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Foreign Direct Investment in Services and Manufacturing Productivity Growth:

Evidence for Chile

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Abstract

During the 1990s, foreign direct investment in producer service sectors in Latin America was massive. Such investment may increase the quality of services, reduce their cost, and offer opportunities for knowledge spillovers to downstream users of the services. This paper examines the effects of foreign direct investment in services on manufacturing productivity growth in Chile between 1992 and 2004. The authors estimate an extended production function where plant output growth depends on input growth and a weighted measure of foreign direct investment in services. The novelty of the approach is that the authors are able to assess the intensity of usage of various types of services at the plant level and use that information in the estimation of the importance of foreign direct investment in those services. The econometric results show a positive and significant effect of foreign direct investment in services on productivity growth of Chilean manufacturing plants which is robust to a multitude of tests. The economic impact of the estimates is that forward linkages from foreign direct investment in services account for almost 5 percent of the observed increase in Chilean manufacturing productivity growth during the sample period. This evidence therefore suggests that reducing the barriers restricting foreign direct investment in services in many developing economies may help accelerate productivity growth in their manufacturing sectors.

This paper—a product of the Trade Team, Development Research Group—is part of a larger effort in the department to understand the effects of foreign direct investment for developing countries. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at afernandes@worldbank.org.

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1. Introduction

Foreign direct investment (FDI) inflows into the services sector experienced a boom during the 1990s.[1] By 2002, services accounted for 60% of the world stock of FDI, a four-fold increase since 1990 (UNCTAD, 2004). The main recipients of FDI have been profit-seeking producer services which range from network-intensive services such as electricity, telecommunications, and transport to finance and business services. These services are characterized by the facilitating and intermediating role which they play for downstream user firms (Francois, 1990). Thus, better performing producer services sectors would strengthen a country's business environment. A potentially powerful means to achieve such improvements is FDI which can lead to increases in the quality and variety of services available and lower their cost. Manufacturing firms may also benefit from their interaction with foreign services suppliers through spillovers of management, organizational, marketing, or technological knowledge.[2]

Despite the relevance of this topic, the effects of vertical linkages resulting from the openness of producer services to FDI on manufacturing firms have not been widely documented (Hoekman, 2006). This paper attempts to fill this gap by addressing the following question: did the increased penetration of FDI into producer services sectors in Chile benefit productivity growth of manufacturing plants between 1992 and 2004? Chile is an interesting economy to study as its services sector received large FDI inflows during the 1990s. Our empirical framework estimates an extended production function where plant output growth depends on plant input growth (including growth in services inputs)

[1] This boom in mode 3 of trade in services according to the GATS nomenclature (i.e., the case where the services provider moves to the location of the consumer) occurred despite the strong restrictions to FDI in services that remain in place across many countries, particularly in East Asia (Gootiz and Mattoo, 2007).
[2] See Markusen (1989) and Rivera-Batiz and Rivera-Batiz (1992) for a theoretical discussion of benefits from services FDI.

and on a services FDI linkage measure. The following intuitive argument is made in defining that measure. If services FDI has productivity growth effects, then one would expect plants that use services more intensively to benefit more. To identify a causal effect of services FDI on manufacturing plant productivity growth, we use two-period lagged measures of the services FDI linkage which is defined as services FDI penetration weighted by the intensity of services usage at the plant level. Moreover, we control for unobserved fixed differences in productivity growth across plants, for observable plant characteristics, for industry-level and region-level time-varying heterogeneity, and for year fixed effects.

We find evidence of a positive and significant effect of services FDI on the productivity growth of Chilean manufacturing plants that use those services more intensively. Our results are robust to the use of a measure of plant TFP growth based on production function estimation following Levinsohn and Petrin (2003), Ackerberg et al. (2007), Olley and Pakes (1996), or growth accounting. Variations in the definition of the services FDI penetration and the plant-level weights, and other robustness checks confirm our evidence. Interestingly, we also show that our results are not driven by any specific industry. Finally, we find weak evidence of a stronger effect of services FDI for plants in differentiated product industries and no evidence of differential effects across small and large plants. Our preferred estimate suggests that the average increase in the services FDI linkage between 1992 and 2004 added 1.1 percentage points to annual plant productivity growth in Chile, all else constant. The corresponding economic impact is that forward linkages from services FDI accounted for almost 5% of the observed increase in manufacturing users' productivity growth in Chile during the sample period. This economic impact is quite meaningful in light of the finding by Haskel et al. (2007) that spillovers from manufacturing FDI explain a roughly similar share of manufacturing TFP growth in the U.K. during the 1973-1992 period. Since a large fraction of services FDI inflows in Chile consisted in the acquisition of incumbent firms - many of which were privately-owned since the late 1980s - our impact is likely to be an underestimate of the potential impacts in countries where FDI inflows are directed at the privatization of services providers or at the creation of new services providers. The positive effects of services FDI on productivity growth of manufacturing plants may capture to some extent an unmeasured decline in quality-adjusted services prices but also the spillover of managerial and organizational knowledge from foreign services providers to manufacturing users.

The microeconomic evidence provided by our study contributes to the emerging literature on the impact of services liberalization on economic growth and on the performance of services users. At the macro level, Mattoo et al. (2006) and Eschenbach and Hoekman (2006) show that countries with liberalized services sectors grow faster, once all standard growth correlates are controlled for. Based on computable general equilibrium models, Konan and Maskus (2006) and Jensen et al. (2007) argue that business services liberalization could bring large GDP gains to Tunisia and Russia, respectively.[3] The main mechanism for these gains is the increase in the number of services available for manufacturing users as a result of services FDI.[4] At the industry level, Francois and Woerz (2007) show that the increased openness of business services

[3] Markusen et al. (2005) also show important GDP gains from services liberalization based on general equilibrium simulations for a hypothetical country. In their model, the presence of foreign-owned services providers allows final goods producers to rely on more specialized expertise.

[4] This increase in the number of services increases the total factor productivity of manufacturing firms through a Dixit-Stiglitz-Ethier framework (Dixit and Stiglitz, 1977; Ethier, 1982).

through exports and FDI has strong positive effects on exports, value added, and employment of manufacturing industries in the OECD. Fernandes (2007) estimates positive and significant effects of liberalization of finance and infrastructure on labor productivity of downstream manufacturing industries in Eastern European countries. At the firm-level, Arnold et al. (2007a) show significant positive effects of services liberalization in the Czech Republic on manufacturing firms' total factor productivity (TFP) while Arnold et al. (2007b) find significant positive effects of banking, telecommunications, and transport reforms on Indian manufacturing firms' TFP. Finally, Javorcik and Li (2007) estimate a positive effect of FDI in Romania's retail sector on the TFP of manufacturing suppliers to that sector. By exploiting plant heterogeneity in services usage, our study differs from these studies which capture the dependence of manufacturing firms on services using industry-level coefficients from input-output tables. The advantage of using plant-specific time-varying measures of the intensity of services usage is that these enable us to better identify the heavy users of services within the manufacturing sector and to account for the substantial increase in the usage of services by manufacturing plants in Chile over the sample period.

By considering the potential role of knowledge spillovers from services providers to manufacturing users, our study also relates to the literature on vertical spillovers from manufacturing FDI, which are shown to be more important than horizontal spillovers by Javorcik (2004), Kugler (2006), Blalock and Gertler (2008), and Marcin (2008). A rationale provided in this literature for forward linkages is that foreign suppliers provide assistance and complementary services to local buyers. [5]

The remainder of the paper proceeds as follows. Section 2 describes recent trends in services FDI in Chile. Section 3 discusses the expected effects of services FDI and the available evidence. Section 4 describes the data. Section 5 describes our empirical specification. Section 6 discusses our main results and the robustness checks results. Section 7 discusses extensions to our main results. Section 8 concludes.

2. Trends in FDI in Services in Chile

We begin by documenting the substantial increase in FDI in services in Chile. Over the last three decades, liberalization, privatization, and deregulation reforms in Chile opened its economy to trade and investment more than any other country in Latin America (Moreira and Blyde, 2006).[6] In the 1980s, most FDI inflows were related to Chile's comparative advantage in the extraction and processing of natural resources. However, during the 1990s, FDI inflows into services sectors take on a leading role.[7] Electricity and water, transport and telecommunications, and business services represent about 60% of net FDI inflows into Chile during the 1996-2001 period. Figure 1 shows that these substantial FDI inflows resulted in a growing FDI stock in the main services

[5] The main rationale for the strong backward linkages found by Javorcik (2004) for Lithuania and Blalock and Gertler (2008) for Indonesia is that MNCs can benefit from sharing knowledge with local manufacturing suppliers, whereas they are likely to minimize information leakages to domestic competitors.

[6] FDI in Chile is governed by Decree Law 600 in place since 1974 which regulates conditions for market entry, capitalization, and foreign capital remittances (ECLAC, 2000). The decree law grants equal treatment to foreign and domestic investments in mining, manufacturing, and most services sectors, the exceptions being professional services such as engineering, or legal services (Moreira and Blyde, 2006).

[7] FDI inflows achieved a peak in 1999 in the electricity and water sector due to the purchase of Enersis and Endesa-Chile by the Spanish electricity firm Endesa-Spain (ECLAC, 1999).

sectors in Chile Also, the ratio of FDI to output increased substantially in most Chilean services sectors over the 1990s, as shown in Figure 2.[8]

The large FDI inflows in Chile during the 1990s reflect first and foremost the worldwide increase in services FDI mainly motivated by the interest of multinationals (MNCs) in becoming global services providers by gaining access to domestic and regional markets, particularly in the developing world (UNCTAD, 2004). In sectors such as electricity, Chilean firms were privatized before 1990 and later acquired by foreign players. Global MNCs identified Chile's largely privately-owned firms as an attractive investment opportunity to consolidate their positions in Latin America (ECLAC, 2000).

3. The Effects of Services FDI

Services FDI can provide various benefits to the host country: price changes, quality improvements, increased variety of services available, and knowledge spillovers.[9] We describe each of these benefits in turn and provide evidence of their presence in Chile or in developing countries more generally.

3.1 Effects on the Services Sector

First, FDI in services sectors is likely to increase competition in local markets and result in services price reductions. The reason is that incumbent firms - particularly in electricity and telecom sectors - no longer retain the rents they obtained from being previously monopoly providers. The available evidence confirms price decreases for Chile. In the telecom sector, Stehmann (1995) argues that FDI led to more competition,

[8] The computation of the variables shown in Figures 1 and 2 is described in Section 4 and in the Appendix.

