Spillover Effects of FDI in the Manufacturing Sector in Chile

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Acknowledgements

Abstract

Foreign direct investments are often argued to transfer technology to host countries. These so called spillover effects are many times assumed to have a positive and important impact on these economies. However, mainly due to problems with measuring these effects, researchers have found little or no evidence of such positive influence. Taking a closer look at Chile, a country that has seen a large inflow of foreign direct investments in recent decades, I will try to explain if such spillovers have influenced the Chilean economy. To understand the dynamics of spillover effects and the complexity of the subject both an econometric study of the manufacturing sector and a case study of the wine industry are performed. The results show that there are spillover effects but that differences between firms and sectors are of importance.

Keywords: Foreign direct investments; Spillover effects; Chile; Manufacturing sector; Wine industry.

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1. INTRODUCTION

Foreign direct investment, i.e. FDI, has in a number of countries become an important source of financing. In many developing countries however, these investments are also often seen to have another important function. Resulting in better competition, new knowledge or improvements in managerial skills, it is the common belief that foreign direct investments, through so-called spillover effects, can result in productivity improvements.

Even though foreign direct investments have increased significantly in the last few decades, especially in developing countries, there is little evidence of productivity improvements. Some suggest that the explanation lies in the fact that export-oriented countries could benefit more from such investments (Aitken and Harrison 1999). Others suggest that differences in absorption capacities matter for such spillovers.

Depending on the choice of countries and time periods, foreign direct investments seem to have different impacts. Taking a closer look at Chile, a country that has seen a great increase in foreign direct investments, I examine this relationship more closely. Chile is also one of the most export-oriented developing countries, which makes such a study even more interesting. Since the country liberalized over two decades ago, changes from this liberalization will also be more easily observed.

Taking a closer look at the manufacturing sector using an econometric study, I will first be able to investigate potential spillover effects in a more general manner. Since the economy for a long time has been largely dependent on the mining sectors, such a study also makes it possible to see how the shift from traditional industries to more non-traditional industries has affected the economy. Performing a field study in the wine industry will further enable me to understand the nature and dynamics of spillover effects in greater detail. Such a study will also make it possible for me to see how an industry, largely dependent on export, is affected by the presence of foreign firms. Analyzing spillover effects using different methodologies, in this case regression analysis and interviews, will finally enable me to understand earlier inconclusive results in more depth.

The purpose of this paper is hence to investigate if and how the presence of foreign firms in Chile has affected the economy and especially the productivity of domestic firms. To be able to understand why such spillovers take place a closer look at underlying factors in the host economy as well as between foreign firms is also taken. In a final stage, I will try explain what could be done to enhance such positive spillover effects in Chile. This paper tries to answer the following questions:

- Have there been spillover effects from the presence of foreign firms on domestic firms productivity in the manufacturing sector in Chile?
- Do differences in foreign ownership and foreign export activity matter for these spillover effects?
- Do differences between domestic firms matter for spillover effects?
- Has one been able to observe spillovers in the wine industry? If so, what characterizes these effects?
- What could be done in the wine industry and in the economy as a whole to increase these spillover effects?

Due to the complexity of these issues only certain spillover effects are studied. I have focused on two spillover effects, spillovers from foreign presence in the same sector and spillovers from foreign presence in the same region. Further, only some differences in underlying factors are analyzed. Only one year, 2000, has been chosen for this study. The field study focuses only on the dynamics in the wine industry. Other industries could not be studied due to the time and size limit of this paper. Due to the same reasons, the potential effects and recommendations for improvements are also limited to a few. The field study concentrates mainly on the spillover effects from foreign wineries but also tries to account for spillovers from other foreign firms in the industry.

The remainder of the paper is organized as follows: In section two, the characteristics of spillovers are explained in more detail. Earlier findings and theory are also presented in this section. In section three, an econometric analysis is used to investigate if and how such spillovers have occurred in the manufacturing sector in Chile. In section four, a closer look at potential spillover effects in the wine industry is taken. Potential improvements for increasing positive spillover effects are also discussed in this section. Conclusions and concluding remarks are presented in section five.

2. FDI AND SPILLOVERS - A CLOSER LOOK AT THEORETICAL AND EMPIRICAL FINDINGS

2.1. Technology and the importance of multinationals

It is a common belief that multinational enterprises can affect the host country in different ways. By setting up a new production facility, multinationals can for example have a direct effect on employment. Large investments from such companies, relative to the size of the economy, can further have an effect on both GDP and the trade balance of the host country. Apart from these outcomes, the presence of multinationals can also result in spillover effects. These effects are not as clear-cut as earlier mentioned effects but can nevertheless have a large impact on the economy. According to Caves (1974) spillovers are events where the presence or entries of multinational affiliates result in improvements in the technology or productivity of local firms in the host country, and where the multinational cannot capture all quasi-rent due to the productive activity (Caves, 1974, p. 176). The presence or entry of a multinational can therefore have both a direct and an indirect effect on the host country.

The importance of spillover effects is often argued to come from the possibility of acquiring new technology and know-how. With new technology and knowledge, host countries can improve the usage of existing resources and hence the productivity of the economy. Since multinational companies produce and own a large part of the world s advanced technology (Kokko 1992) they are often seen as an important source for technology transfers and hence for spillover effects.

Technology is however difficult to measure, which makes it hard to see how technology is spread and how important multinationals are for this process (Kokko 1992, p 21). One reason for this is that technology is a vague concept that can refer to several factors. First of all, technology can refer to different physical equipment such as machinery. Second, technology can refer to knowledge, skills or to people. To more clearly understand what technology is, I use the same definition as Kokko (1992) and define technology as *the perishable resource comprising knowledge, skills, and the means for using and controlling factors of production for producing delivering and maintaining goods and services* (Kokko 1992, p 21).

Another factor that makes it difficult to measure the importance of technology and multinationals is that technology can be transferred through several channels. These channels can be both formal and informal, and technology can further be transferred intentionally and unintentionally (Kokko 1992, p 21). Maybe the most important factor determining the process of technology transference is the characteristics of the technology itself. Kogu and Zander (1993) show for example that *tacitness, codifiability, teachability* and *complexity* of the analyzed technology determine the way it is transferred. The more codified and teachable the technology is, the more likely it is to be transferred through licensing rather than through wholly owned subsidiaries (Kogu and Zander 1993, p 11). On the other hand, the more tacit and complex the technology is, the more likely it will be transferred to wholly owned subsidiaries (Kogu and Zander 1993, p 11). Mansfield and Romeo (1980) further argue that technology transferred to joint ventures is older than technology transferred to affiliates (Mansfield and Romeo 1980, p 739).

When transferring such technology, multinationals have consequently many factors to consider. In general, multinationals try to find the most efficient strategy to exploit their firm specific assets, such as know-how, technology and organizational/managerial skills. Since these firms can benefit in many ways by transferring knowledge through foreign direct investments instead of licensing, it is common that multinationals choose this form when transferring technology (Greenaway et al 2001, p 2). Most importantly, by doing so they can keep the knowledge inside the firm.

2.2. Effects on the host country

When firms set up a plant overseas or acquire a foreign plant, i.e. when they make a direct investment, they are said to be distinguished from already established firms in the host country for two reasons. First of all, they can bring with them some of their special assets, such as technology know-how (Kokko 1992, p 25). And second, their entry can disturb the existing equilibrium in the market and hence make local firms act not to lose their market shares and profits.

There are many possible ways such investments can affect the host country. First, the technology used by the affiliates might not be available in the host country. Knowledge about the costs and benefits of an innovation can further be limited to new users in the host economy. Since the presence of an affiliate can provide users with this information, the probability of

imitating this innovation can increase (Kokko 1992, p 27). Multinationals are further more likely to enter markets with high barriers to entry and with high concentration than local firms (Kokko 1992, p 27). An entry of a multinational in such a market can therefore have a large effect on the local economy.

One of the first economists to study these spillover effects was Caves (1974). He divided possible spillover effects into three groups: *allocative efficiency* that multinationals could improve by entering markets with high barriers; *technical efficiency* that multinationals could affect by improving local firms use of resources; and finally *technology transfer and diffusion* that the presence of multinationals could affect by enforcing imitation and competition (Kokko 1992, p 30).

Today, new factors have become important in the study of spillover effects. To explain and clarify these factors I will first, in accordance with earlier studies e.g. Görg and Greenaway (2003), use four different groups of spillover effects. Further, I will take a closer look at the characteristics of the host country that can matter for these spillovers. The four chosen groups of spillover effects are: spillover from imitation, spillovers from increased competition, spillovers from improvements in human capital and spillovers from export.

2.2.1. Four different spillover effects

Spillovers from imitation refer first of all to a situation where a local firm can improve its efficiency by copying technologies or managerial and/or organizational innovations of foreign affiliates operating in the local market. This can be done either by observation or by hiring workers trained by the multinational firm. Such a spillover can therefore be beneficial to the host country in many ways. However, since such a situation can result in an increase in competition between the affiliates and the local firms, the affiliates have incentives to prevent such spillover effects. By using protection, such as intellectual property rights or paying higher wages, multinationals can protect their special assets and therefore minimize these spillover effects. At the same time the multinationals have incentives to prevent information from spreading to competing firms, they sometimes also want to transfer part of this knowledge to their local suppliers (Smarzynska 2002, p 2). Even though protection exists, spillovers in the form of imitation are therefore still possible.

The second group of spillovers is spillovers from competition. When a multinational affiliate enters the local market, the number of firms will increase. Unless the affiliate creates a monopoly on the local market such an increased number of firms will result in a greater competition on the market (Görg and Greenaway 2003, p 4). Even though local firms can imitate or learn from the multinationals they are under greater pressure to use resources more efficiently to be able to compete successfully. Using available resources more efficiently and improving technology as well as other assets can therefore result in a productivity improvement. A similar effect could come from wage spillovers. Given that multinationals often pay higher wages than local firms do, the wage level in the country can be affected. Multinationals often pay higher wages to minimize the labor turnover or to attract workers (Lipsey and Sjöholm 2001, p 1). Because of this, local firms can be forced to raise their wage level to be able to compete.

The presence of a multinational can however also decrease the possibility for domestic firms to compete successfully and therefore result in a decrease in productivity. Such a situation can occur when an imperfect competitive firm, that faces a fixed cost of production, meets a foreign firm with a lower marginal cost. In such a case the foreign firm will have an incentive to increase production, which can draw demand away from the domestic firm (Aitken and Harrison 1999, p 607). When the demand for the domestic firms is lower, the productivity of the firms will decrease since the fixed cost is spread out on fewer products (Aitken and Harrison 1999, p 607). Even though technology spillovers can decrease the average cost of the domestic firms, such a situation can increase the firms cost (Aitken and Harrison 1999, p 607). It has finally been suggested that an entry of an affiliate can increase competition in the short run but can in the long run decrease competition. Affiliates can for example buy out local firms or make barriers to entry even higher (Kokko 1992, p 55). These factors also depend on the initial number of firms on the market and the trade policy of the economy (Kokko 1992, p 55).

As mentioned earlier, multinationals may enter markets where high barriers to entry exist. Because of this, initial competition can be limited, which can make spillovers through increasing competition very effective in the host market. Improvements in productivity from such spillovers could also be more likely in developing economies, since these economies often are more inefficient (Kokko 1992, p 52). On the other hand local firms in developing countries might not pose a threat to foreign firms, which could result in fewer spillovers (Kokko 1992, p 52).

