.05)	(0.07)	(0.08)	(0.08)	(0.02)
Markup* FDI services input linkage	3.73**	-12.89***	-17.49***	-2.18	-7.58***
	(1.69)	(4.59)	(3.66)	(5.04)	(0.69)
FDI services input linkage	2.73***	1.73	6.82***	5.06**	2.21***
	(0.67)	(1.62)	(2.57)	(2.41)	(0.29)
No. of obs.	779	505	242	245	6746
R^2	0.91	0.83	0.85	0.86	0.76

The model is estimated in deviations from the firm-specific mean. Standard errors are presented in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1% level. For full names of sectors see Appendix C.