[9] Note that some of these benefits could also be linked to improvements in market regulations accompanying the openness of services markets to FDI. Moreover, services FDI can also entail potential costs: (1) foreign ownership in inherently monopolistic sectors such as electricity or telecom may result in higher prices unless the regulatory system is very well defined and managed by the government, and (2) foreign ownership may crowd out domestic firms for example in the banking sector (UNCTAD, 2004).

particularly in the long-distance market where MNCs entered early. In the electricity sector, Pollitt (2004) shows declines in prices during the 1990s. For a group of 80 countries including Chile, Claessens et al. (2001) find that increased foreign equity shares in the banking sector led to stronger competition and reduced margins from 1988 to 1995.

Second, FDI in services sectors may lead to improvements in services quality. These may result from increased competition and from the superior technological, organizational, and managerial know-how of foreign services providers.[10] The superiority of services MNCs is akin to that of manufacturing MNCs and is based on their ownership of intangible assets such as management or marketing techniques, widely documented in the literature (Dunning 1993; Caves, 1996). In the electricity and telecom sectors, quality relates also to the reliability of service provision. FDI can provide the necessary finance for the major investments required for the modernization and expansion of existing networks. UNCTAD (2004) provides evidence of a positive impact of FDI on the reliability of services in Latin America during the 1990s.[11] World Bank (2004) shows improved service quality in the electricity sector in Latin America as a result of privatization often to foreign MNCs and of deregulation.

Third, FDI in services sectors may result in a greater variety of services being provided, including new and technologically advanced services or services provided to new regions or new types of clients. Evidence of an increased number of innovative financial products available and of electronic banking techniques as a result of FDI in the banking sector is provided by Denizer (1999) for Turkey, Akbar and McBride (2004) for

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[10] Shelp et al. (1984) describe the process of technology transfer from MNCs parents to their affiliates in the insurance and engineering and consulting services sectors across developing countries.

[11] We should note that despite the strong foreign presence in its electricity sector, Chile experienced an energy crisis in 1998. The crisis was mainly due to a drought, but brought to light some technical failures and problems of coordination and transparency in the activities of power-generating firms (Gabriele, 2004).

Hungary, and Cardenas et al. (2003) for Mexico. ECLAC (2000) shows that FDI in the Chilean telecom sector led to the provision of a wider range of products and services in addition to an increase in the number of telephone lines.

Fourth, FDI in services sectors may result in leaking of managerial, marketing, and organizational know-how and best practices (e.g., linked to the environment or to labor codes) from foreign to domestic providers. Miroudout (2006) documents these knowledge spillovers for the banking, telecom, and transport sectors across developing countries.

The four potential effects from FDI in services sectors just described - price reductions, quality improvements, increased variety of services available, and knowledge spillovers - are likely to stimulate productivity growth within the services sector, for both foreign and domestic providers. The fact that MNCs may have acquired the best performing services firms (some privatized since the late 1980s) instead of opening new subsidiaries could reduce the potential for positive effects of FDI on the performance of Chilean services firms. Nevertheless, the evidence suggests that those positive effects materialized for example in the electricity sector which exhibits significant improvements in labor productivity due to FDI during the 1992-2002 period (Pollitt, 2004).

3.2 Effects on the Manufacturing Sector

The crucial hypothesis that we test in this paper is whether the aforementioned FDI-induced improvements in services sectors benefit the productivity growth of downstream manufacturing users. If present, these dynamic benefits could be classified as pecuniary (rent) spillovers which are a by-product of market interactions (Griliches, 1992). Manufacturing plants benefit from pecuniary spillovers if they use services and the services' quality improvements are (i) not fully appropriated by services providers and/or

(ii) not incorporated in services price deflators.[12] Regarding (i), for services sectors which tend to be characterized by imperfect competition, the most likely reason why providers do not appropriate the full surplus from better and more diversified services is their inability to perfectly price discriminate.[13] Regarding (ii), price deflators for services sectors in Chile do not capture the improved quality and variety of services (e.g., through hedonic methods). Hence, an estimated significant effect of services FDI on manufacturing plants' measured TFP growth may capture to some extent the pecuniary spillovers from an unmeasured decline in quality-adjusted services prices. In Section 5, we give analytical content to this possibility by drawing on Griliches and Lichtenberg (1984). Note however, that even if price deflators capture perfectly quality improvements there may be services under-pricing due the market structure prevailing in the services sectors and to the inability of services providers to perfectly price discriminate.

Services FDI can also benefit manufacturing plants through spillovers of 'soft technology' linked to managerial, organizational, or marketing know-how and technical skills. Learning by manufacturing plants could result from demonstration effects, personal contacts, and manager or worker turnover.[14] Griliches (1992) distinguishes knowledge spillovers from pecuniary spillovers since in principle only the former allow manufacturing plants to use that knowledge to advance their own innovation capabilities. While this provides a conceptually clear distinction, in practice pecuniary spillovers may become knowledge spillovers if downstream users of better services apply the knowledge embodied in services to improve their own productivity growth (Branstetter, 2001). First,

[12] For this reasoning new services are equivalent to services quality improvements as they replace less suitable alternatives which manufacturing plants had to use previously.

[13] If FDI increases the degree of competition in services sectors, then intensive competitive pressures may prevent services providers from appropriating that surplus. In both cases, services providers charge a price that is lower than the quality of the services provided.

[14] See Malerba (1992) on interactions with suppliers as a spur for incremental technical change by plants.

for knowledge-intensive business services such as marketing, technical, and other consultancy services (e.g., related to information technology), the actual service provided *is* a knowledge-intensive input upon which manufacturing plants may rely to improve their innovation capabilities and productivity growth (Kox and Rubalcaba, 2007).[15] The capability of routine problem-solving as part of everyday project work and the instructions and know-how for installing and using new equipment and systems exemplify knowledge flows between a business services provider and its manufacturing client (den Hertog, 2002). Second, the usage of newer services (e.g., internet banking) may embody technological knowledge which allows manufacturing plants to improve their production and operations (e.g., by increasing the effectiveness of their investments in information technology). Third, the increased reliability of service provision resulting from FDI discussed above may (1) allow manufacturing plants to optimize their machinery usage (e.g., production processes are less disrupted due to electricity outages) and (2) provide the incentives for plants to use technologically more advanced production processes that depend on telecom or internet/data connection. These possibilities capture multiple dimensions of technological change thus motivating a positive effect of services FDI on plant productivity growth and at the same time epitomize the overlap between pecuniary and knowledge spillovers which will characterize our main results.

4. Manufacturing Plant-Level Data

The main dataset used in our analysis is the Encuesta Nacional Industrial Annual (ENIA), which is the annual manufacturing survey of Chilean plants with more than 10

[15] The providers of knowledge-intensive business services can act as facilitators of innovation for manufacturing plants by sharing with them experience and ideas on best practice solutions for technological and business problems based on their observation of localized tacit knowledge across their clients (Muller and Zenker, 2001).

employees. The dataset is an unbalanced panel capturing plant entry and exit. The dataset covers the 1992-2004 period and includes an average of 4913 plants per year classified into 4-digit ISIC revision 2 industries.[16] The Appendix provides details on how the final sample of 57025 observations is obtained and shows the sample composition across years and 3-digit industries as well as summary statistics for the variables used in our econometric analysis. The ENIA survey collects plant-level information on sales, employment, raw materials, investments (buildings, machinery and equipment, transportation, and land) which are used to construct output and inputs for the extended production function specification described in Section 5. All nominal variables are expressed in real terms using appropriate deflators and capital is constructed applying the perpetual inventory method formula, as described in the Appendix.

A particularly interesting feature of the ENIA survey is that it collects information on plant-level expenditures on a variety of services: advertising, banking commissions and interest payments, communications, insurance, legal, technical, and accounting services, licenses and foreign technical assistance, rental payments, transport, other services, electricity, and water. This information allows us to include services (with the exception of electricity) appropriately deflated as inputs in the production function presented in Section 5.1. For electricity, the quantity consumed is the input included. This information also enables us to construct plant-specific time-varying weights representing the intensity of services usage for four categories of services: electricity and water, transport and communications, financial, insurance, and business services, and real estate,

[16] The ENIA dataset has been widely used in research e.g., by Pavcnik (2002), Alvarez and Lopez (2004), and Bergoeing and Repetto (2006). Note that the dataset provides information by plant and not by firm. However, according to Pavcnik (2002) more than 90% percent of firms during the 1979-1986 period were single-plant firms. Therefore plant information corresponds to a large extent to firm information.

further detailed in Section 5.2. Panel A of Figure 3 shows that the average share of services in total sales increased substantially over the sample period for Chilean plants, with business services being the most important component. Panel B of Figure 3 shows substantial differences in the average intensity of services usage across manufacturing industries. However, note that most of the variation in the average intensity of services usage is due to variation within industries rather than across industries.

5. Empirical Specification

5.1 Basic Framework

In this section we present the reduced form framework used to estimate the impact of services FDI on the productivity growth of Chilean manufacturing plants. We consider the following Cobb-Douglas production function in logarithms and first-differences for plant *i* in industry *j* at time *t*:

$$d\ln Y_{it}^{j} = d\ln A_{it}^{j} + \sum_{m=1}^{5} \eta_m^j * d\ln X^{m}{}_{it}^{j} + \eta_s^j * d\ln S_{it}^{j}, \tag{1}$$

where Y_{it}^{j} is output, $\overline{X}_{it}^{j}$ is a vector of five inputs (skilled and unskilled labor, materials, electricity, and capital), S_{it}^{j} is a services input, η_m^j (η_s^j) is the contribution of growth in input X^m (in the services input) to output growth, and A_{it}^{j} is a plant-specific index of Hicks-neutral TFP measuring the plant's efficiency in transforming inputs into output.