The third group of spillover effects can come about through improvements in human capital in the host country. Even though multinationals often look for locations with low wages, these firms often require relatively skilled labor (Görg and Greenaway 2003, p 3). By investing in training, multinationals can for example help local workers acquire new knowledge. There are many different types of training. Training can for example be both on-the-job training and overseas education. The knowledge acquired from these training programs can nevertheless spillover to the rest of the economy, especially when workers leave their jobs at the multinational company and move to existing firms or to newly established firms. Hence knowledge of new techniques and managerial skills can be transferred to other firms. Since the multinationals in such a case might need to train new workers, spillover through training can consequently increase. When the host country has absorbed this new knowledge, the technology gap between the two countries can also become smaller. In the end this might force the affiliates to import new technology, which can create even more possible spillover effects (Kokko 1992, p 63).

Since the education system in developing countries often are less developed than in industrial countries, spillover effects from improvements in human capital could become more important in developing countries (Kokko 1992, p 48). Since training and working for multinationals might require a certain level of education, a relatively low level of education might however diminish these spillover effects.

The forth group of spillovers can come about from export. To be able to export successfully knowledge about foreign markets, tastes, distribution networks and transport infrastructure are important to possess. Since multinationals often have better knowledge about these markets than local firms, their presence in the local market can help local firms to learn how to export or to become more efficient at exporting. Such knowledge can be transferred when local firms and multinationals work together. In other cases, local firms can imitate multinationals and therefore learn how to export (Görg and Greenaway 2003, p 4). As mentioned earlier, increased competition on the domestic market can result in a more efficient use of resources. Consequently, an increase in competition can further facilitate entry into the foreign market and therefore make export easier (Greenaway et al 2001, p 3).

2.2.2. Characteristics of the host country

There are also numerous factors in the host country that can influence spillover effects from foreign affiliates. Some of these factors are distance in development, education level and learning capacity. Distance in development between the host and the home country can both hinder and facilitate spillovers from foreign firms. Great distance in development can first of all imply that there are great opportunities in the host country that can be exploited. Great opportunities would therefore mean great pressure for change, which in the long run could lead to faster adoption and imitation of technology (Görg and Greenaway 2003, p 5). On the other hand, great distance in development can imply that the host country does not have enough resources for the multinational. In the long run this can diminish the absorption capacity of the host country and the willingness of the multinational to invest. The greater the gap, the more difficult it would therefore be to absorb new technology and new spillovers (Görg and Greenaway 2003, p 5). Maybe the most plausible explanation is that the gap between countries should not be too large or too small (Kokko et al 1996). Since technology, or the development gap, seems to be an important factor, one should also be able to argue that such a difference between countries should influence the size, amount and quality of technology transferred (Glass and Saggi 1998).

In more specific terms, the education level could affect the possible spillover effects from foreign affiliates. Higher education levels would imply a shorter time to learn and less expensive training, which could benefit multinationals. A high education level could however also mean high wage levels, which would make investments more expensive. As argued earlier, no, or a very low level of, education could also hinder the possible spillovers effects. Other factors such as poor infrastructure, political instability, uncertain property-rights and specific requirements from the host country can further affect the possible spillover effects drastically (CUHK, Mito Takamichi, 2002-10-10).

How fast new technology can be adopted and imitated further depends on the exposure the multinationals have on the economy. If the multinational for example quickly establishes downstream and upstream firms, more local firms will faster be exposed to technology and other assets the multinational possesses (Görg and Greenaway 2003, p 5). On the other hand, multinationals that establish contacts with few local firms can diminish the possible spillover effects (Görg and Greenaway 2003, p 5).

It has also been argued that differences in composition between local and foreign firms in the local market can affect the possibilities of spillovers. Cantwell (1989) argued that spillovers from the presence of foreign affiliates are not likely in industries where foreign firms are strong and local firms are weak. On the other hand, in industries where local firms are strong and foreign firms are weak, local firms are forced to use resources more efficiently, which in the end could create spillover effects (Cantwell 1989). In industries where foreign and local firms are equally strong, spillovers can also be transferred (Cantwell 1989). Another similar argument is that the size of the firm should influence the possibilities for spillover effects. Large firms often have more resources to spend on technology and should therefore be able to absorb new technology more easily. Large firms should also be able to attract educated workers, which could help them handle a tougher competition better. On the other hand, large firms could have better access to advanced technologies even before the entrance of the foreign firms. Small firms could therefore benefit more from such an entry.

It has also commonly been argued that spillovers are more likely in industries where the foreign share is high. However, foreign affiliates might be attracted to industries where the competition is weak and where domestic firms cannot compete successfully (Kokko 1992, p 185). The foreign share in such industries could therefore be high. On the other hand, industries with a low foreign share could be more dynamic. The possibility of spillovers from few foreign affiliates in such an industry could therefore be more likely than in industries where the foreign share is high (Kokko 1992, p 185). A similar argument to this is that proximity to multinationals is important for spillover effects. Proximity would make it easier for local firms to absorb and imitate the activities of the multinationals. Proximity could nevertheless also imply a large concentration of multinationals, which does not necessarily have to be positive for the local firms.

Other factors that can affect the possibility for spillovers are the type of affiliate. It has for instance been suggested that foreign affiliates that focus on the domestic market tend to purchase more locally than export-oriented ones (Belderbos et al 2001, p 195). Focusing on the domestic market often implies that foreign firms have closer ties with local firms, which as a consequence can increase spillover effects. Affiliates that concentrate on the international market can also be more dependent on their parent company and therefore have less freedom to choose their own suppliers. Differences in spillovers can also arise due to differences in nationality of the parent company. It has for example been suggested that Japanese

multinational use local suppliers less often than other nationalities (CUHK, Mito Takamichi, 2001-10-04).

It has also been argued that affiliates established through mergers and acquisition or joint ventures are likely to buy more locally than those projects that are Greenfield projects (Belderbos et al. 2001, p 202). Greenfield project need time to establish links and to find suitable suppliers. Joint ventures on the other hand can use already established contacts and can therefore buy more locally. With time, contacts with local firms and suppliers are however expected to increase, since foreign firms will learn how to produce for the local market (Belderbos et al 2001, p 195).

In conclusion, there are numerous ways in which the presence of foreign affiliates can affect productivity in the host country. The amount and extent of technology transferred to these countries depend first on the characteristics of the technology. The ability of the host market to absorb such spillover effects depends further on the characteristics of the affiliate as well as of the host market itself. Spillover can be transferred through many different channels; four of these are spillovers through imitation, spillovers through increased competition, spillovers through improvements in human capital and spillovers through export. The possibility for local firms to absorb such spillover effects also depends on, among other factors, the size of domestic firms and the closeness to foreign firms.

2.3. What do earlier studies tell us?

The general idea that interaction among firms can generate spillover effects dates back to Marshall (1920). He argued that agglomeration economies could generate spillover effects when multiple firms come together. More recent studies focus on how foreign direct investments affect productivity in the industry or in the individual firm. These studies have been performed using developing, developed and transitional economies and find both positive and negative results.

The existing evidence on whether there are productivity spillovers can today be divided into three groups. The first group is case studies, which takes a closer look at certain FDI-projects or specific countries. These studies are often very detailed and give a good description of a specific case. Since they can be very specific they are however often difficult to use in a general way.

The second group is industry-level studies. These studies use industry level data to see how foreign direct investments affect productivity in the industry. These studies often use foreign shares of industry employment or value-added to test these relationships. Examples of such studies are Caves (1974), studying Australian industry and Blomström (1986), analyzing Mexican industry. Even though most of these earlier studies show a positive correlation between industry-level FDI and productivity, many argue that the direction of this correlation is unclear. It is possible that the positive correlation is caused by the fact that multinationals tend to locate in high productive industries rather than by resulting in productivity spillovers. It is also possible that the presence of a multinational has a negative effect on the domestic firms in the market. In such a situation less productive firms could leave the market, which also could result in a productivity improvement in the industry. Kokko (1992) argues for example that spillovers might occur but not necessarily in all kinds of industries. Foreign firms might isolate themselves and therefore hinder spillovers from taking place (Kokko 1992).

The third group of studies is micro-level studies. These studies examine whether the productivity of domestic plants and firms are correlated with the presence of foreign firms. Using such a method one can study the effects of foreign direct investments more in detail. Many of these studies find however no or negative correlation between productivity and the presence of multinationals. Haddad and Harrison (1993), studying the productivity improvement in Morocco, found for instance a smaller transference of productivity improvements in sectors with more foreign firms. Aitken and Harrison (1999), using panel data from Venezuelan plants, also found a negative correlation between these variables.

2.4. How to explain the negative effects?

The failure to find positive or convincing results in these earlier studies could be due to a number of factors. First of all spillovers, despite the theoretical arguments, could be unimportant. Multinationals could for example ensure that no spillovers occur. Second, positive spillovers could exist but researchers have not been able to capture these effects. Difficulties in finding reliable data could be one explanation; creating a well-designed model could be another. Finally, researchers could be looking at the wrong variables and are therefore not able to find a positive relationship between foreign direct investments and productivity improvements.

To explain the lack of positive correlation more recent papers have therefore tried to find new relationships and new explanatory variables. These papers often emphasize backward linkages, increased competition and absorption capacity as important factors in the study of spillover effects. Haskel et al (2002) have for instance examined FDI spillovers from backward linkages. Examining spillovers in the UK-industry they found a positive correlation between these variable. Smarzynska (2002) also found a positive correlation between FDI and productivity when studying backward linkages in Lithuania. She argues that even though multinationals have an incentive to prevent information from spreading, they also want to transfer knowledge to their local suppliers. Such a situation should therefore make spillovers more likely in the cases when FDI is vertical rather than horizontal (Smarzynska 2002, p 5). Using plant-level data from several Latin American countries, Alfaro and Rodríguez-Clare (2004) show once again that foreign direct investments have a positive backward linkage effect on the host country

Spillovers can also come from forward linkages. Forward linkages take place, in contrast to backward linkages, through downstream connection between foreign affiliates and domestic firms. Backward linkages, on the other hand, take place through upstream connection between foreign businesses and domestic firms. Few have however studied these downstream connections. One exception is Girma et al (2004) who found a positive correlation between forward linkages and productivity. According to them forward linkages also seem to be larger than backward linkages (Girma et al 2004, p 13).

Another explanation for these negative results is increased competition. As mentioned earlier, Aitken and Harrison (1999) suggest that multinationals can draw away demand from local firms and therefore reduce the productivity of these firms (Aitken and Harrison 1999, p 607). Studying emerging economies Konings (2001) finds a similar result.

Another plausible explanation for these results is that only some firms can absorb spillovers from multinationals. As mentioned earlier, differences in development, technology and education can hinder spillovers from taking place. Kokko et al (1996) have for instance analyzed the importance of the technology gap. They found that local firms only benefit from the presence of multinationals if the technology gap is not too large. Glass and Saggi (1998) further argue that the technology gap influences the quality of technology transferred. In contrast to these studies Sjöholm (1998) found no connection between spillovers and the size of the technology gap.

Absorption capacities of the local firms can further on be influenced by the proximity to the multinationals. Audretsch (1998) suggests that closeness to multinationals is necessary for spillover to take place, since technology spillovers are spatially restricted (Audretsch 1998, p 26). The closer the firm is to the affiliates, the easier it should become to absorb spillovers and imitate the activity of the multinationals. Contrary to this study, Aitken and Harrison (1999) found no evidence of spillovers for domestic firms in the same region as the multinational.