For each plant, the services input is measured by nominal services expenditures (excluding those on electricity) deflated by a services price deflator. Improvements in the quality and variety of services available for manufacturing plants possibly linked to services FDI are not fully captured by the services price deflators in Chile. Following Griliches and Lichtenberg (1984), we can define a discrepancy d_{it}^{j} between the change in the available services price deflator, $d\ln ps_{it}^{j}$, and the change in the true quality-adjusted services price deflator $d\ln ps^{*}{}_{it}^{j}$: $d\ln ps_{it}^{j} = d\ln ps^{*}{}_{it}^{j} + d_{it}^{j}$.[17] If the change in nominal services expenditures is correctly measured ($d\ln NS_{it}^{j} = d\ln NS^{*}{}_{it}^{j}$), then growth in services in (1) is calculated as $d\ln S_{it}^{j} = d\ln NS_{it}^{j} - d\ln ps_{it}^{j}$. However, growth in true services is given by $d\ln S^{*}{}_{it}^{j} = d\ln NS_{it}^{j} - d\ln ps^{*}{}_{it}^{j}$. Thus, $d\ln S^{*}{}_{it}^{j} - d\ln S_{it}^{j} = -d\ln ps^{*}{}_{it}^{j} - (-d\ln ps_{it}^{j}) = d_{it}^{j}$. Making the simplifying assumption that output is correctly measured and services is the only mismeasured input, (1) can be rewritten in true growth rates as:[18]

$$d\ln Y_{it}^{j} = d\ln A^{*}{}_{it}^{j} + \sum_{m=1}^{5} \eta_{m}^{j} * d\ln X^{m}{}_{it}^{j} + \eta_{s}^{j}(d\ln S_{it}^{j} + d_{it}^{j})\,. \qquad (2)$$

where $d\ln A^{*}{}_{it}^{j}$ is actual productivity growth. This implies that measured productivity growth $d\ln A_{it}^{j}$ based on (1) deviates from true productivity growth by the discrepancy in the change of the services prices deflator: $d\ln A_{it}^{j} = d\ln A^{*}{}_{it}^{j} + \eta_{s}^{j} d_{it}^{j}$. As Griliches and Lichtenberg (1984) state, this equality is a definitional relationship between measured productivity growth and true productivity growth.

The crucial hypothesis tested in this paper is whether services FDI affects the productivity growth of manufacturing plants. This effect could result from pecuniary

[17] The use of the quantity of electricity in (1) implies that the pecuniary spillover discussion does not apply to that input directly. However, the discussion may be of relevance indirectly as the quantity of electricity may not capture improvements in the reliability of provision, which can be an important effect of FDI in the electricity sector.

[18] This is a strong assumption given the problems associated with the measurement of output and intermediates by deflated revenues and deflated expenditures in the absence of data on physical quantities of output and intermediates. Plant productivity measures based on deflated revenues and deflated expenditures combine true plant efficiency and price-cost markups. If the mark-ups increase with efficiency as for example in the model developed by Bernard et al. (2003), then productivity measures are correlated with true plant efficiency. We abstract from the issues of measurement of output and intermediates to focus on the effect of services FDI on manufacturing TFP growth.

spillovers showing up in measured productivity growth through mismeasured improvements in services quality and variety by services prices deflators. Equally important is the possibility that services FDI may generate knowledge spillovers for manufacturing plants, and pecuniary spillovers themselves can result in knowledge spillovers, as discussed in Section 3. Thus, we allow measured plant productivity growth to depend on a measure of services FDI $FDIsl_{it-1}^{j}$ discussed in Section 5.2 as:

$$d\ln A_{it}^{j} = \beta_{fdi\_s} FDIsl_{it-1}^{j} + \gamma_{Z} \overline{Z}_{it-1}^{j} + \lambda_{t}, \tag{3}$$

where $\overline{Z}_{it-1}^{j}$ is a vector of lagged control variables potentially affecting plant productivity growth, and λ_t are time specific effects. Combining (3) and (1) and adding a stochastic residual we obtain a preliminary version of our empirical specification:

$$d\ln Y_{it}^{j} = \beta_{fdi\_s} FDIsl_{it-1} + \sum_{m=1}^{5} \eta_{m}^{j} * d\ln X^{m}{}_{it}^{j} + \eta_{s}^{j} * d\ln S_{it}^{j} + \gamma_{z} \overline{Z}_{it}^{j} + \lambda_{t} + \varepsilon_{it}^{j}. \tag{4}$$

A positive β_{fdi_s} indicates a beneficial impact of services FDI on plant productivity growth, i.e., output growth controlling for input growth. Before discussing the econometric issues associated with the estimation of (4), we present our measure of services FDI.

5.2 Services FDI Linkage Measure

To estimate the effects of services FDI on manufacturing productivity growth, we make the working hypothesis that Chilean plants that are relatively heavy users of services should (ceteris paribus) benefit disproportionately more from increases in services FDI than plants that are less heavy users of services.[19] To capture the intensity of services usage by plants, we compute the ratio of plant expenditures on the various services listed in Section 4 to plant sales. Information on a plant's usage of foreign-provided services as separate from domestic-provided services would be the ideal measure to use. However, to the extent that domestic services providers improve their quality and variety and lower their prices due to the presence of FDI in their sector - through increased competition or knowledge spillovers - a plant's total services usage can adequately capture the benefits which a Chilean manufacturing plant may derive from services usage for its *productivity* growth beyond the contribution that services input growth per se generates for the plant's *output* growth.

To capture the presence of FDI, we compute net FDI inflows for each sector based on data from the Chilean Foreign Investment Committee by subtracting from annual FDI inflows the corresponding annual FDI outflows (which represent foreign investors' repatriation of capital, profits, and dividends). Net FDI inflows however do not adequately capture the importance of FDI in a services sector and year because they neither account for past investments nor for the size of the sector. Thus, we cumulate net FDI inflows using the perpetual inventory method formula to construct an FDI stock for each services sector, as described in the Appendix.[20] Then, our measure of FDI penetration in a services sector is given by the ratio of the sector's FDI stock to the sector's output (GDP) obtained from the Chilean Central Bank.[21]

[19] This assumption is inspired by that made by Rajan and Zingales (1998) in the estimation of the benefits of access to finance for industry growth. Our assumption implies that cost is the only limitation to purchase services and that there are no other restrictions preventing the access to certain services by certain users.
[20] Our approach is similar to that followed for example to construct R&D stocks (Coe and Helpman, 1995).
[21] Note that this measure differs from the traditional measures of the presence of FDI in a sector used in the FDI spillovers literature, i.e., the share of a given sector's sales or employment accounted for by foreign firms.

To construct our final measure that captures both the presence of FDI in services sectors and plant usage of those services, we weigh the FDI penetration ratio in a services sector by the intensity of plant usage of those services in year *t*. The 'services FDI linkage' measure is computed as: $FDIsl_{it} = \sum_{k=1}^{K} \alpha_{it}^{k} * FDI_{kt}$, where FDI_{kt} is the FDI penetration ratio in services sector *k* and α_{it}^{k} is the intensity of usage of services from sector *k* by plant *i* in year *t.* We drop the manufacturing industry subscript *j* from $FDIsl_{it}^{j}$ in what follows to emphasize the fact that this is a plant-level time-varying measure rather than an industry-level time-varying measure. The sum is computed over four groups of services: (1) electricity and water, (2) transport and communications, (3) financial, insurance, and business services, and (4) real estate.[22]

To validate our aforementioned working hypothesis, we generate 1000 groups of random plant-level time-varying services intensity weights, recompute our services FDI linkage variable using those random weights, and estimate our main specification 1000 times, following Keller (1998).[23] The average coefficient on the services FDI linkage obtained from this simulation is negative and insignificant suggesting that that the intensity of services usage by plants does matter for the estimated impact of FDI on the productivity growth of Chilean manufacturing plants, which will be shown to be positive and significant in Tables 1-4.

Our services FDI linkage measure draws upon the measures used by Javorcik (2004), Blalock and Gertler (2008), and Arnold et al. (2007a), but differs from those by

[22] These groups of services are dictated by the availability of sectoral GDP from the Chilean Central Bank. Business services encompass advertising, legal, technical, and accounting services, licenses and foreign technical assistance, and other services. More details on the services FDI linkage measure are provided in the Appendix.
[23] We follow Keller (1998) in drawing the random plant-level time-varying services intensity weights from a uniform distribution with support [0,1] using the pseudo random number generator of the GAUSS software.

relying on a plant-specific time-varying intensity of services usage instead of services usage measures based on input-output table coefficients. A first shortcoming of measures based on input-output tables is that they provide information on average industry usage which does not identify the heavy users of services within the industry. Indeed, Figure 3 Panel B shows a large degree of heterogeneity in services usage across plants within 3-digit industries in Chile. A second shortcoming of measures based on input-output tables is that they provide information for a single year which is particularly restrictive for services usage during our sample period when the linkages between services and manufacturing resulting from processes of outsourcing or splintering increased dramatically (Francois and Woerz, 2007). Figure 3 Panel A confirms this trend for Chile.

5.3 Econometric Issues and Final Specification

First, Chile experienced strong economic growth during most of our sample period, which may have resulted simultaneously in manufacturing productivity growth and in the attraction of FDI into services sectors. Thus, an estimated positive effect of the services FDI linkage could be due to its spurious correlation with productivity growth through the strong economic growth channel. Hence, (4) includes year fixed effects which also account for economy-wide technological progress.

Second, plant unobservables such as managerial ability may affect both plant productivity growth and the services FDI linkage through the intensity of services usage. To address this possibility, we allow the residual ε_{it}^{j} in (4) to include a plant-specific component f_i such that $\varepsilon_{it}^{j} = f_i + u_{it}^{j}$, where u_{it}^{j} is an independent and identically distributed disturbance. Hence, our final specification is estimated by plant fixed-effects.

Third, time-varying plant- or industry-level observable factors could be correlated with the services FDI linkage and with plant productivity growth. Those factors' omission could bias the estimated coefficient on the services FDI linkage in (4). Main candidate factors are contemporaneous FDI in manufacturing and mining. The services FDI linkage in (4) could be proxying for the effects of FDI in these other sectors. To address this possibility, we include in our final specification FDI linkage variables for manufacturing and mining whose construction is described in the Appendix. The coefficient on the services FDI linkage could also pick up differences in services usage by foreign-owned, exporting, or larger plants, which in turn may exhibit different productivity growth rates relative to other plants. Hence, we include in the vector $\overline{Z}_{it-1}^{j}$ dummies to control for foreign ownership, export status, and plant size.[24]

Fourth, it is possible that certain manufacturing industries experience faster technological progress or changes in their market structure relative to other industries, with potential consequences for plant productivity growth. Chilean regions may also exhibit differential growth rates over time due to the evolving nature and importance of agglomeration economies. To account for these possibilities, we control for industry-year interaction effects and region-year interaction effects in our final specification.