Another factor that can explain why some firms absorb spillovers more easily than others is export activity. As mentioned earlier, domestic firms can learn how to export by imitating or co-operating with multinationals (Görg and Greenaway 2003, p 13). Others that have taken the importance of export spillovers into account are Greenaway et al (2001). They found that the probability of domestic firms to export was positively influenced by the relative importance of multinationals production as well as by their export activity in the host country (Greenaway et al 2001, p 14). When studying export propensity they further found that the propensity to export was positively correlated with the intensity of R&D (Greenaway et al 2001, p 14). No evidence of export information spillovers was however found in this study (Greenaway et al 2001, p 14).

Finally, it has been suggested that the possibilities for spillovers depend on whether the multinational is an export-oriented company or not. It has for example been said that spillovers are more likely to be transferred from non-exporting foreign firms since these firms tend to purchase more locally than export-oriented ones (Belderbos et al 2001, p 202).

In conclusion, there are many plausible explanations for the lack of positive correlation in earlier studies. One of the more credible explanations is the existence of backward linkages, which many argue has been overlooked. Others suggest that increasing competition can explain the lack of positive correlation between spillovers and productivity. Maybe the most convincing explanation is that there are differences in development, technology, market characteristics and other factors in the host country as well as between affiliates that affect the likelihood of spillover effects.

3. FDI AND SPILLOVERS IN CHILEAN MANUFACTURING

Taking a closer look at Chile, a country that has seen a large inflow of foreign direct investments, will make it possible to understand the relationship between spillover effects and the productivity of domestic firms in greater detail. Chile is an interesting country to study due to many factors. First of all, few studies of this type have been performed focusing on Latin American countries and on Chile. One exception is the study of Alfaro and Rodríguez-Clare (2004) who take a closer look at the spillover effects in four Latin American countries: Chile, Mexico, Venezuela and Brazil. Using plan-level data they found a positive correlation between the presence of foreign affiliates and backward linkages. Chile is also interesting to analyze since the country has seen a major change in development strategy; from an import substitution industrialization political model to a more export-oriented approach. Since the export activity of a host country often is argued to matter for spillover effects, such a study is therefore of great interest.

Another important change from the liberalization is the change in composition of the economy; in particular from a focus on the mining sector to a more diversified economy, where the non-traditional sector has become more important. One sector that especially has been affected by such a change is the manufacturing sector, which has seen a great inflow of capital and particularly foreign direct investment. With a heavy dependency on the mining sector and especially the copper industry, the inflow of investments into the manufacturing sector can for example diminish the dependency on world prices for mining products and hinder resources from other sectors from being drawn away to the mining sector. Investment flows to the non-traditional sector, such as to the manufacturing sector, can also help keep up a better balance in the export sector (INSEAD 2002). Since the inflow of foreign direct investments also has increased particularly in the manufacturing sector, a study of this sector is specifically of interest. Due to the efforts of diversifying the economy, a study of the manufacturing sector will nevertheless also be of interest for other more indirect reasons.

3.1. Econometric study

To investigate if spillovers have taken place in the manufacturing sector a regression analysis will first be used. In this analysis the correlation between the presence of foreign firms and productivity of domestic firms in the manufacturing sector is analyzed for the year 2000. To account for different spillover variables and differences in the host country as well as between foreign firms, several spillover variables and groups are constructed. However, due to the complexity of the subject, not all of the above mentioned potential spillover effects will be looked at.

3.1.1. Data construction and summary statistics

The data used in this study comes from the annual survey Encuesta Nacional de la Industria Manufacturera conducted by the Chilean national statistical bureau (INE), the Chilean economic development agency (Corfo) and Latin American Demographic center (CELADE) and is at firm level. The survey collects information from all firms in the manufacturing sector over a number of years and covers among other things, variables concerning employment, reimbursement, use of combustive materials, water, materials, sales, production and financial information. The data also covers background information such as type of firm, region and industry. The number of firms varies over the years but lies often between 3000-5000. The number of used observations is presented in the individual regression results below.

In accordance with earlier studies, only firms with more than 10 employees are included. Studying the material also shows one extreme value, observation 1395, that is excluded. Also excluding firms with negative values added, i.e. 65 firms, I am left with 4042 observations for domestic firms. Finally taking away observations with partial missing values for the used variables, 3551 observations are left for the total material. The sector distributions of all firms, both the number of firms and employees in 2000, are presented in table 1.

Table 1. Sector distribution

Sector, CIIU 3	Total # of firms	# of foreign firms	% foreign firms in each sector	% of all foreign firms	Total # of emp	# of foreign emp	% foreign emp in each sector	% of all foreign emp
15 - Manu. of food products & beverages	1332	78	5.86	30.12	117611	22842	19.42	42.67
16 - Manu. of tobacco products	3	0	0	0	787	0	0	0
17 - Manu. of textiles	254	10	3.94	3.86	15718	797	5.07	1.49
18 - Manu. of wearing apparel; dressing & dyeing of fur	255	6	2.35	2.32	14318	1085	7.58	2.03
19 - Tanning & dressing of leather; manu. of luggage, handbags, saddlery, harness & footwear	129	1	0.78	0.39	9016	21	0.23	0.04
20 - Manu. of wood & of products of wood & cork, except furniture; manu. of articles of straw & plaiting materials	283	12	4.24	4.63	23037	1834	7.96	3.43
21 - Manu. of paper & paper products	106	7	6.6	2.7	11769	1137	9.66	2.12
22 - Publishing, printing & reproduction of recorded media	174	6	3.45	2.32	11741	1694	14.42	3.16
23 - Manu. of coke, refined petroleum products & nuclear fuel	6	2	33.33	0.77	1427	152	10.65	0.28
24 - Manu. of chemicals & chemical products	246	57	23.17	22.01	25716	8062	31.35	15.06
25 - Manu. of rubber & plastics products	250	16	6.4	6.18	16886	2957	17.51	5.52
26 - Manu. of other non-metallic mineral products	174	10	5.75	3.86	13132	1468	11.18	2.74
27 - Manu. Of basic metals	92	11	11.96	4.25	22419	5515	24.6	10.3
28 - Manu. of fabricated metal products, except machinery & equipment	388	12	3.09	4.63	20933	1475	7.05	2.76
29 - Manu. of machinery & equipment n.e.c.	198	11	5.56	4.25	11622	1087	9.35	2.03
31 - Manu of electrical machinery & apparatus n.e.c	62	6	9.68	2.32	4309	1218	28.27	2.28
32 - Manu. of radio, television & communication equipment & Apparatus	6	2	33.33	0.77	144	58	40.28	0.11
33 - Manu. of medical, precision & optical instruments, watches & Clocks	17	4	23.53	1.54	1019	429	42.1	0.8
34 - Manu. of motor vehicles, trailers & semi-trailers	59	3	5.08	1.16	3351	1030	30.74	1.92
35 - Manu. of other transport equipment	32	1	3.13	0.39	5953	204	3.43	0.38
36 - Manu of furniture; manu. n.e.c.	234	4	1.71	1.54	10158	469	4.62	0.88
39 - Other manufacturing	1	0	0	0	31	0	0	0
Total	4301	259		100	341097	53534		100

Source: Own calculations from data obtained from Encuesta Nacional de la Industria Manufacturera.

As can be seen in table 1 most foreign firms, relative to the total number of firms in the same sector, are located in sectors 23 and 32. Compared to the total number of foreign firms in the manufacturing sector, most foreign firms can be found in sector 15, the food production and beverage sector. Focusing on the number of employees in foreign firms most foreign employees, compared to all firms in the sector, can be found in sector 32 and 33. Also here, most foreign employees compared to all foreign firms in the manufacturing sector are located in the food production and beverage sector, sector 15.

To examine the correlation between the productivity of domestic firms and the presence of foreign firms I follow the same approach taken by many earlier papers and estimate the following equation to begin with:

$$\text{Ln}y_i = \alpha + \beta_1 \ln C_i + \beta_2 \ln M_i + \beta_3 \ln L_i + \beta_4 Renum_i + \beta_5 Exp_i + \beta_6 FSsec_i + \beta_7 FSreg_i + \varepsilon_i \qquad (1)$$

Where $\ln y_i$ is the logarithm value added in domestic firm i. The variable value added is hence used as a proxy for productivity. Other variables such as total factor productivity could have been used. However, due to access and simplicity value added is chosen.[1] $\ln C_i$ is the logarithm fixed values at the end of each year for domestic firm i. $\ln M_i$ is the logarithm value of material used in domestic firm i and $\ln L_i$ is the logarithm of total employees in domestic firm i. In many earlier studies a variable measuring skills or knowledge is often used. Since no similar variables are available in this study remuneration in the domestic firm, i.e. $Renum_i$ is instead used as a proxy. Since education often is supposed to result in higher wages these variables should therefore be correlated.[2] To also account for openness and domestic firms export activities, total income from export in domestic firm i, is used as a proxy. Finally ε_i is an error term that is supposed to have a normal distribution with a constant mean and variance and that the εs are independent across observations.

To measure the correlation between foreign presence and productivity of domestic firms, two variables are constructed.[3] To first of all analyze whether spillovers from the presence of foreign firms in the same sector are important, the ratio of the number of employees in foreign firms in

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[1] See for example Huang Jr-Tsung (2004), in which TFP (total factor productivity) is used.
[2] See for example Björklund (2000).
[3] In a similar fashion as Barrios et al (2002).

one sector to the total number of employees in all firms in the same sector, is used as a proxy.[4]
In other words:

$$FSsec_i = \frac{\frac{\sum_{i=1}^{m} L_{Fi}}{n}}{\sum_{i=1}^{n} L_{TOTi}} \qquad (2)$$

Where, L_{Fi} represents the number of foreign employees in foreign firms i through m in the sector. L_{TOTi} represents the total number of employees in all firms in the sector. Here, the smallest measurement of sector, i.e. 4-digit level, is used. There are 110 sectors at 4-digit level in Chile. Foreign firms are, as in many earlier studies, defined as firms with more or equal to 10 % foreign ownership. This variable will be refereed to as sector spillovers.

To also control for spillover effects through the location and closeness to foreign firms, the ratio of the number of employees in foreign firms in the region to the total number of employees in the same region, is used as a proxy. Since the probability of spillovers taking place should increase the closer a firm is to a foreign firm, the smallest measurement of a region, i.e. commune is used. There are 226 communes in Chile. The variable looks like the following:

$$FSreg_i = \frac{\frac{\sum_{i=1}^{m} L_{Fi}}{n}}{\sum_{i=1}^{n} L_{TOTi}} \qquad (3)$$

Here, L_{Fi} represents the number of foreign employees in foreign firm i through m in the region. Similar, L_{TOTi} represents the total number of all employees in all firms in the region. Foreign firms are also here defined as firms with more than 10 % foreign ownership. This variable will be referred to as regional spillovers.[5]

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[4] An alternative measurement of spillovers is the use of foreign share of total sales. This measurement is not used however, due to missing values.
[5] For a more detailed description of the chosen variables, see Appendix A, table A.1.

3.1.2. Extensions

As has been argued in section two of this paper, differences in absorption capacities and differences between foreign firms can affect the transfer of spillovers from multinationals to domestic firms.[6] Dividing the material into several groups[7], where both absorption capacities for domestic firms as well as differences in foreign firms are used as measurements, makes it possible to understand underlying factors better. Doing so also gives me the opportunity to understand earlier inconclusive results in more depth.

One factor that has been assumed to influence spillover effects is the ownership structure. Dimelis and Louri (2002) found for example, when estimating the effects of foreign presence on domestic productivity levels in Greece, using the complete cross-sectional sample, that spillovers only come from minority held foreign firms, i.e. firms with less than 50 % foreign ownership. Dividing the material into two groups, foreign firms with small amount of foreign ownership, i.e. 10-49 % and foreign firms with large foreign ownership, i.e. 50-100 %, I try to investigate these potential relationships further.

Another factor that can influence the transference of spillover effects is the export activity of the foreign firms. It has for example been suggested that foreign affiliates that focus on the domestic market tend to purchase more locally than export-oriented ones (Belderbos et al 2001, p 195). Reconstructing the spillover variables, using exporting foreign firms on the one hand and non-exporting foreign firms on the other, gives me the possibility of looking closer at this potential relationship.

Differences and absorption capacities between domestic firms can also matter for spillover effects. One potential factor that could influence the absorption capacity of a firm is the size of the domestic firm. One could for example argue that the bigger the firms, the bigger the chances for contact with foreign firms and therefore the bigger the change for spillover effects. To account for such a difference the material is divided in a similar fashion to Sinani and Meyer (2002) into two groups: domestic firms with less than 50 employees and domestic firms with 50 employees or more. This limit has also been used by the INE, Corfo and CELADE and should give a good picture if large and small firms benefit differently from spillover effects.

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[6] See for example Blomström and Kokko (1998).
[7] For more details of the construction of the different groups, see Appendix A, table A.1.

Other similar variables measuring absorption capacities are R&D and export.[8] Since no data concerning R&D is available, export is instead used as a proxy. One could argue that exporting firms that are exposed to foreign markets might already have higher levels of technology relative to those firms that only operate on local markets, a factor that could influence potential spillovers. In the case of Chile, investigating whether export is important is also interesting since a large part of the economy is export dependent. To investigate whether export activities matter for spillover effects the material is, in accordance with Sinani and Meyer (2002), first divided into two groups, those that export and those that do not export. To also see whether differences in export activities matter given that the firm exports, exporting firms are further divided into two groups. The first group includes domestic firms that export less than 25 % of their total income. The second group includes domestic firms that export 25 % or more of their total income. A closer study of the material makes such a cut-off point seemingly reasonable. Firms that do not export are here treated as missing values.

It has also been suggested that the number of foreign firms located in a specific industry matters for spillover effects. Spillovers are often said to be more likely in industries where the foreign share is high. On the other hand, spillovers could occur in industries with a low foreign share, since these industries could be more dynamic. To see whether the foreign presence in different sectors matters for spillovers, the material is divided into two groups: domestic firms that are present in sectors with relatively low foreign presence and domestic firms that are present in sectors with relatively high foreign presence. Foreign presence is here measured as the ratio between the number of foreign labor and the total number of labor in the same sector. A 10 % cut-off point is chosen. Such cut-off point divides the material into two approximately equal groups.

A similar argument is that regional proximity to foreign firms could affect spillover effects. Proximity could make it easier for local firms to absorb and imitate the activities of the multinationals. To see whether proximity matters for spillover effects, domestic firms, in the same manner as above, are divided into two groups: those that are located in regions where foreign labor constitutes less or more than 10 % of the total labor.

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[8] See for example Barrios (2000) and Barrios et al (2002).

3.1.3. Hypothesis and diagnostic testing

To check the reliability of the model a number of criteria are used. To understand whether the model as a whole is significant, P-values from F-tests, obtained from analysis of variance tables, are first analyzed. To see whether the model as a whole is significant the following hypotheses are used:

Null hypothesis: $\beta_1 = \beta_2 = ... = \beta_3 = 0$

Alternative hypothesis: at least one of $\beta_i \neq 0$

Where $i = 1,2,...,k$

Where low P-values indicate that the null hypothesis can be rejected. P-values from this F-test are presented in each regression result. To also investigate whether individual x-variables are significant individual P-values for each variable are studied. To test this, the following hypotheses are used:

Null hypothesis: $\beta_i = 0$

Alternative hypothesis: $\beta_i \neq 0$

Where $i = 1,2,...,k$

Where low P-values indicate that the individual x-variable is significantly different from zero, holding everything else constant. Individual P-values are presented in the respective regression results. To control for multicolinearity VIF-values i.e. Variance Inflation Factor values are constructed. These values measure the increase in the variances and are calculated as follows:

$$\text{VIF}_j = \frac{1}{\left(1 - R_j^2\right)} \ , \quad \text{where } j = 1,2,....,k \tag{4}$$

According to Kleinbaum et al (1998) a rule of thumb is that values bigger than 10 could imply multicolinearity (Kleinbaum et al 1998, s 241). The individual VIF-values are presented for each explanatory variable in the regression results.

To further control for autocorrelation the Durbin-Watson test (DW) is used. In this test, which is presented below, d is approximately equal to two when no autocorrelation of first order is present.

$$d = \frac{\sum_{t=2}^{T}\left(\varepsilon_t - \varepsilon_{t-1}\right)^2}{\sum_{t=1}^{T}\varepsilon_t^2} \qquad (5)$$

Studying the residuals, heteroskedasticity and normality assumptions can also be analyzed. Due to space limitation only residual plots for the first regression are shown.[9] However, since regression results, seen in tables 3 through 8 and A.3., use sub-sets of the total data set, these residual plots should show similar results to residual plots from regressions using the total data set. Each residual plot is also analyzed and comments are presented in the different sections.

To evaluate the overall fit of the model, a goodness of fit measurement is further constructed. To account for the number of variables in the model, adjusted R^2 is chosen and is calculated with the following formula:

$$R_{adj}^2 = R^2 - \frac{k}{n-(k+1)}\left(1 - R^2\right), \quad \text{where } R^2 = \frac{\sum\left(\hat{y}_i - \bar{y}\right)^2}{\sum\left(y_i - \bar{y}\right)^2} \qquad (6)$$

Where k is degrees of freedom and n number of observations.

3.1.4. Problem discussion

There are a number of problems the chosen regression analysis can give rise to. The most acute problem is the choice of dependent variable, i.e. value added, which is used as a proxy for productivity. As has been argued, productivity itself is very difficult to quantify and hence difficult to measure. Both a traditional Solow residual and a more detailed total factor productivity measurement have been used to measure productivity. To minimize measurement problems and to simplify the study a simpler proxy, value added, is chosen for the study.

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[9] See Appendix A, table A.2.

Other problems that can arise are problems with the explanatory variables. First, a number of other variables as well as combinations of variables could make the model more accurate and explain the variation in *y* in more detail. Second, spillover effects are difficult to quantify and to measure. Other proxies for spillover effects than those used in this paper could consequently show different results. As argued in sector two, spillovers might also depend on the technology gap and education. Since data is not available to measure such factors or other potential underlying variables, it is not possible to measure all potential spillover effects.

Studying specific sectors, regions and years could also influence the given results. Dividing the material into several groups might also cause problems, since fewer observations are used. However, since the number of observations is still relatively large, dividing the material into several groups should not cause substantial problems for the analysis. Finally, econometric aspects, for example autocorrelation, multicorrelation and heteroskedasticity could cause problems for the models. Even though the most common problems are controlled for, other factors that are not seen or that cannot be controlled for, could cause problems for the models. Consequently one should have these potential weaknesses in mind when reading this paper.

3.1.5. Econometric results

Investigating whether there are spillover effects of foreign firms on the productivity of domestic firms all variables are used in a first stage. Nevertheless, problems with multicorrelation are discovered. Investigation of the material shows that the variables employees and remuneration are highly correlated. Since the variable remuneration seems to be the one causing the problem, it is excluded. Excluding this variable gives the following result:

Table 2. Regression results for total material

Predictor	Coef	SE Coef	P	VIF
Constant	5.54435	0.08367	0.000	
ln C	0.191160	0.009804	0.000	2.5
ln M	0.135408	0.009019	0.000	2.3
ln L	0.84757	0.02087	0.000	2.6
Exp	0.00000001	0.000000	0.000	1.1
FSsec	0.6049	0.1073	0.000	1.0
FSreg	0.2320	0.1008	0.021	1.0
R-Sq(adj)	77.2 %			
DW	1.73558			
P-value from F-test	0.000			
n	3551			

As can be seen in table 2, positive spillover effects of the presence of foreign firms on the productivity of domestic firms appear to exist. Both spillover variables, *FSsec* and *FSreg*, show significant results. However the variable spillover effects from the presence of foreign firms in the same regions (*FSreg*) seems to be less significant than the variable measuring spillovers from the presence of foreign firms in the same sector, (*FSsec*). Both variables show however positive significant results at the 5 % significant level. All other variables show expected signs. Residual plots in Appendix A, table A.2. and test statistics in table 2 above indicate that the model fulfills autocorrelation, multicorrelation and heteroskedasticity requirements. However residual plots indicate that problems with the normal distribution, particularly in the lower tails, could exist. The model explains 77.2 % of the variation of *y*.

Foreign firms are here defined as firms with more or equal to 10 % foreign ownership. To investigate whether the used cut-off point for foreign firms matters, different cut-off points, such as 0 % foreign ownership and 5 % foreign ownership, are also investigated. However they show very similar results. In accordance with earlier studies 10 % is therefore used as the cut-off point for foreign firms in the rest of the paper.

Extensions

To understand in more detail how spillover effects influence the productivity of domestic firms, the material is divided into several groups. To first see whether differences between foreign firms matter for spillover effects, both ownership structure and export activities of foreign firms are studied. To further see whether differences in domestic firms matter for spillover effects, domestic firms are divided into groups where size, export and closeness to foreign firms are analyzed.

Does foreign ownership matter?

To investigate whether ownership structures of the foreign firms affect the results, spillover variables, *FSsec* and *FSreg,* are reconstructed.[10] Results from regressions using majority and minority owned foreign firms to measure different spillover effects are shown below:

Table 3. Foreign ownership

Group	Majority				Minority			
Predictor	Coef	SE Coef	P	VIF	Coef	SE Coef	P	VIF
Constant	5.57106	0.08321	0.000		5.60138	0.08412	0.000	
Ln K	0.191445	0.009802	0.000	2.5	0.195052	0.009830	0.000	2.4
Ln M	0.134055	0.009009	0.000	2.3	0.134303	0.009079	0.000	2.3
Ln L	0.84901	0.02087	0.000	2.6	0.84680	0.02099	0.000	2.6
Exp	0.000001	0.00000	0.000	1.1	0.0000001	0.000000	0.000	1.1
FSsec	0.6335	0.1147	0.000	1.0	0.3072	0.2765	0.267	1.0
FSreg	0.2241	0.1092	0.040	1.0	0.1635	0.2280	0.473	1.0
R-sq(adj)	77.2 %				77.0 %			
DW	1.73365				1.72067			
P-value from F-test	0.000				0.000			
n	3551				3551			

As can be seen in table 3, spillovers seem to affect the productivity of domestic firms. Nevertheless, these effects only appear to come from foreign firms with majority foreign ownership structures. Spillovers from the presence of foreign firms in the same sector tend to be more significant than spillovers from the presence of foreign firms in the same region. All other variables show expected signs. The model is significant and explains approximately 77 % of the variation in *y*. Durbin-Watson and VIF-values indicate that that the models fulfill the

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[10] For definitions, see Appendix A, table A.1.

autocorrelation and multicorrelation requirements. Residual plots indicate that heteroskedasticity and normality assumptions are fulfilled.