Finally, a major challenge for our estimation is the potential endogeneity of the services FDI linkage with respect to manufacturing productivity growth. Two potential rationales could motivate this endogeneity. On the one hand, manufacturing industries experiencing fast productivity growth may lobby the government for services liberalization, which would result in an upward-biased coefficient on the services FDI

[24] We define three size categories based on plant-level total employment as in Stumpo and Alarcon (2001): small plants have less than 50 employees, medium plants have 50 to 200 employees and large plants have more than 200 employees. We also experiment with other size categories and found the results to be robust.

linkage. However, since Chile's FDI regime was liberal since the 1980s, lobbying by manufacturing industries for services liberalization would have occurred well before our sample period and is thus unlikely to be source of bias for our coefficient of interest.[25] On the other hand, the productivity growth of manufacturing plants in Chile in the 1990s may have been a driving force for services MNCs to invest in Chile in expectation of strong demand for services. This reverse causality could lead to an upward-biased coefficient on the services FDI linkage. While ECLAC (2004) argues that foreign investors were attracted to the sound performance of recently privatized services firms in Chile, there is no clear evidence that the performance of the manufacturing users of those services was a driving force for FDI. Nevertheless, strong productivity growth in some manufacturing industries in Chile may have provided an additional incentive for MNCs to invest in the country's services sectors. Our choice of a services FDI linkage measure based on services FDI *stocks* instead of FDI *inflows* helps to mitigate this potential reverse causality. Moreover, our final empirical specification includes the services FDI linkage lagged two periods, instead of being lagged one period as in (4). The question that arises is whether the two-period lagged services FDI linkage is exogenous to current plant productivity growth. This would not be the case if plant productivity growth was serially correlated over time. While plant productivity *levels* tend to exhibit strong serial correlation in micro datasets, this is not expected for plant productivity *growth*. Indeed, our tests for first-order autocorrelation in plant productivity growth based on the Baltagi-Wu locally best invariant (LBI) test show no evidence of serial correlation. We therefore

[25] In fact, one may even question whether such type of lobbying played a role given that the privatization of services firms starting in the late 1980s was partly motivated by the need to solve a public deficit problem (Bitran and Saez, 1994).

argue that the use of a services FDI linkage measure based on FDI stocks and lagged two periods is a reasonable way to mitigate potential reverse causality problems.

The considerations above lead to our final empirical specification:

$$d\ln Y_{it}^{j} = \beta_{fdi\_s} FDIsl_{it-2} + \sum_{j=1}^{J}\sum_{m=1}^{6} \eta_{m}^{j} * d\ln X^{m}{}_{it}^{j} + \eta_{s}^{j} * d\ln S_{it}^{j} + \gamma_{fdi\_i} FDIndl_{jt-2}$$
$$+ \gamma_{fdi\_r} FDIres_{jt-2} + \gamma_{z} \overline{Z}_{it-1}^{j} + \gamma_{ind}\, ind * year + \gamma_{reg}\, reg * year + \lambda_t + f_i + u_{it}^{j} \quad (5)$$

where $FDIsl_{it-2}$ is the two-period lag of the services FDI linkage, $FDIl_{jt-2}$ and $FDIres_{jt-2}$ are the two-period lag of the manufacturing and the mining FDI linkages, respectively.[26] In the estimation, the coefficients on input growth are allowed to differ across 2-digit industries. Finally, recall that the vector $\overline{Z}_{it-1}^{j}$ includes dummies for foreign ownership, export status, and size, that *ind * year* and *reg * year* are industry-year and region-year interaction fixed effects, and u_{it}^{j} is an i.i.d. disturbance.

6. Results

6.1 Main Results

Our main results are shown in Table 1. Column 1 presents the results from a plant fixed-effects specification that follows previous studies in weighing services FDI penetration by industry-level services usage based on coefficients from the Chilean 1996 input-output table, as detailed in the Appendix. We find insignificant effects of that measure of weighted services FDI penetration on plant productivity growth. In Column 2, we estimate a variant of (5) including only the one-period lag of the services FDI linkage. We find a strong positive effect of services FDI on the productivity growth of

[26] These variables are indexed by the industry subscript *j* since they are calculated based on coefficients from the 1996 Chilean input-output table, as described in the Appendix.

manufacturing plants. However, the specification in Column 2 does not take into account potential endogeneity and thus the effect of services FDI on productivity growth is likely to be over-estimated. Indeed, the use of the two-period lag of the services FDI linkage in Column 3 reduces substantially the magnitude of the effect. However, the estimated coefficient on the services FDI linkage is still positive and significant at the 1% confidence level. In Column 4 we add the manufacturing and mining FDI linkages and find the coefficient on the services FDI linkage to be unaffected. Finally, Column 5 estimates the complete empirical specification in (5) which controls for plant-level observables, industry-year and region-year interaction effects and is our preferred specification. The standard errors in Table 1 and all subsequent tables are robust and clustered at the plant-level to allow for possible correlation across observations belonging to the same plant.[27] The plant fixed effects are found to be jointly significant in all our specifications. Our choice of plant fixed effects estimation is driven by the results from Hausman tests which reject random effects in favor of fixed effects for our specifications. Finally, note that the estimated input growth coefficients corresponding to the specification in Column 5 of Table 1 are shown in Appendix Table A.3 and are generally significant and have magnitudes in line with those in previous studies.

Our finding of positive and generally significant effects of electricity growth and of services growth in Appendix Table A.3 indicates that above and beyond those positive contributions to plant output growth, increases in services FDI in Chile during the 1992-2004 period led to a significant increase in productivity growth for the plants that use services more intensively. Our preferred coefficient (0.153) implies that the average

[27] The use of non-clustered robust standard errors or other levels of clustering – at the year level, at the 3-digit industry level and at the 3-digit industry-year level – does not affect the significance of our results.

increase in the services FDI linkage over the sample period (0.073) added 1.1 percentage points to annual plant productivity growth in Chile, all else constant. To quantify further the economic impact of services FDI, note that, based on our estimates, productivity growth increased by about 24% between 1992 and 2004 in the Chilean manufacturing sector.[28] Thus, our preferred coefficient implies that the forward linkages from services FDI explain 4.7% of the observed increase in Chile's manufacturing users' productivity growth. This economic impact is quite meaningful in light of the finding by Haskel et al. (2007) that spillovers from manufacturing FDI explain 5% of manufacturing TFP growth in the U.K. between 1973 and 1992. Moreover, in Chile, a large fraction of services FDI inflows consisted in the acquisition of incumbent services providers, some of which were privately-owned since the late 1980s, thus our impact is likely to underestimate the potential impacts in countries where FDI inflows are directed at the privatization of services providers or at the creation of new services providers.

The specification estimated in Table 1 uses output growth as the dependent variable, following (5) exactly. However, to ensure that our strong positive effects of services FDI are not due to the use of a particular productivity growth measure, we compute an alternative measure of plant productivity growth as follows. We estimate a Cobb-Douglas production function with all six inputs (including real services) separately for each 2-digit industry following the estimation technique proposed by Levinsohn and Petrin (2003) and report the estimated coefficients in Appendix Table A.4. The advantage of this method over simple OLS production function estimation is that it corrects for the potential endogeneity between inputs and plant unobserved productivity. Plant-level

[28] Following Haskel et al. (2007), we compute manufacturing productivity growth as the difference between output growth and the weighted contribution of input growth, where weights are the input growth coefficients shown in Appendix Table C.3. Productivity growth is calculated for each plant and is then averaged by year.

logarithmic TFP levels are computed as the residuals from the production function. The first difference in these plant-level logarithmic TFP levels gives us an alternative measure of plant productivity growth used as the dependent variable in the regressions whose results are shown in Table 2. The specifications shown are similar to those in Table 1 with the exception that they do not include input growth. Column 5 provides evidence of a significant positive effect of the services FDI linkage on the TFP growth of manufacturing users, similar in magnitude to that in Column 5 of Table 1.

Overall, we find a positive impact of FDI in services sectors on the productivity growth of manufacturing plants. This impact may capture to some extent pecuniary spillovers due to a reduction of services prices, improvements in services quality and variety as result of FDI but may also capture the spillover of managerial and organizational knowledge or technical skills from foreign services providers to manufacturing plants. Moreover, as discussed in Section 3, our impact can also reflect pecuniary spillovers-driven knowledge spillovers.

6.2 Robustness Checks

While we believe that our services FDI linkage measure captures the importance of FDI in services sectors in Chile, we verify whether our results are robust to modifications in the definition of that measure. We modify three components of our linkage measure: the numerator and the denominator of the services FDI penetration and the plant-level weights. The first two columns of Table 3 report the results from specifications where the numerator of the services FDI penetration - FDI stocks - are computed using depreciation rates of 0% and 10% which differ from the rate used in our main measure. The next three columns of Table 3 report the results from specifications where we modify the denominator of the services FDI penetration - time-varying sectoral GDP. In Column 3 we use sectoral output in 1996 from the 1996 input-output table, which ignores the time variation. In Column 4, we use the time-varying economy-wide GDP. In Column 5, we drop the denominator and use simply the log of the services FDI stock. Each of these alternative services FDI penetration variables is interacted with the same plant-level weights as in our main specification. Panels A and B report, respectively, the results for output growth and TFP growth using Levinsohn and Petrin (2003). Across all specifications, we find the coefficient on the services FDI linkage to be positive and significant. The coefficients differ from those in Tables 1 and 2 since the magnitude of the services FDI penetration measures are quite different across specifications. The last two columns of Table 3 report the results from specifications where we use alternative measures of the intensity of plant-level services usage. In Column 6 we subtract from the plant-level weights the time-varying median service usage in the plant's 3-digit industry. In Column 7, we define plant-level services usage relative to total revenues instead of total sales. The coefficient on the services FDI linkage remains positive and significant.

In Table 4 we perform additional robustness tests. First, to address further the potential reverse causality we estimate our main specification including the three-period lag of the services FDI linkage. We find positive and significant effects of the services FDI linkage using both output growth (Column 1 of Panel A) and TFP growth from Levinsohn and Petrin (2003) (Column 2 of Panel A) as the dependent variable.

Second, despite being confident in the appropriateness of the data cleaning procedures applied to the Chilean data described in the Appendix, we impose a more stringent criterion on the data to guarantee that our results are not being driven by remaining potential outlier observations, In Columns 3-4 of Panel A, we drop from the sample plants whose output or TFP growth is in the top or bottom percentiles of the corresponding distribution. The effects of the services FDI linkage measure on productivity growth are still positive and significant.