Does foreign export activity matter?

As has been argued earlier in this paper spillover effects can further depend on the export activities of the foreign firms. To see whether foreign firms export activity matters for spillover effects, spillover variables are once again reconstructed.[11] Foreign firms are hence divided into two groups, exporting foreign firms and non-exporting foreign firms. Results from regression using different levels of foreign export activities when measuring spillover effects are shown below.

Table 4. Foreign export activities

Group	Export activity				No export activity			
Predictor	Coef	SE Coef	P	VIF	Coef	SE Coef	P	VIF
Constant	5.59750	0.08346	0.000		5.55505	0.08460	0.000	
ln C	0.193786	0.009816	0.000	2.4	0.191792	0.009822	0.000	2.5
ln M	0.132039	0.009041	0.000	2.3	0.138796	0.009163	0.000	2.4
ln L	0.84890	0.02093	0.000	2.6	0.84554	0.02093	0.000	2.6
Exp	0.00000001	0.000000	0.000	1.1	0.00000001	0.000000	0.000	1.1
FSsec	0.4322	0.1208	0.000	1.0	0.8715	0.1939	0.000	1.0
FSreg	0.1600	0.1188	0.178	1.0	0.5279	0.2050	0.010	1.0
R-Sp(adj)	77.0 %				77.1 %			
DW	1.72677				1.73000			
P-value from F-test	0.000				0.000			
n	3551				3551			

As can be seen, foreign export activities seem to matter for spillover effects. Using only exporting foreign firms when measuring spillover effects shows significant result at the 5 % level for the variable sector spillover. However, using non-exporting foreign firms shows significant results for both spillover variables. Sector spillovers do also seem to be of relatively more importance for this group, with a coefficient of 0,8715 compared to 0,4322 when using exporting foreign firms. The models explain approximately 77 % of the variation of *y*. Model requirements appear to be fulfilled.

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[11] See Appendix A, table A.1. for definitions.

To further understand if differences in domestic firms matter for spillover effects, the material is divided into several groups where differences in characteristics of the domestic firms are studied. In particular differences in size, export, sector and regional presence are looked at in more detail. To also understand whether differences in ownership structure and foreign export activities influence the results for these groups, both the total number of foreign firms as well as foreign firms with different ownership structures and export activities are used in the different sub-group regressions.

Does the size of domestic firms matter?

As has been argued earlier in this paper one factor that might affect spillovers is the size of the domestic firms. Large firms might more easily adopt new technology and new ideas from foreign firms than small firms and would therefore absorb spillovers more easily. To measure whether size matters domestic firms are divided into two groups, firms with less than 50 employees and firms with 50 employees or more. To also understand how differences in foreign ownership structures and foreign export activities affect these two groups, spillover variables are measured first using all foreign firms. Spillovers are then measured using majority/minority owned firms and foreign firms with different export activities. The results of these regressions can be seen in table 5 below. Due to space limitations, standard errors are not shown. Individual P-values are shown in parentheses and VIF-values are shown in cursive font.

Focusing on domestic firms with less than 50 employees, which can be seen in the left hand side of table 5, both spillover variables seem to affect productivity, but differences in ownership structure and export activities also seem to matter. Focusing on ownership structure, only majority-owned foreign firms seem to affect productivity significantly through spillovers, in this case through sector spillovers. No spillover variables are significant when using minority-owned foreign firms. Foreign export activities also seem to influence the results. Both regional and sector spillovers are significant at the 5 % level when using non-exporting foreign firms. Only the sector spillover variable is significant when using exporting foreign firms. In general the most important spillover variable is sector spillovers, which is significant in most of the regressions.

Table 5. Size of domestic firms

Group	Domestic firms with less than 50 employees					Domestic firms with more or equal to 50 employees				
	Total	Majority	Minority	Exp act.	No exp act	Total	Majority	Minority	Exp act	No exp act
Predictor	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF
Constant	5.6659 (0.000)	5.7008 (0.000)	5.7533 (0.000)	5.7299 (0.000)	5.7020 (0.000)	5.4234 (0.000)	5.4352 (0.000)	5.4590 (0.000)	5.4340 (0.000)	5.4462 (0.000)
ln C	0.18297 (0.000) 1.5	0.18237 (0.000) 1.5	0.18492 (0.000) 1.5	0.18445 (0.000) 1.5	0.18254 (0.000) 1.5	0.18111 (0.000) 1.8	0.18326 (0.000) 1.8	0.18631 (0.000) 1.8	0.18502 (0.000) 1.8	0.18142 (0.000) 1.8
ln M	0.09455 (0.000) 1.4	0.09291 (0.000) 1.4	0.09142 (0.000) 1.4	0.09023 (0.000) 1.4	0.09601 (0.000) 1.4	0.22442 (0.000) 1.8	0.22413 (0.000) 1.8	0.22468 (0.000) 1.8	0.22423 (0.000) 1.8	0.22913 (0.000) 1.9
ln L	0.96851 (0.000) 1.3	0.97016 (0.000) 1.3	0.97326 (0.000) 1.3	0.97296 (0.000) 1.3	0.97010 (0.000) 1.3	0.66805 (0.000) 1.8	0.66433 (0.000) 1.8	0.66243 (0.000) 1.8	0.66497 (0.000) 1.8	0.66028 (0.000) 1.8
Exp	0.0000004 (0.000) 1.1	0.0000004 (0.000) 1.0	0.0000004 (0.000) 1.1	0.0000004 (0.000) 1.1	0.0000004 (0.000) 1.1	0.0000001 (0.000) 1.2	0.0000001 (0.000) 1.2	0.0000001 (0.000) 1.2	0.0000001 (0.000) 1.2	0.0000001 (0.000) 1.2
FSsec	0.6072 (0.000) 1.0	0.6944 (0.000) 1.0	-0.1137 (0.747) 1.0	0.5218 (0.000) 1.0	0.6356 (0.008) 1.0	0.4551 (0.014) 1.0	0.4027 (0.045) 1.0	0.5602 (0.202) 1.0	0.1720 (0.410) 1.0	0.3332 (0.001) 1.0
FSreg	0.2172 (0.072) 1.0	0.1845 (0.153) 1.0	0.2953 (0.300) 1.0	0.0889 (0.530) 1.0	0.6126 (0.010) 1.0	0.3103 (0.080) 1.0	0.3733 (0.059) 1.0	-0.0105 (0.977) 1.0	0.3763 (0.073) 1.0	0.3923 (0.507) 1.0
R-sq(adj)	48.8 %	48.9 %	48.3 %	48.6 %	48.6 %	65.8 %	65.7 %	65.5 %	65.6 %	65.8 %
DW	1.77443	1.77880	1.76391	1.76680	1.77247	1.81845	1.82036	1.81686	1.81890	1.80794
P-value from F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
n	2443	2443	2443	2443	2443	1108	1108	1108	1108	1108

Instead, focusing on domestic firms with 50 or more employees, which can be seen on the right hand side of table 5, a similar pattern appears. Spillovers seem to exist but differences in ownership structures, export activities and type of spillovers seem to matter. The most important spillover variable here is also sector spillover, but the difference between the two variables is less clear in this group. Ownership structure also seems to matter for spillovers for domestic firms with 50 or more employees. Majority-owned foreign firms seem to be the most important in transferring spillovers to domestic firms, but these spillovers are not strongly significant. Looking closer at foreign export activities, a difference between non-exporting and exporting foreign firms also seems to exist. Analysis using non-exporting foreign firms show significant results for the variable measuring sector spillovers. Analysis using exporting foreign firms shows, on the other hand, regional spillover effects, but these effects are only significant at the 10 % level.

All the models seem to fulfill autocorrelation, heteroskedasticity, multicorrelation and normality requirements. The models explain about 48 % of the variation in y in the case of domestic firms with fewer than 50 employees and 65 % of the variation in y in the case using domestic firms with 50 or more employees.

In conclusion, there seem to be spillover effects in both studied groups. These effects appear to mainly come from the variable measuring sector spillovers and not so often from regional spillovers. Looking closer at ownership structure, only foreign firms with majority foreign ownership seem to matter for spillover effects. The relationship between foreign export activities and spillovers also seems to be influenced by differences in size.

Does domestic export activity matter?

To further see whether domestic firms export activity matters for spillover effects, the material is once again divided into two groups: exporting domestic firms and non-exporting domestic firms. Results from these regressions can be seen in table 6 below.

Focusing on non-exporting domestic firms, which can be seen on the left hand side of equation 6, regression using all foreign firms shows significant results at the 5 % level for both spillover variables. Regional spillovers are however only significant at 5 % and not at lower levels. In accordance with most of the other regressions, sector spillovers seem to be the most important spillover variable. Once again, only majority-owned foreign firms show significant results for spillover effects. For firms that have less than 50 % foreign equity no spillover effects seem to be of importance. Focusing on the export activities of foreign firms one can also see here a difference between the studied groups. Analysis using non-exporting foreign firms show that both types of spillovers are significant, in this case at the 1 % and 5 % levels. Analysis using exporting foreign firms shows, on the other hand, that only sector spillovers are of importance.

When focusing on exporting domestic firms, which can be seen on the right hand side of table 6, few spillovers can be seen. None of the spillover variables are significant at the 5 % level. However, non-exporting foreign firms seem to have a greater impact on exporting domestic firms productivity than any other foreign firms in this analysis. The models explain close to 70 % of the variation in y in both cases. The models appear to fulfill autocorrelations, multicorrelation, heteroskedasticity and normality requirements.

To understand these relationships in more detail, domestic firms that export are further divided into two groups: those that export a relatively small share and those that export a relatively large share of their total income. Results from these regressions can be found in Appendix A, table A.3. Both studied groups show no significant results for spillover variables at the 5 % level. Hence, regardless if domestic firms export a large or a small share, spillovers from foreign firms do not seem to be of importance.