Third, to examine whether domestic plants benefit more from services FDI than foreign plants which may rely on the parent MNC for some services, we show in Columns 5-6 of Panel A the results from estimating our main specifications domestic plants only. The magnitude of the services FDI linkage coefficient is unchanged, suggesting that domestic and foreign plants benefit equally from services FDI.

Fourth, while the industry-year interaction effects included in our preferred specifications account in a general way for industry-specific technological progress and competition, we include an observable measure of the degree of competition - the normalized Herfindahl index of plant market shares at the 3-digit industry level - instead of the interaction effects in Columns 7-8 of Panel A. The results show that the effect of services FDI on plant productivity growth is still positive and significant. The effect of competition on productivity growth is found to be positive but insignificant.[29]

Fifth, given the inherent difficulty and the controversy associated with the estimation of production functions (Bond and Söderbom, 2005), we consider three alternative estimates of plant productivity growth. We follow the Olley and Pakes (1996) technique to estimate a production function for each 2-digit industry. While this technique corrects for the endogeneity of input choices with respect to productivity and for potential biases in the capital coefficient due to plant exit, it restricts the production

[29] In unreported regressions that include the market share of the top 4 plants in each 3-digit industry as the measure of competition we also find the effects of the services FDI linkage to be robust.

function's estimating sample to include only plants which invest. On average in a sample year, 45% of Chilean manufacturing plants do not invest and these plants tend to be smaller than those that do invest, which might introduce a different source of bias to the production function coefficients, plant TFP levels and growth.[30] Even so, we pursue the Olley and Pakes (1996) estimation, obtain residual plant TFP levels, and use the corresponding plant TFP growth as the dependent variable in Column 9 of Panel A.[31] The results show a positive and significant effect of the services FDI linkage on TFP growth smaller than those estimated in Tables 1-2. Next, we compute plant TFP growth using an index number approach where the contribution of input growth to output growth is given by the share of each input in total sales, an approach which is advocated by Van Biesebroeck (2007) and is described in the Appendix. The coefficient in Column 10 of Panel A shows a positive and significant effect of the services FDI linkage of a larger magnitude than those in the other columns and tables. Lastly, we estimate a production function for each 2-digit industry following the technique proposed by Ackerberg et al. (2007) which addresses the potential problems of collinearity from which the Levinsohn and Petrin (2003) technique may suffer.[32] Column 11 of Panel A presents the results from using the plant TFP growth measures based on the corresponding residual TFP levels as the dependent variable. Again, we find a positive and significant effect of the services FDI linkage on TFP growth.

Sixth, we examine whether our results are driven by any particular industry. Panel B of Table 4 shows the results from estimating our preferred specification using output

[30] The average total employment for plants in the full sample considered in Tables 1 and 2 is 71 workers while that average for plants entering the Olley and Pakes (1996) estimation is 95 workers.
[31] Note that we compute TFP growth rates (based on TFP levels) for *all* plants - including those that do not invest - following Olley and Pakes (1996).
[32] The Olley and Pakes (1996) and Ackerberg et al. (2007) coefficients are available upon request.

growth as the dependent variable and excluding one 2-digit industry at a time. The findings show that the positive effects of services FDI on plant productivity growth are not driven by any industry, not even by food, the largest industry in Chile. We obtain similar findings using TFP growth as the dependent variable. This robustness check is particularly reassuring about the strength of our results. It also highlights the interesting fact that the positive effects of services FDI in Chile are universal within the manufacturing sector. However, the strength of the effects varies across industries.

We should note that when we consider a translog functional form for our production function, the unreported results also show a positive and significant coefficient on the services FDI linkage of a similar magnitude as those discussed above.

Finally, one concern for the interpretation of our main results relates to the composition of the services FDI linkage measure. One could argue that the stronger usage of services by some plants is what is driving up their productivity growth (and thus producing our estimated positive effects in Tables 1-4), rather than the presence of FDI in those services sectors. To address this issue we estimate two variants of (5) and perform a simulation exercise. A first variant includes the services FDI linkage measure as in Table 1 and growth in the four services which enter the computation of that measure instead of growth in electricity and growth in other services as in (5). The unreported results show a significant coefficient on the services FDI linkage of similar magnitude as that in Table 1. The coefficients on growth in the four services inputs are generally positive and significant across industries. A second variant includes this growth in the four services inputs and separates the services FDI linkage into its four components shown in Section 5.2. The unreported results show positive effects of FDI in transport and communications, financial, insurance, and business services, and in electricity and water with the strongest effect being that of financial, insurance, and business services. Our simulation exercise consists of generating 1000 random time-varying FDI penetration ratios for the four services, recomputing our services FDI linkage variable using those random ratios, and estimating the specification in column 5 of Table 1 1000 times, as in Keller (1998).[33] The average coefficient on the services FDI linkage obtained from this simulation exercise is positive but smaller than our estimates in Table 1 and it is insignificant suggesting that our estimated effect of services FDI on productivity growth of Chilean plants is not driven only by the stronger usage of services by some plants.

7. Heterogeneity in the Effect of Services FDI

Our main findings concern the average impact of services FDI on plant productivity growth across all manufacturing industries. However, the evidence in Panel B of Table 4 suggests that the strength of that impact may differ across industries. We focus on one particular dimension of heterogeneity: the degree of product differentiation in the industry. One can argue that differentiated product industries are characterized by stronger product complexity (Berkowitz et al., 2006).[34] As such, it is likely that services needs are greater for differentiated product industries (Fink et al., 2002). Thus, productivity growth of plants in industries producing differentiated products may benefit more from services FDI. To test this hypothesis, we use the differentiated product

[33] We draw random time-varying FDI penetration ratios for each of the four services sectors from a uniform distribution whose support ranges from 0 to the maximum FDI penetration ratio observed in our sample using the pseudo random number generator of the GAUSS software.
[34] The authors argue that differentiated products have many characteristics that are difficult to stipulate in a contract, thus trade in such products benefits more from good dispute resolution and enforcement institutions.

definition proposed by Rauch (1999).[35] We estimate our main specification allowing the effect of the services FDI linkage to vary across differentiated and non-differentiated products' industries. The results in Columns 1-2 of Table 5 show that services FDI seems to have a stronger effect on the productivity growth of plants in differentiated product industries. However, unreported F-tests show that the difference in the effect of services FDI across the two types of industries is not statistically significant.

Next, we ask whether the impact of services FDI on productivity growth differs by plant size. On the one hand, larger plants may be able to internalize some services and have less to gain from FDI-related services improvements, relative to smaller plants which outsource most services due to scale indivisibilities. On the other hand, larger plants may be technologically more advanced and thus require stronger usage of highly specific and complex services. It is an empirical question whether smaller or larger plants benefit more from services FDI. We estimate our main specification allowing the effect of the services FDI linkage to differ across small and large plants and show the results in Columns 3-4 of Table 5. To define plant size, we compute the median employment for each plant across its sample years and then divide plants according to this measure: plants with less than 25 employees are considered to be small. In Columns 5-6 we separate plants into small and large based on employment in the first plant year. The evidence is mixed depending on whether the first or second criterion is used. Moreover, unreported F-tests show that the difference in the effects of services FDI across smaller and larger

[35] Differentiated products are defined to be those that are neither (i) homogenous products traded in organized exchanges (e.g., steel) nor (ii) reference-priced products which have listed prices in trade publications (e.g., some chemical products) and require a more important degree of buyer-seller interaction. To apply Rauch's definition, we establish a correspondence between his classification of products based on 4-digit SITC rev. 2 codes and our 4-digit ISIC rev. 2 codes. For the printing industry (ISIC 342), we are unable to establish an unambiguous correspondence and thus drop it from the regressions in Table 5.

plants is not statistically significant. Our evidence does not suggest a differential effect of services FDI across plant sizes.

8. Conclusion

This paper examines the effects of services FDI on the productivity growth of manufacturing plants in Chile between 1992 and 2004 by estimating an extended production function where plant output growth depends on input growth and on a weighted services FDI penetration measure. The novelty of our approach is the reliance on measures of plant-level time-varying intensity of services usage as weights for services FDI penetration. Our results provide strong evidence of a positive and significant effect of services FDI on the productivity growth of manufacturing plants that use services more intensively. We find qualitatively similar results based on plant TFP growth obtained following Levinsohn and Petrin (2003). Our findings are also robust to alternative measures of productivity growth and to a variety of tests and are not driven by any specific industry.

While governments spend large sums to attract FDI inflows in expectation of spillovers, the literature focusing the manufacturing sector has provided mixed evidence: relatively weak for horizontal spillovers and strong for vertical spillovers. Our study suggests that researchers may need to focus on the services sector to find strong positive spillover effects from FDI. Our findings also suggest that reducing the barriers that still protect FDI in services sectors in many emerging and developing economies may help accelerate productivity growth in their manufacturing sectors.

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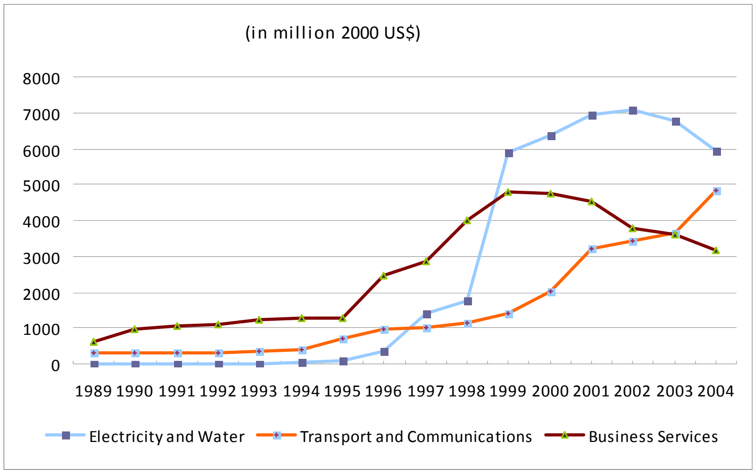
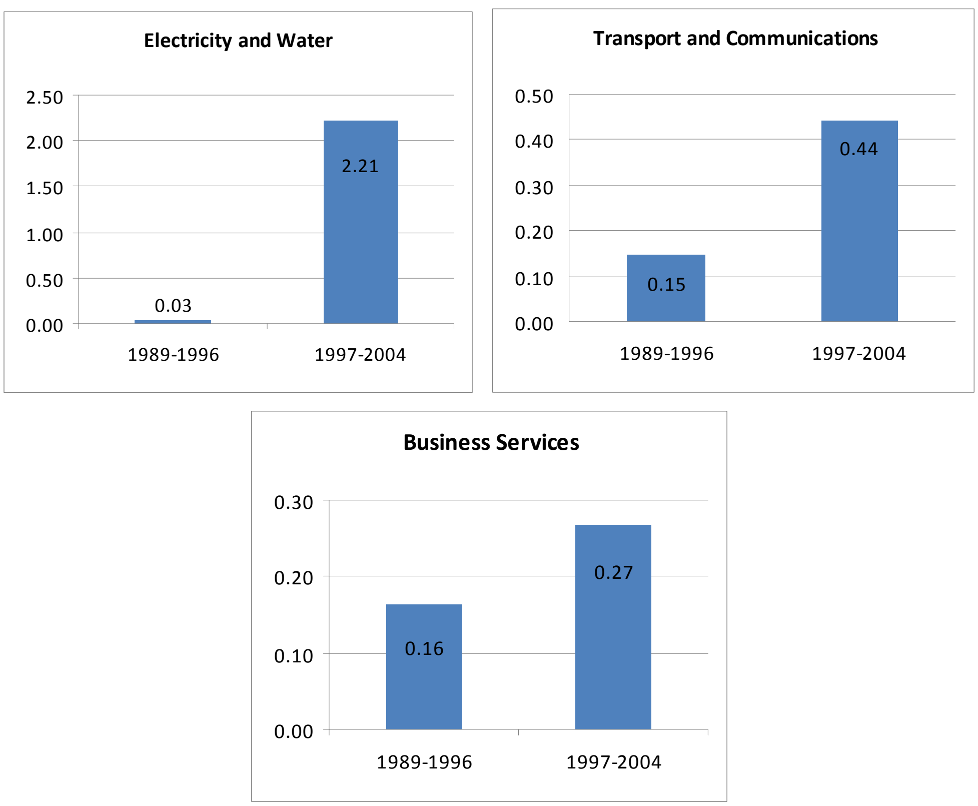
Figure 1: Stocks of FDI in Chilean Services Sectors



Source: Author's calculations based on data from the Chile Foreign Investment Committee.

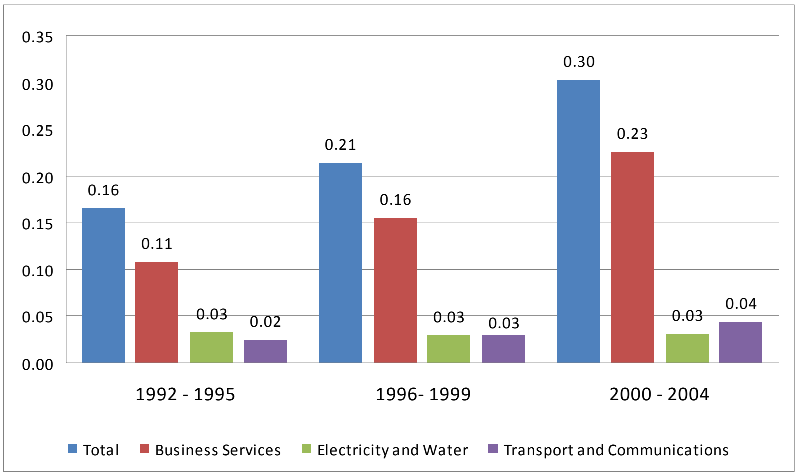
Figure 2: Average Ratio of Sectoral FDI Stocks to Sectoral GDP



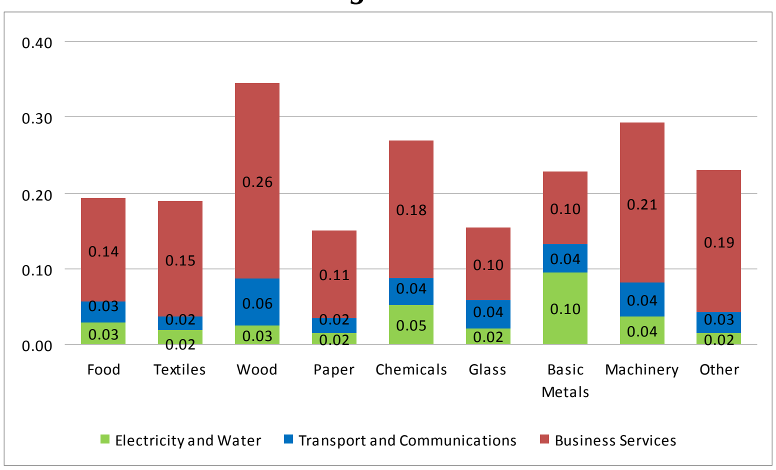
Source: Author's calculations based on data from the Chile's Foreign Investment Committee and the Central Bank.
Note: The figures show the average ratio of sectoral FDI stocks to sectoral GDP in each of the two time periods.

Figure 3: Intensity of Plant-Level Services Usage

Panel A. Averages across Periods



Panel B. Averages across Industries



Source: Author’s calculations.
Note: In Panel A, the figure shows the average ratio of services usage to sales computed across plants in all industries in each of the three time periods. In Panel B, the figure shows the average ratio of services usage to sales computed across plants over the sample period in each of the 3-digit industries.

Table 1: Effect of Services FDI on Plant Output Growth

	Dependent Variable: Plant Output Growth				
	Plant Fixed Effects Estimation				
	(1)	(2)	(3)	(4)	(5)
Services FDI Linkage 1996 IO$_{t-2}$	-0.0741				
	(0.052)				
Services FDI Linkage$_{t-1}$		0.622***			
		(0.077)			
Services FDI Linkage$_{t-2}$			0.147***	0.146***	0.153***
			(0.051)	(0.050)	(0.050)
Manufacturing FDI Linkage$_{t-2}$				0.241	0.986**
				(0.290)	(0.490)
Mining FDI Linkage$_{t-2}$				0.097	0.071
				(0.074)	(0.080)
Input Growth	Yes	Yes	Yes	Yes	Yes
Plant Controls	Yes	No	No	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Region*Year Fixed Effects	Yes	No	No	No	Yes
Industry*Year Fixed Effects	Yes	No	No	No	Yes
Number of Observations	38308	46439	38185	38185	38185
R-Squared	0.43	0.45	0.42	0.42	0.43

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively. Input Growth includes growth of skilled labor, unskilled labor, electricity, other services, materials, and capital. The unreported coefficients on input growth are estimated separately for each 2-digit industry. Plant controls include export, FDI, and size dummies. The services FDI linkage measure in Column 1 is based on industry-level weights from the Chilean 1996 input-output table while that in Columns 2-5 is based on plant-level shares of services in sales.

Table 2: Effect of Services FDI on Plant TFP Growth

	Dependent Variable: Plant TFP Growth (Levinsohn and Petrin (2003))				
	Plant Fixed Effects Estimation				
	(1)	(2)	(3)	(4)	(5)
Services FDI Linkage 1996 IO$_{t-2}$	-0.104				
	(0.065)				
Services FDI Linkage$_{t-1}$		0.567***			
		(0.078)			
Services FDI Linkage$_{t-2}$			0.142**	0.142**	0.149**
			(0.060)	(0.060)	(0.060)
Manufacturing FDI Linkage$_{t-2}$				0.169	0.984
				(0.320)	(0.630)
Mining FDI Linkage$_{t-2}$				0.002	0.037
				(0.055)	(0.096)
Plant Controls	Yes	No	No	No	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Region*Year Fixed Effects	Yes	No	No	No	Yes
Industry*Year Fixed Effects	Yes	No	No	No	Yes
Number of Observations	38308	46439	38185	38185	38185
R-Squared	0.03	0.02	0.01	0.01	0.03

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively. Plant controls include export, FDI, and size dummies. The services FDI linkage measure in Column 1 is based on industry-level weights from the Chilean 1996 input-output table while that in Columns 2-5 is based on plant-level shares of services in sales.

Table 3: Robustness to Changes in the Definition of Services FDI Linkage

Panel A. Dependent Variable: Plant Output Growth

	Plant Fixed Effects Estimation						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Services FDI Linkage Deprec. Rate 0	0.144***						
	(0.044)						
Services FDI Linkage Deprec. Rate 10		0.159***					
		(0.056)					
Services FDI Linkage Den. 1996 IO Output$_{t-2}$			0.209***				
			(0.064)				
Services FDI Linkage Den. GDP$_{t-2}$				2.222***			
				(0.570)			
Services FDI Linkage Den. Log$_{t-2}$					0.007***		
					(0.002)		
Services FDI Linkage Wgt. Diff. to Ind. Median$_{t-2}$						0.153***	
						(0.050)	
Services FDI Linkage Wgt. Revenues$_{t-2}$							0.174***
							(0.065)
Number of Observations	38185	38185	38185	38185	38185	38185	38185
R-Squared	0.43	0.43	0.43	0.43	0.43	0.43	0.46

Panel B. Dependent Variable: Plant TFP Growth (Levinsohn and Petrin (2003))

	Plant Fixed Effects Estimation						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Services FDI Linkage Deprec. Rate 0	0.142***						
	(0.054)						
Services FDI Linkage Deprec. Rate 10		0.154**					
		(0.067)					
Services FDI Linkage Den. 1996 IO Output$_{t-2}$			0.206***				
			(0.079)				
Services FDI Linkage Den. GDP$_{t-2}$				1.792***			
				(0.660)			
Services FDI Linkage Den. Log$_{t-2}$					0.006***		
					(0.002)		
Services FDI Linkage Wgt. Diff. to Ind. Median$_{t-2}$						0.150**	
						(0.060)	
Services FDI Linkage Wgt. Revenues$_{t-2}$							0.151**
							(0.07300)
Number of Observations	38185	38185	38185	38185	38185	38185	38185
R-Squared	0.03	0.03	0.03	0.03	0.03	0.03	0.03

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively. In Panels A and B the regressions include also FDI linkages for manufacturing and mining, year fixed effects, industry*year and region*year interaction effects, and plant controls (export, FDI, and size dummies). In Panel A, regressions include also input growth (including growth of skilled labor, unskilled labor, electricity, other services, materials, and capital). The unreported coefficients on input growth are estimated separately for each 2-digit industry.