Table 6. Export activities of domestic firms

	Non-exporting domestic firms					Exporting domestic firms				
Group	Total	Majority	Minority	Exp act	No exp act	Total	Majority	Minority	Exp act	No exp act
Predictor	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF
Constant	5.67310 (0.000)	5.69859 (0.000)	5.75042 (0.000)	5.72689 (0.000)	5.70391 (0.000)	5.1115 (0.000)	5.1268 (0.000)	5.1613 (0.000)	5.1396 (0.000)	5.1658 (0.000)
ln C	0.17557 (0.000) 2.0	0.17557 (0.000) 2.0	0.17894 (0.000) 2.0	0.17782 (0.000) 2.0	0.17626 (0.000) 2.0	0.20514 (0.000) 2.2	0.20581 (0.000) 2.2	0.20616 (0.000) 2.2	0.20736 (0.000) 2.2	0.20323 (0.000) 2.2
ln M	0.112376 (0.000) 1.8	0.110910 (0.000) 1.7	0.109699 (0.000) 1.8	0.108118 (0.000) 1.7	0.114792 (0.000) 1.8	0.26006 (0.000) 2.6	0.26077 (0.000) 2.6	0.26214 (0.000) 2.6	0.26206 (0.000) 2.6	0.25864 (0.000) 2.6
ln L	0.93155 (0.000) 2.0	0.93352 (0.000) 2.0	0.93148 (0.000) 2.0	0.93486 (0.000) 2.0	0.92702 (0.000) 2.0	0.56197 (0.000) 2.3	0.56053 (0.000) 2.3	0.55654 (0.000) 2.3	0.55645 (0.000) 2.3	0.56670 (0.000) 2.4
Exp	-	-	-	-	-	0.00000001 (0.000) 1.2	0.00000001 (0.001) 1.2	0.00000001 (0.000) 1.2	0.0000001 (0.001) 1.2	0.0000001 (0.000) 1.2
FSsec	0.5967 (0.000) 1.0	0.6522 (0.000) 1.0	0.1594 (0.585) 1.0	0.4768 (0.000) 1.0	0.7697 (0.000) 1.0	0.0.4214 (0.125) 1.0	0.3596 (0.220) 1.0	0.6957 (0.352) 1.0	0.1538 (0.594) 1.0	0.9491 (0.058) 1.0
FSreg	0.2163 (0.048) 1.0	0.2179 (0.063) 1.0	0.1202 (0.627) 1.0	0.1603 (0.212) 1.0	0.4220 (0.050) 1.0	0.2433 (0.320) 1.0	0.2189 (0.424) 1.0	0.2838 (0.604) 1.0	0.1596 (0.581) 1.0	0.7613 (0.185) 1.0
R-sq(adj)	70.7 %	70.7 %	70.4 %	70.6 %	70.6 %	72.4 %	72.3 %	72.3 %	72.2 %	72.5 %
DW	1.75072	1.76057	1.74372	1.75187	1.75266	1.73472	1.73007	1.74130	1.73489	1.73329
P-value from F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
n	2884	2884	2884	2884	2884	667	667	667	667	667

In conclusions, spillovers seem to matter only for domestic firms that do not export. For this group the sector spillover seems to be the most important spillover variable. For domestic firms that do not export, majority-owned and non-exporting foreign firms appear to have the biggest impact on productivity. Worth noting is that the number of observations used for the group exporting domestic firms is much smaller than for the group non-exporting domestic firms, which could influence the result.

Does foreign presence matter?

The number of foreign firms located in the same sector might also affect spillover effects. To understand this in more detail, the material is once again divided into two groups: those that belong to sectors with a relatively low foreign presence and those that below to sectors with a relatively high foreign presence. Results of regressions using these two groups can be seen in table 7 below.

Focusing on domestic firms located in sectors with a relatively low foreign presence one can first of all see that spillovers seem to exist. However both negative and positive spillovers seem to be of importance for this group. In general sector spillovers appear to be the most important spillover variable. Ownership structure also appears to be of importance. In accordance with earlier findings, majority-owned foreign firms seem to transfer spillovers, but, in this case only regional spillovers. On the other hand, highly significant negative sector spillovers can be found for minority-owned foreign firms, a result which is different in many ways from earlier findings. Looking closer at the results obtained when using exporting and non-exporting foreign firms, sector spillovers seem to be the most important spillover variable for the two groups. Also here negative spillovers can be found.

Table 7. Foreign presence in the sector

	Domestic firms present in sectors with low foreign presence					Domestic firms present in sectors with high foreign presence				
Group	Total	Majority	Minority	Exp act	No exp act	Total	Majority	Minority	Exp act	No exp act
Predictor	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF
Constant	5.4981 (0.000)	5.4195 (0.000)	5.6359 (0.000)	5.5506 (0.000)	5.3529 (0.000)	5.7531 (0.000)	5.7751 (0.000)	5.7753 (0.000)	5.7954 (0.000)	5.7540 (0.000)
ln C	0.22945 (0.000) 2.3	0.23113 (0.000) 2.3	0.21585 (0.000) 2.3	0.21803 (0.000) 2.3	0.22538 (0.000) 2.3	0.15928 (0.000) 2.8	0.16074 (0.000) 2.8	0.16026 (0.000) 2.8	0.16012 (0.000) 2.8	0.16078 (0.000) 2.8
ln M	0.09784 (0.000) 2.0	0.09607 (0.000) 2.0	0.10824 (0.000) 2.1	0.11078 (0.000) 2.1	0.10239 (0.000) 2.1	0.18920 (0.000) 2.8	0.19080 (0.000) 2.8	0.19755 (0.000) 2.7	0.19153 (0.000) 2.8	0.19681 (0.000) 2.7
ln L	0.87634 (0.000) 2.5	0.87606 (0.000) 2.5	0.87303 (0.000) 2.5	0.88248 (0.000) 2.5	0.87889 (0.000) 2.5	0.75426 (0.000) 2.7	0.75237 (0.000) 2.7	0.74672 (0.000) 2.7	0.75224 (0.000) 2.7	0.74650 (0.000) 2.7
Exp	0.00000001 (0.000) 1.1	0.00000001 (0.002) 1.1	0.00000001 (0.005) 1.1	0.00000001 (0.001) 1.1	0.0000001 (0.001) 1.1	0.00000002 (0.001) 1.2	0.00000002 (0.001) 1.2	0.00000002 (0.001) 1.2	0.00000002 (0.001) 1.2	0.0000002 (0.001) 1.2
FSsec	-1.6359 (0.006) 1.0	-0.0251 (0.970) 1.0	-8.265 (0.000) 1.1	-4.4113 (0.000) 1.0	3.3017 (0.000) 1.0	0.4443 (0.008) 1.1	0.3076 (0.050) 1.0	0.2824 (0.329) 1.0	0.2659 (0.093) 1.1	0.3784 (0.141) 1.0
FSreg	0.2864 (0.062) 1.0	0.3405 (0.037) 1.0	0.0598 (0.875) 1.0	0.0938 (0.608) 1.0	0.5594 (0.073) 1.0	0.1189 (0.384) 1.0	0.0873 (0.562) 1.1	0.1877 (0.514) 1.0	0.0441 (0.779) 1.0	0.3839 (0.157) 1.0
R-sq(adj)	77.6 %	77.5 %	78.0 %	78.1 %	77.8 %	78.7 %	78.6 %	78.6 %	78.6 %	78.6 %
DW	1.92773	1.92201	1.91777	1.93788	1.92152	1.77817	1.77744	1.77258	1.77069	1.78083
P-value from F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
n	1585	1585	1585	1585	1585	1592	1592	1592	1592	1592

Focusing instead on domestic firms present in sectors with a relatively high foreign presence, which can be seen on the right hand side of table 7, few spillover effects can be found overall. Once again, spillovers from a foreign presence in the same sector appear to be the most important spillover variable. Nevertheless this effect is only significant using all foreign firms or only majority-owned foreign firms. Further, sector spillovers seem to be of some importance for exporting foreign firms. Test statistics and residual plots for all models indicate that the model requirements are fulfilled. The models explain approximately 78 % of the variation in *y*.

In conclusion, the presence of foreign firms in individual sectors seems to matter for the transference of spillovers. In sectors where there is a low foreign presence, negative and positive as well as regional and sector spillovers are found. In sectors with a relatively high foreign presence, few spillover variables show significant results. Foreign ownership structure and foreign export activity also seem to influence spillovers differently for these two groups. In the case of firms located in sectors with a low foreign presence both majority and minority-owned foreign firms seem to transfer spillovers. In this case, negative and positive as well as sector and regional spillovers can be found. In the case of firms located in sectors with a high foreign presence only sector spillovers seem to be of importance. These spillovers seem to come most often from majority-owned foreign firms. Differences in foreign export activities also seem to matter for spillover effects. Sector spillover is the most important spillover variable in both groups.

Does proximity to a foreign firm matter?

Proximity to foreign firms can also matter for spillover effects. To investigate this, the material is divided into two groups: firms located in regions with a relatively low or high foreign presence. Regression results from analysis using domestic firms that are located in regions with either relatively low foreign presence or relatively high foreign presence are shown in table 8 below.

Focusing on domestic firms present in regions with a low foreign presence, which can be seen on the left hand side of table 8, shows that sector spillovers are the most important spillover effect across the different groups. Differences in the ownership structure and export activities of foreign firms do however seem to matter. Like earlier findings, majority-owned firms seem to be the most important source for spillovers. No spillover variables are significant for minority-owned foreign firms. Export activities also seem to influence the transference of spillovers.

Exporting foreign firms seem to be the most important firms transferring spillovers in this group. Worth noting is that spillovers from the presence of foreign firms in the same region are negative in three of the regressions, but none of these effects are significant at the 5 % level.

Focusing on domestic firms that are present in regions with a relatively high foreign presence, one can see a similar pattern. The most important spillover variable appears to be sector spillovers, which is significant in most of the regressions. Regional spillovers seem to be of less importance throughout the different subgroups. Majority-owned foreign firms are also here the most important firms in transferring spillovers to domestic firms. Looking closer at foreign export activities, sector spillovers from both exporting and non-exporting firms are positive and significant at the 5 % level. As can be seen, non-exporting foreign firms might also affect productivity through regional spillovers. Nevertheless, this variable shows a P-value of 7.4 % and is therefore only significant at the 10 % level. Worth noting is that the variable export is less significant than in earlier regressions. The models appear to fulfill the model requirements and explain approximately 77 % of the variations of *y*.

In conclusion, proximity to foreign firms in the same regions seems to be of some importance for spillover effects. In both groups only significant sector spillovers can be found. Majority-owned firms matter the most for such spillover transference. Both exporting and non-exporting firms appear to be important for spillover effects in these groups.

Table 8. Foreign presence in the region

Group	Domestic firms present in regions with low foreign presence					Domestic firms present in regions with high foreign presence				
	Total	Majority	Minority	Exp act	No exp act	Total	Majority	Minority	Exp act	No exp act
Predictor	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF
Constant	5.6170 (0.000)	5.6559 (0.000)	5.6519 (0.000)	5.6831 (0.000)	5.5396 (0.000)	5.6519 (0.000)	5.6835 (0.000)	5.7187 (0.000)	5.7137 (0.000)	5.6875 (0.000)
ln C	0.19896 (0.000) 2.4	0.19853 (0.000) 2.4	0.20274 (0.000) 2.4	0.20300 (0.000) 2.4	0.20103 (0.000) 2.4	0.18342 (0.000) 2.3	0.18336 (0.000) 2.3	0.18606 (0.000) 2.3	0.18561 (0.000) 2.3	0.18196 (0.000) 2.4
ln M	0.12232 (0.000) 2.3	0.11960 (0.000) 2.3	0.11734 (0.000) 2.3	0.11439 (0.000) 2.3	0.12761 (0.000) 2.3	0.13187 (0.000) 2.3	0.13037 (0.000) 2.3	0.13186 (0.000) 2.3	0.12898 (0.000) 2.3	0.13498 (0.000) 2.3
ln L	0.84657 (0.000) 2.7	0.84994 (0.000) 2.7	0.84732 (0.000) 2.7	0.85250 (0.000) 2.7	0.84343 (0.000) 2.7	0.86435 (0.000) 2.5	0.86635 (0.000) 2.5	0.86275 (0.000) 2.5	0.86588 (0.000) 2.5	0.86210 (0.000) 2.5
Exp	0.00000003 (0.002) 1.1	0.00000003 (0.002) 1.1	0.00000003 (0.002) 1.1	0.00000003 (0.002) 1.1	0.0000003 (0.003) 1.1	0.00000001 (0.057) 1.1	0.00000001 (0.059) 1.1	0.00000001 (0.029) 1.1	0.00000001 (0.043) 1.1	0.0000001 (0.024) 1.1
FSsec	0.7028 (0.001) 1.0	0.8183 (0.001) 1.0	0.1202 (0.820) 1.0	0.5206 (0.038) 1.0	1.0804 (0.009) 1.1	0.5128 (0.000) 1.0	0.5053 (0.000) 1.0	0.4007 (0.235) 1.0	0.3554 (0.012) 1.0	0.7315 (0.003) 1.0
FSreg	-0.8450 (0.366) 1.0	-1.2564 (0.144) 1.0	1.574 (0.365) 1.0	-1.953 (0.090) 1.0	0.514 (0.627) 1.0	0.1630 (0.248) 1.0	0.1639 (0.210) 1.0	-0.1226 (0.614) 1.0	0.0287 (0.851) 1.0	0.4247 (0.074) 1.0
R-sq(adj)	76.4 %	76.5 %	76.2 %	76.3 %	76.3 %	77.5 %	77.5 %	77.3 %	77.4 %	77.4 %
DW	1.88957	1.89401	1.89107	1.88671	1.90169	1.84422	1.84263	1.83607	1.83865	1.84317
P-value from F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
n	955	955	955	955	955	1949	1949	1949	1949	1949

3.1.6. Hypothesis test for differences between groups

To understand in more detail whether spillover effects influence domestic firms differently for the above groups, hypothesis tests of the β-coefficients are performed. This test, which can be seen in equation 7, tests whether a significant difference between the same x-variable in different groups can be found. Such a test studies for example whether a statistical difference can be found between the effects of regional spillovers for exporting and non-exporting domestic firms.

$$Z = \frac{\left(\hat{\beta}_{grupp1} - \hat{\beta}_{grupp2}\right) - 0}{\sqrt{\left(SE\left(\hat{\beta}_{grupp1}\right)\right)^2 + \left(SE\left(\hat{\beta}_{grupp2}\right)\right)^2}} \tag{7}$$

Null hypothesis:
$\beta_{\text{group 1}} = \beta_{\text{group 2,}}$

Alternative hypothesis:
$\beta_{\text{group 1}} \neq \beta_{\text{group 2,}}$

Since the main interest of this study is to investigate spillover effects, only differences between spillover variables, i.e. *FSsec* and *FSreg*, are used. Due to the number of observations normal distribution is assumed. When different groups are studied independence can also be assumed. A significance level of α equals 5 % gives critical values of +1.96 and -1.96. Results of these hypothesis tests are shown in table 9 below:

Table 9. Results from hypothesis tests for β		
	FSsec	FSreg
Size		
Total	0.675	0.435
Majority	1.198	0.801
Minority	-1.199	0.655
Export activity	1.376	1.135
No export activity	0.741	0.481
Export vs. no export		
Total	0.590	0.377
Majority	0.922	0.003
Minority	0.668	0.273
Export activity	1.019	0.002
No export activity	0.331	0.554
Little vs. much exp		
Total	1.147	0.694
Majority	1.102	0.778
Minority	0.083	0.099
Export activity	0.994	1.041
No export activity	0.156	0.227
Sectors		
Total	*-3.381**	0.817
Majority	0.488	1.141
Minority	*-6.344**	0.268
Export activity	*-6.912**	0.206
No export activity	*3.434**	0.424
Regions		
Total	0.744	-1.068
Majority	1.138	-1.634
Minority	0.447	0.971
Export activity	0.576	-1.705
No export activity	0.729	0.083

* significant result at 5 % level

The first column shows whether differences in the impacts of sector spillovers can be found for the different groups. The second column shows, in the same manner, whether differences in the impacts of regional spillovers can be found for the studied groups. As can be seen in table 9, the majority of the values are less than the absolute value of 1.96. Consequently, no significant differences between these studied groups can be found. Nevertheless, differences seem to exist between domestic firms present in sectors with a low or high foreign presence. Worth noting is that only regressions using the total number of foreign firms, when studying the difference between sectors with a low or high foreign presence, show significant results in both regression analyses for sector spillovers. As can be seen in table 7, regressions using minority-owned firms and exporting/non-exporting foreign firms, show that only one of the two variables used is significant at the 5 % level. In these cases, significant spillovers are only found for domestic firms that are present in sectors with a low foreign presence, see table 9.

3.1.7. Conclusions from the econometric study

Conclusively, there seem to be significant spillover effects from foreign firms on the productivity of domestic firms in the manufacturing sector in Chile in 2000. Using the total sample shows that both sector and regional spillovers appear to be of importance. However, sector spillovers seem to be of greater importance than regional spillovers. Investigating whether differences between foreign firms, in this case using ownership and export differences, shows that spillover effects can be influenced by these differences. First of all using different ownership structures shows that only majority-owned foreign firms matter for spillover effects. Differences in export activities also show that more spillovers seem to come from non-exporting foreign firms.

Dividing the material into several sub groups gives me a further opportunity to see whether differences in capabilities between domestic firms matter for spillovers. Size appears to be of little importance for these spillover effects. Both large and small firms benefit from the presence of foreign firms. For both groups sector spillovers seem to be the most important spillover effect. Differences between ownership structures also seem to exist, and only foreign firms with majority foreign ownership matter for spillover effects in this subgroup. Looking closer at the export activities of foreign firms one can also observe a difference. Spillovers from exporting foreign firms only seem to matter for small domestic firms, while spillovers from non-exporting foreign firms seem to benefit both groups. Both regional and sector spillovers seem to come from non-exporting foreign firms, while exporting foreign firms only seem to result in sector spillovers.

The export activities of domestic firms also seem to matters for these spillover effects. Spillovers only appear to benefit non-exporting domestic firms. Few or no spillover effects seem to be present for firms that export. Regardless of whether domestic firms export a large or small part, spillovers for these firms seems to be few. One should have in mind however, that the number of observations for exporting domestic firms is relatively small, which could influence the result.

Differences in the relative presence of foreign firms in the same sector also appear to matter for spillover effects. For firms located in sectors where there is a low foreign presence, negative and positive as well as regional and sector spillovers can be found. For firms located in sectors where there is a relatively high foreign presence only positive sector spillover effects can be found. In general, spillovers for this group seem to be few.

Looking closer at differences in proximity to foreign firms shows once again that spillovers seem to exist. Spillovers appear nevertheless to have similar effects for firms located in regions with a high and a low foreign presence. Proximity to foreign firms should therefore not matter for differences in spillover effects. In both groups only positive sector spillovers can be observed. Only majority-owned foreign firms seem to matter for spillover effects. Both exporting and non-exporting foreign firms seem to be of importance for such spillovers.

Analyzing whether the same spillover variable affects the studied groups differently shows that only sector spillovers affect groups in different ways, which is in accordance with earlier findings. The test also shows that this difference only can be found when dividing the material into domestic firms located in sectors with low/high presence of foreign firms.

In conclusion, there seem to be significant positive spillover effects from the presence of foreign firms on the productivity of domestic firms in the manufacturing sector in Chile. These effects appear to be strongest from the foreign presence in the same sector. Regional spillovers are few. When looking at ownership structures, majority-owned foreign firms are clearly the most important firms for such spillovers. Further, non-exporting foreign firms seem to bring spillovers more often than exporting foreign firms. Differences between groups seem to matter in some cases. Domestic export activity and the relative presence of foreign firms in a specific sector are especially important variables for spillover effects. In general one should however also have in mind that difficulties measuring and quantifying spillover effects could influence these results.

4. FDI AND SPILLOVERS IN THE CHILEAN WINE INDUSTRY

To better understand the dynamics of spillover effects, I take a closer look at the Chilean wine industry in this chapter.

4.1. Dynamics of the wine industry

Chile has a long tradition of producing wine. It all started in the 16th century and grew at a steady pace up till only a few decades ago. During the last two decades however, the Chilean wine industry has seen a drastic boom in both production and value of wine.

Table 10. Evolution of wine production 1991-2004 (from grapes used for wines)
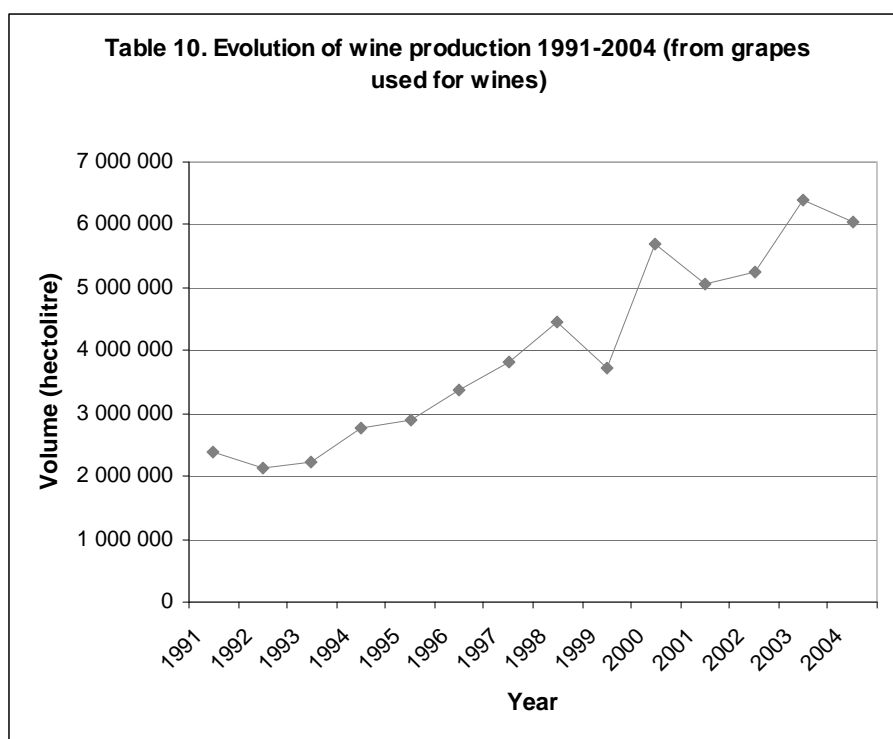
Source: SAG (Servicio Agrícola y Ganadero)

As can be seen in table 10, the volume of all wine production has more than doubled during the last decade. This boom depends on several factors. In the 1990s one could for example observe an increasing demand for New World wines. Due to this as well as other factors, the Chilean wine export has increased drastically (see table 11). As a consequence, the industry s share of the world market has grown from less than 0.5 % to almost 5.5 % over a period of less than 15 years.

Table 11. Wine exports 1988-2001

Year	Volume in hectoliters	% of world market
1988	185 100	0.38
1989	286 100	0.61
1990	430 500	0.96
1991	646 730	1.48
1992	740 290	1.63
1993	866 300	1.82
1994	1 079 040	2.07
1995	1 253 510	2.32
1996	1 840 835	3.74
1997	2 162 675	3.57
1998	2 298 018	3.42
1999	2 298 437	3.53
2000	2 647 499	4.01
2001	3 089 414	4.47
2002	3 553 000	5.20
2003	4 029 421	5.45

Source: Viñas de Chile

One of the most important factors for such a change is the liberalization of the Chilean economy. The liberalization brought with it a sharp change in the market structure. As a consequence a large number of firms were forced out of the market or had to make drastic changes to be able to survive (Sofofa, Javier Fuenzalida, 2004-10-22). One way of surviving was to start exporting. This often required new knowledge and technologies, which was in many cases brought from already established European wineries (Sofofa, Javier Fuenzalida, 2004-10-22). Another major change that has taken place due to the opening up of the economy and the development of the industry is a change in the composition of the export sector. In the 1980s most wine export went to other Latin American countries. Today the majority of all wine exports goes instead to Europe. Consequently, the liberalization has resulted in a change in the number and activities of firms as well as in the amount of knowledge and technology present in the industry.