Table 4: Additional Robustness Results

Panel A

	Plant Output Growth	Plant TFP Growth (LP (2003))	Plant Output Growth	Plant TFP Growth (LP (2003))	Plant Output Growth	Plant TFP Growth (LP (2003))	Plant Output Growth	Plant TFP Growth (LP (2003))	Plant TFP G rowth (Olley Pakes (1996))	Plant TFP Growth Index	Plant TFP Growth (Ackerberg et al. (2007))
	Dependent Variable:										
	3-Period Lag of FDI Link		*Exclude Top Bottom 1%*		*Sample of Domestic-Owned Plants*		*Add Control for Competition*				
	Plant Fixed Effects Estimation										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Services FDI Linkage$_{t-3}$	0.141***	0.137**									
	(0.050)	(0.060)									
Services FDI Linkage$_{t-2}$			0.136***	0.0694*	0.153***	0.153**	0.152***	0.142**	0.105**	0.196***	0.135**
			(0.041)	(0.035)	(0.052)	(0.061)	(0.050)	(0.060)	(0.053)	(0.063)	(0.054)
Number of Observations	31759	31759	37781	37467	35763	35763	38185	38185	38185	34852	38185
R-Squared	0.42	0.03	0.35	0.03	0.44	0.03	0.42	0.02	0.03	0.05	0.03

Panel B

	Excluding Food (ISIC 31)	Excluding Textiles Apparel (ISIC 32)	Excluding Wood Furniture (ISIC 33)	Excluding Paper Printing (ISIC 34)	Excluding Chemicals (ISIC 35)	Excluding Nonmet. Minerals (ISIC 36)	Excluding Basic Metals (ISIC 37)	Excluding Machinery (ISIC 38)	Excluding Other Manuf. (ISIC 39)
	Dependent Variable: Plant Output Growth								
	Plant Fixed Effects Estimation								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Services FDI Linkage$_{t-2}$	0.172***	0.144***	0.158***	0.172***	0.133**	0.138***	0.149***	0.138***	0.148***
	(0.057)	(0.051)	(0.058)	(0.052)	(0.056)	(0.053)	(0.051)	(0.053)	(0.050)
Number of Observations	25916	32017	34395	35730	33193	36520	37502	31575	37641
R-Squared	0.41	0.44	0.42	0.43	0.43	0.43	0.43	0.44	0.43

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively. In Panels A and B the regressions include also FDI linkages for manufacturing and mining, year fixed effects, region*year and industry*year interaction effects, and plant controls (export, FDI, and size dummies). However, the regressions in Columns 7-8 of Panel A include the normalized Herfindahl index instead of industry*year interactions. The regressions whose dependent variable is plant output growth include also input growth (including growth of skilled labor, unskilled labor, electricity, other services, materials, and capital). The regressions in Panel B exclude from the estimating sample the 2-digit industry whose name is listed in the column heading.

Table 5: Extensions

	Dependent Variable:					
	Plant Output Growth	*Plant TFP Growth (LP (2003))*	*Plant Output Growth*	*Plant TFP Growth (LP (2003))*	*Plant Output Growth*	*Plant TFP Growth (LP (2003))*
	Plant Fixed Effects Estimation					
	(1)	(2)	(3)	(4)	(5)	(6)
Services FDI Linkage*Differ.$_{t-2}$	0.205***	0.207**				
	(0.064)	(0.087)				
Services FDI Linkage*Non-Differ.$_{t-2}$	0.116*	0.11				
	(0.070)	(0.073)				
Services FDI Linkage*Small$_{t-2}$			0.191***	0.221**	0.0932	0.156*
			(0.072)	(0.088)	(0.086)	(0.091)
Services FDI Linkage*Large$_{t-2}$			0.125**	0.0964	0.195***	0.145**
			(0.056)	(0.069)	(0.049)	(0.068)
Number of Observations	36476	36476	38185	38185	38185	38185
R-Squared	0.43	0.03	0.43	0.03	0.43	0.03

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively. All regressions include also FDI linkages for manufacturing and mining, year fixed effects, region*year and industry*year interaction effects, and plant controls (export, FDI, and size dummies). The regressions whose dependent variable is plant output growth include also input growth (including growth of skilled labor, unskilled labor, electricity, other services, materials, and capital). In the regressions shown in Columns 1-2 the 3-digit industries classified as differentiated product industries are: Textiles (ISIC 321), Apparel (ISIC 322), Leather Products (ISIC 323), Footwear (ISIC 324), Wood Products (ISIC 331), Furniture (ISIC 332), Rubber Products (ISIC 355), Plastics (ISIC 356), Ceramics (ISIC 361), Glass (ISIC 362), Metal Products (ISIC 381), Nonelectrical Machinery (ISIC 383), Transport Equipment (ISIC 384), Professional Equipment (ISIC 384) and Other Manufacturing (ISIC 390). In the regressions in Columns 3-4 plants whose median employment over their lifetime in the sample is less than 25 employees are considered "small" while other plants are considered "large". The regressions in Columns 5-6 use the same threshold of 25 employees but instead of the median employment, plants are classified into small and large according to employment in their first year of presence in the sample.

Appendix

A. Sample Details

From 1992 to 2002, the ENIA survey gives each plant a unique identifier that allows us to link plants over time to generate a panel dataset. In 2003, the plant identifier changed. We established a correspondence between the old and the new plant identifier by merging two versions of the 2001 dataset (one including the pre-2003 identifier and one including the post-2003 identifier) according to more than 100 variables. We confirm the correspondence by merging two versions of the 2002 dataset (one including the pre-2003 identifier and one including the post-2003 identifier). Thus, we are able to create a panel of plants from 1992 to 2004. In cases where the correspondence between the old and the new plant identifier was ambiguous, we kept the plant with the old identifier and the plant with the new identifier in the sample as separate plants.

The ENIA survey data is judged to be of high quality and has been widely used in research. Thus, only minor data cleaning procedures are applied. First, we exclude from the analysis plants with missing identifiers, missing output or input variables, or missing industry affiliation. Second, we impute output and inputs to correct for non-reporting by a plant in a single year (occurring in fewer than 30 plant-year observations). Third, we exclude from the analysis plants whose output growth is larger than (smaller than) 400% and those whose output growth ranges between 100% and 300% (-300% and -100%) but is not accompanied by corresponding high (low) growth rates of inputs. The sample includes some plants with discontinuous data over the sample period. For those plants, we consider only the observations across consecutive years for which yearly growth rates can be computed. After applying these data cleaning procedures our final sample consists of 57025 plant-year observations. The distribution of the sample across years and industries is shown in Appendix Table A.1. We should note that we also performed our empirical analysis based on a sample where we did not exclude extreme values for the growth rates using both plant fixed effects estimations and robust regression techniques and obtained qualitatively similar results to those discussed in the main text.

B. Production Function Variables

Output is measured by deflated sales. The output price deflator is based on information on indexes of total sales and indexes of physical production for each 3-digit industry from the Chilean Statistical Institute. Based on the equality total sales=physical production * price, one obtains growth in total sales=growth in output + growth in prices. Using this formula we compute an industry output price deflator using 2002 as the base year. For years 1992-2002, the price deflator is obtained for 3-digit ISIC Rev. 2 industries while for 2003-2004 it is obtained for 3-digit ISIC Rev. 3 industries.

Skilled and unskilled labor are measured by the number of workers in the following occupational categories: (a) skilled: owners, managers, administrative personnel, and specialized production workers, and (b) unskilled: workers directly or indirectly involved in the production process, and home workers.

Materials is measured by deflated materials expenditures. The materials price deflator is based on a weighted average of the aforementioned 3-digit output price deflators where the weights are given by the share that each 3-digit industry's output represents in total manufacturing intermediates used by all 3-digit industries based on an input-output table. For years 1992-2002 [2003-2004], the weights are based on the 1986 [1996] Chilean input-output table.

Electricity is the quantity of electricity bought plus the quantity of electricity generated minus the quantity of electricity sold in thousands of kilowatts.

Services is measured by the deflated sum of expenditures on advertising, banking commissions and interest payments, communications, insurance, legal, technical, and accounting services, licenses and foreign technical assistance, rental payments, transport, other services, and water. The services price deflator is based on GDP deflators for 4 groups of services from the Chilean Central Bank: (i) electricity and water, (ii) transport and communications, (iii) financial services, insurance and business services, and (iv) real estate. We calculate a weighted average of these GDP deflators where the weights are given by the share that each of these 4 groups of services represents in total intermediate expenditures (manufacturing plus services) for each 3-digit industry based on the 1996 Chilean input-output table.

Capital is computed using the perpetual inventory method (PIM). The ENIA survey provides information on four types of capital: buildings, machinery and equipment, transport equipment, and land. For each type of capital we compute net investment flows as the sum of purchases of new capital, purchases of used capital and improvements to capital minus the sales of capital and deflate these by an investment price deflator constructed as the ratio of current gross capital formation to constant gross capital formation (in local currency units) from the World Development Indicators with base year 2002. For each type of capital, the PIM formula $K_{it+1} = (1 - \delta)\, K_{it} + I_{it}$ is applied, where I_{it} are real net investment flows and δ is a depreciation rate. Since detailed studies of depreciation rates in Chile are unavailable, we use the following rates proposed by Pombo (1999) who studied the same type of capital goods in Colombia: 3% for buildings, 7% for machinery and equipment, and 11.9% for transport equipment. Land is assumed not to depreciate. We also experimented with alternative rates of depreciation but did not find this to make a substantial difference to the final capital stock values nor to our main results. The initial value of the capital stock needed to apply the PIM formula is given by the book value of each of the four types of capital in the first year of plant presence in the sample. Whenever the book value is available only in a latter year, we back out that value until the plant's first year in the sample taking into account the investment price deflator and the corresponding depreciation rate.

Summary statistics for the production variables are shown in Appendix Table A.2 for the final sample and for the estimating sample which includes a smaller number of observations given that we use growth rates and two-period lags.

C. FDI Linkage Measures

The services FDI linkage measure is obtained based on the following five steps.

1) For each services sector *k* net FDI inflows *NI* are given by $NI_{kt} = I_{kt}^{FDI} - O_{kt}^{FDI}$, where I are sectoral inflows and O are outflows for each year *t between* 1974 to 2004.

2) Using the PIM formula, we compute an FDI stock S^{FDI} for each services sector *k* in year *t* as $S_{kt}^{FDI} = NI_{kt}^{FDI} + (1-\partial)S_{kt}^{FDI}$, where δ is the depreciation rate assumed to be equal to 5.65%, which is the average of the depreciation rates for the capital goods machinery, buildings, vehicles, and land used in the construction of the capital stock for Chilean

manufacturing plants. The initial value of the FDI stock needed to apply the PIM formula is given by the net FDI inflows in 1974 for each services sector *k*. This initial value is reasonable given that FDI inflows into services sectors prior to 1974 were minor. While FDI stocks are calculated for the 1974-2004 period, only the values for the 1992-2004 period are used in Steps 3) to 5).

3) For each services sector *k*, we calculate a measure of FDI penetration *FDI* in year *t* as $FDI_{kt} = S_{kt}^{FDI} / GDP_{kt}$, where GDP is sectoral output.

4) For each plant *i* the intensity of services usage in year *t* is given by $\alpha_{it}^{k} = spending_{it}^{k} / sales_{it}$ or plant services expenditures from sector *k* as a ratio to sales.

5) We use the FDI penetration from Step 3) and the plant intensity of services usage from Step 4) to construct the weighted sum which constitutes the services linkage included in our main specifications as: $FDIsl_{it} = \sum_{k=1}^{K} \alpha_{it}^{k} * FDI_{kt}$.

The FDI linkage variables based on input-output table weights are computed as follows. For example for services, we calculate the share that each services sector *j* represents in total intermediate inputs (mining plus manufacturing plus services) τ_{jm} used by a 4-digit manufacturing industry *m* based on the 1996 Chilean input-output table. We interact each services share with the corresponding services FDI penetration to obtain the FDI linkage variable as: $FDIsl\_io_{jm} = \sum_{j} \tau_{jm} * FDIpe_{jt}$. Mining and manufacturing FDI linkages are obtained analogously.

D. TFP Growth Measures Obtained Using Index Numbers

In Table 5 we use a plant TFP growth measure obtained following an index number approach: $d \ln A_{ijt} = d \ln Y_{ijt} - \sum_{m=1}^{6} (\frac{s_{mt-1}^{j} + s_{mt}^{j}}{2}) * d \ln inputs_{ijt}^{m}$, where $d \ln Y_{it}$ and $d \ln inputs_{it}^{m}$ are defined as in the main text and $\frac{s_{mt-1}^{j} + s_{mt}^{j}}{2}$ is the average share of expenditures in input *m* in total revenues across years *t-1* and *t* calculated separately for each 2-digit industry *j*. This index number approach assumes perfect competition and constant returns to scale, thus for each 2-digit industry the average share of capital is equal to 1 minus the average shares of the other 5 inputs. Also, note that we exclude from the calculation of these average shares plants whose input shares exceed 1. We experimented with using median input shares based on all plants instead of average shares and obtained similar results.

Appendix Table A.1: Sample Composition

Panel A: Across Years

Year	Number of Plants	Share in Total
1992	4394	7.71
1993	4497	7.89
1994	4586	8.04
1995	4583	8.04
1996	4872	8.54
1997	4670	8.19
1998	4252	7.46
1999	3875	6.80
2000	3994	7.00
2001	4038	7.08
2002	4366	7.66
2003	4332	7.60
2004	4566	8.01
Total	57025	100.00

Panel B: Across Industries

ISIC		Number of Observations	Share in Total
311	Food Products	15959	27.99
312	Other Food Products	837	1.47
313	Beverages	1131	1.98
314	Tobacco	8	0.01
321	Textiles	3774	6.62
322	Apparel	3293	5.77
323	Leather Products	494	0.87
324	Footwear	1604	2.81
331	Wood Products	3967	6.96
332	Furniture	1761	3.09
341	Paper	1052	1.84
342	Printing	2604	4.57
351	Industrial Chemicals	723	1.27
352	Other Chemicals	2149	3.77
353	Petroleum Refineries	52	0.09
354	Petroleum and Coal Products	202	0.35
355	Rubber Products	693	1.22
356	Plastics	3161	5.54
361	Ceramics	186	0.33
362	Glass	277	0.49
369	Nonmetallic Minerals	1898	3.33
371	Iron and Steel	457	0.80
372	Non-ferrous Metals	444	0.78
381	Metal Products	5365	9.41
382	Nonelectrical Machinery	2021	3.54
383	Electrical Machinery	805	1.41
384	Transport Equipment	1102	1.93
385	Professional Equipment	295	0.52
390	Other Manufacturing	711	1.25
Total		57025	100.00

Note: The estimating sample whose summary statistics are shown in Panel B is smaller than the final sample since we use growth rates and lags in the final regressions.

Appendix Table A.2: Summary Statistics

Panel A: Final Sample (57025 Observations)

Variable	Mean	Median	Std Dev.
Services FDI Linkage	0.054	0.033	0.090
Manufacturing FDI Linkage	0.023	0.018	0.018
Mining FDI Linkage	0.021	0.002	0.078
Export Dummy	0.214	0.000	0.410
Size Dummy	0.389	0.000	0.628
FDI Dummy	0.052	0.000	0.221
Log of Output	13.010	12.713	1.676
Log of Skilled Labor	2.392	2.197	1.101
Log of Unskilled Labor	2.915	2.944	1.456
Log of Materials	12.314	12.026	1.734
Log of Services	10.360	10.464	2.466
Log of Electricity	4.627	4.331	1.906
Log of Capital	11.985	11.846	2.070

Panel B: Estimating Sample (38185 Observations)

Variable	Mean	Median	Std Dev.
Services FDI Linkage	0.060	0.040	0.092
Manufacturing FDI Linkage	0.024	0.019	0.018
Mining FDI Linkage	0.023	0.002	0.082
Export Dummy	0.230	0.000	0.421
Size Dummy	0.417	0.000	0.645
FDI Dummy	0.054	0.000	0.226
Log of Output	13.150	12.838	1.704
Log of Skilled Labor	2.466	2.303	1.125
Log of Unskilled Labor	2.953	2.996	1.474
Log of Materials	12.429	12.121	1.774
Log of Services	10.480	10.571	2.481
Log of Electricity	4.778	4.466	1.922
Log of Capital	12.145	11.999	2.069

Note: The estimating sample whose summary statistics are shown in Panel B is smaller than the final sample since we use growth rates and lags in the final regressions.

Appendix Table A.3: Input Growth Coefficient Estimates

	Input Growth Coefficient Corresponding to the Specification in Column (5) of Table 1								
	Food (ISIC 31)	Textiles Apparel (ISIC 32)	Wood Furniture (ISIC 33)	Paper Printing (ISIC 34)	Chemicals (ISIC 35)	Nonmet. Minerals (ISIC 36)	Basic Metals (ISIC 37)	Machinery (ISIC 38)	Other Manuf. (ISIC 39)
Growth of Skilled Labor	0.030***	0.022*	0.059***	0.008	0.037**	0.098***	0.124*	0.044***	-0.004
	(0.007)	(0.013)	(0.016)	(0.019)	(0.015)	(0.025)	(0.069)	(0.013)	(0.035)
Growth of Unskilled Labor	0.021***	0.021**	0.042***	0.021	0.031***	0.057***	0.045**	0.030***	0.016
	(0.006)	(0.008)	(0.012)	(0.013)	(0.008)	(0.018)	(0.019)	(0.008)	(0.027)
Growth of Materials	0.487***	0.350***	0.493***	0.362***	0.390***	0.339***	0.227***	0.396***	0.349***
	(0.023)	(0.019)	(0.025)	(0.060)	(0.028)	(0.035)	(0.064)	(0.018)	(0.052)
Growth of Services	0.007***	0.011***	0.014***	0.006*	0.012***	0.003	0.004	0.017***	0.012
	(0.002)	(0.004)	(0.005)	(0.003)	(0.004)	(0.003)	(0.006)	(0.005)	(0.009)
Growth of Electricity	0.021***	0.030***	0.045***	0.011	0.030***	0.054***	0.035	0.028***	0.008
	(0.005)	(0.007)	(0.012)	(0.009)	(0.009)	(0.017)	(0.027)	(0.008)	(0.017)
Growth of Capital	0.047***	0.023	0.037*	-0.013	0.016	0.031	0.121	0.034	0.109**
	(0.009)	(0.018)	(0.020)	(0.035)	(0.022)	(0.039)	(0.084)	(0.025)	(0.048)

Notes: Robust standard errors clustered at the plant level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively.

Appendix Table A.4: Production Function Coefficient Estimates

	Dependent Variable: Log of Output								
	Levinsohn and Petrin (2003) Estimation								
	Food (ISIC 31)	*Textiles Apparel (ISIC 32)*	*Wood Furniture (ISIC 33)*	*Paper Printing (ISIC 34)*	*Chemicals (ISIC 35)*	*Nonmet. Minerals (ISIC 36)*	*Basic Metals (ISIC 37)*	*Machinery (ISIC 38)*	*Other Manuf. (ISIC 39)*
Log of Skilled Labor	0.077***	0.135***	0.085***	0.144***	0.142***	0.105***	0.061	0.122***	0.142***
	(0.007)	(0.013)	(0.011)	(0.017)	(0.021)	(0.024)	(0.039)	(0.014)	(0.052)
Log of Unskilled Labor	0.038***	0.058***	0.044***	0.020***	0.018**	0.017	-0.025	0.052***	0.084***
	(0.005)	(0.007)	(0.009)	(0.008)	(0.009)	(0.012)	(0.020)	(0.008)	(0.024)
Log of Materials	0.772***	0.657***	0.724***	0.657***	0.680***	0.644***	0.576***	0.642***	0.612***
	(0.011)	(0.012)	(0.016)	(0.020)	(0.018)	(0.023)	(0.039)	(0.013)	(0.058)
Log of Services	0.009***	0.072***	0.040***	0.031***	0.014**	-0.006**	-0.006	0.059***	0.011
	(0.003)	(0.009)	(0.008)	(0.011)	(0.007)	(0.003)	(0.010)	(0.009)	(0.020)
Log of Electricity	0.160***	0.140***	0.080***	0.080*	0.220***	0.030	0.290**	0.160***	0.030
	(0.022)	(0.016)	(0.044)	(0.050)	(0.095)	(0.086)	(0.136)	(0.016)	(0.066)
Log of Capital	0.010***	0.010***	0.010	0.090	0.010	0.010	0.050	0.010***	0.120
	(0.004)	0.000	(0.023)	(0.068)	(0.176)	(0.032)	(0.236)	(0.003)	(0.120)
Number of Observations	16365	8321	5140	3302	6269	2206	777	8689	663

Notes: Bootstrapped standard errors in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% confidence levels, respectively.