Today there are a large number of wineries in Chile. The exact number of wineries differ however, due to the fact that different institutes use different classifications (Visser 2003, p. 20). A large part of the Chilean wineries export their own wines, while many others sell to exporting companies. The large and dominating firms are Concha y Toro, San Pedro, Santa Rita and Santa Carolina. In terms of export value they together held a market share of 33 % in 2002 (Visser 2003, p 20). Concha y Toro, which for a long time has been the biggest and most influential firm, held a market share in 2002 of 14.2 %.

At the same time the liberalization and export boom have brought about a sharp change in the industrial structure of the wine industry. A group of around 70 emerging small-scale exporting wine firms so-called viñas boutique or viña emergente has increased the competition and the diversity of the industry (Farinelli 2003); nevertheless the large firms are still dominating the market. Over the last couple of years one has also seen an opposite trend reintroducing the old pattern. Many small wineries have not had the capacity or the ability to grow and develop successfully and have therefore often become dependent on the larger wineries to sell their wine or grapes (Alejandro Mac Cawley, PUC, 2004-10-05). At the same time, however, a number of quality-focused exporting wineries, possessing the capital, knowledge and distribution channels that are required, have become very successful both nationally and internationally.

Comparing with other countries, Chile s wine industry is less fragmented than for example France, Italy and Spain, but more fragmented than the wine industries in Australia and the USA (Visser 2003, p 20). Despite the more fragmented wine industry in France, Italy and Spain the average turnover of the largest Chilean wine maker is lower than the largest producers in the these countries (Visser 2003, p 20).

Most of the Chilean wineries are located in the center of the country, mainly in the Maule, Libertados Bernandos and O Higgins regions.[12] Today these regions constitute more than 75 % of the wine planted area in Chile (Visser 2003, p 20). The different regions also seem to attract different kinds of wine producers. Large, old and export-oriented wineries, such as Concha y Toro, San Pedro, Santa Rita, Santa Carolina and Undurraga together with a few small, quality-focused wine producers such as Almaviva, El Principal, Antiyaal and Quebrada de Macul are located in the Maipo valley. This region also belongs to the official certificate of origin system. Other such regions are e.g. the Colchagua valley that seems to attract relatively new, small, quality-focused and export-oriented wine producers and the Casablanca valley, which is specialized in producing white wines.

Liberalization of the economy has also had an impact on foreign firms. Due to a more open economy, foreign investments have become more interested in the Chilean economy and potential investment opportunities there. The majority of foreign wineries came in the beginning of the 1990s. However, the pioneer and the foreign company that probably has meant the most for the Chilean wine industry is Miguel Torres, the Spanish wine maker, who arrived in the end

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[12] See map in Appendix B, table B.1.

of 1970s. Among other things, he introduced stainless steel tanks, replacing the traditional concrete vats, strict temperature controls and small oak barrels (Farinelli 2003, p 6). Technology that was commonly known and used in Europe at the time but nearly unheard of in Chile (Farinelli 2003, p 6). Due to the arrival of Miguel Torres, many argue that local firms were able to enhance their winemaking techniques and in many other ways learn from technology and knowledge Miguel Torres brought from Europe.

Today there are a quite large number of foreign firms present in the industry. These companies come from many different parts of the world but the majority come from Europe, i.e. Viña Selentia and Baron Philippe de Rothschild S.A.[13] Today there are about 15 multinational wineries present in the country. Of these, the American multinational firms have invested the most. Since 1974 American firms have invested 64.012 million US dollars in the Chilean wine industry, compared to France, which has invested 21.053 million US dollars.[14]

Today other forms of foreign presence are also common. The most discussed one is joint ventures between foreign and domestic wineries. An example is the joint venture between the Robert Mondavi Corporation from USA and Viña Errázuriz, firms that up to the fall 2004 together owned viña Caliterra. Another example is the French winery Baron Philippe de Rothschild Laffite that has co-operated with Viña Santa Rita and formed viña Los Vascos.

Other forms of co-operation among foreign and domestic firms are also common in the wine industry. It is for example common that foreign firms use foreign wine-makers, i.e. oenologists, from either a foreign firm in Chile or directly from abroad. Foreign firms and foreign private investors have also become interested in starting their own wineries in the industry. It is also common that already established firms in other industries invest in the wine industry.[15]

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[13] For more details concerning foreign wineries see Appendix B, table B.2.
[14] For a list of multinational investments in Chilean wine industry, see Appendix B, table B.3.
[15] For a more detailed list of different forms of foreign presence in the Chilean wine industry, see Appendix B, table B.4.

4.2. Spillover effects in the wine industry

There are several channels through which spillovers can take place in the wine industry in Chile. As argued before, spillovers depend on the characteristics of foreign and domestic firms and can take many different forms. Below follows a discussion on potential spillovers in the Chilean wine industry.

4.2.1. Four different spillover effects

According to Görg and Greenaway (2003), spillover effects can be divided into four groups: spillovers from imitation; spillovers from increased competition; spillovers from improvements in human capital and spillovers from export (Görg and Greenaway 2003). To understand whether spillovers in the wine industry have taken place, these four spillover criteria are first used.

First of all, there seem to be some spillover effects from imitation, but the major effects appear to have come due to the entrance of Miguel Torres. By introducing new technologies and ideas that at the time was commonly unknown, it is possible that he created spillover effects for local firms in Chile. One can also claim that he disturbed the existing equilibrium in the market and made local firms act not to loose their market shares. As a consequence, the entrance of Miguel Torres seems to have resulted in spillovers in the form of imitation for a number of domestic firms in Chile.

At the same time however, the development of the industry at the time also depended, to a large extent, on the change in development strategy. Due to the opening up of the market, domestic firms were able to go abroad and find technology and new ideas themselves (Sofofa, Javier Fuenzalida, 2004-10-22). Due to this, spillovers from imitation of foreign firms in the country became less important after the liberalization.

Today, there seem to be few spillover effects from imitation. Since the industry has become highly dependent on export, international contacts will supply them with new technology and know-how (Terramater, Christian Isbej, 2004-10-29). However one way such spillovers can be transferred is through the use of consultants (Terramater, Christian Isbej, 2004-10-29). Consultants come sometimes from foreign firms in Chile but are also often brought directly from Europe. Hence, spillover effects from consultants do not necessarily come from foreign firms in the Chilean wine industry but can also come from other sources. Due to the

development of the education system in general and more specifically of the wine education, consultants are today also often taken directly from Chile. The number of graduate oenologists, i.e. wine makers, from Chilean universities has increased especially during the last decade, see table 12. Hence, the development of wine education has also decreased the importance of spillovers from foreign firms.

Table 12. Graduated oenologists

University	Before 1980	1980-1989	1990-2000	Total
Pontificia Universidad Católica de Chile	59	15	100	174
Universidad de Chile	118	35	221	374
Universidad de Talca	-	-	-	-
Universidad de Concepciòn	-	-	-	-
Total	177	50	321	548

Source: CEPAL (2000)

Another reason for seemingly few such spillovers could be the high level of competition, which exist in the industry today (Alejandro Mac Cawley, PUC, 2004-10-12) In a highly competitive industry, individual firms have more incentives to keep their knowledge inside their own firms, which will result in fewer spillover effects. Another important reason for few such spillovers could be the size of foreign and domestic firms. For a long time, the dominating firm in the Chilean wine industry has been Concha y Toro, which also has become one of the world s biggest wine producers. Hence, the multinational firms entering the market need to be quite influential to have an impact on the local firms (Terramater, Christian Isbej, 2004-10-29). Thus, the structure of the market in the Chilean wine industry seems to influence the potential spillover effects.

There also seem to be few spillover effects in the form of management and organizational practices. The majority of the wineries in Chile are family-owned with flat organizational structures (Terramater, Christian Isbej, 2004-10-29). Hence, few spillovers of this kind seem to have occurred. According to Terramater, foreign wineries also follow and respect the Chilean way of doing business, which could also explain few such spillover effects. Worth noting is that few negative spillover effects of this kind seem to have occurred (various interviews). Nevertheless, in some cases foreign firms do appear to influence domestic wineries through such spillovers. In the case of Terramater, taking in a new manager from Unilever has influenced the company a great deal. The company has for example become more professional in doing business (Terramater, Christian Isbej, 2004-10-29). At the same time however, other

examples such as the case of Casas del Bosque show once again that few spillovers in the form of management and organizational practices seem to have occurred. Even though the winery belongs to a large investment group, to which the manager can be tied, few spillovers of this kind seem to have taken place (Casas del Bosque, Christian Blanco, 2004-11-04).

Secondly, there appear to be few direct spillover effects of multinationals on competition (various interviews). Even though competition has changed over the years, e.g. through the entrance of a large number of small export-oriented firms, these changes seem mainly to have come from the liberalization of the economy (Sofofa, Javier Fuenzalida, 2004-10-22). Another reason for few spillover effects in the form of competition could be the diversity of the wine industry. A foreign firm is more likely to have an impact on a domestic firm through competition if it is located in the same segment as the domestic firm (Terramater, Christian Isbej, 2004-10-29). Another reason for few spillovers from competition in the wine industry might be the fact that foreign wineries in general do not come to Chile to compete with local producers (Vergara 2001, p 23). According to Sebastian Vergara, foreign wine producers come instead to Chile to produce quality wines, to form separate, or associations with, domestic wineries and to put themselves on the external market (Vergara 2001, p 23).

At the same time multinationals as well as other large domestic firms seem to have had an effect on competition through prices. Since large firms can use scale economies they will be able to cut their prices, which has made it more difficult for small firms to compete (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). As a result of this, small firms have not been able to sell to large supermarkets in Chile and have therefore chosen to enter a niche market, where they can sell at a higher price (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). Due to this, the domestic demand for wines from small firms has decreased. Since the domestic market is often more important for smaller domestic firms than larger ones, this can and has caused problems for a number of firms in Chile (Alejandro Mac Cawley, PUC, 2004-10-05). Since the fixed costs of small firms have been spread out over fewer products, a decrease in the productivity as well as an increase in the costs for domestic firms have consequently occurred (Alejandro Mac Cawley, PUC, 2004-10-05).

Thirdly, there seem to be some spillover effects from human capital. To access new technology and new ideas, as argued before, domestic firms often use foreign consultants. These consultants often came from foreign firms in Chile or directly from abroad; today however the use of

consultants from Chile is also common. It is also common for consultants to change wineries (Viña Aquitania, Felipe de Sominiac, 2004-11-10) or to start new wineries. Even though spillovers from foreign consultants do not always come from foreign firms in Chile, the use of these consultants appears to be an important factor for spillover effects in the Chilean wine industry (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). It brings together different actors in the wine industry, such as foreign and domestic firms. At the same time it seems to be an ongoing process, which could result in even more spillover effects over time.

Fourthly, there seem to be some spillover effects through export. According to Evert-Jan Visser, Chilean wineries with foreign involvement were the first to export to a wide range of markets (Visser 2003, p 22). However, such effects appear to be present mainly in the case when domestic firms work together with foreign firms or in any other way have direct contact with people abroad. Firms with no direct contacts with foreign firms, such as Terramater, have not seen such spillover effects to the same extent (Terramater, Christian Isbej, 2004-10-29).

4.2.2. Direct and indirect spillover effects

As seen above, different structures or arrangements between foreign and domestic firms make it possible for different spillover effects to take place. Looking closer at these arrangements one can distinguish two possible ways spillovers can take place: through direct contact with foreign firms or through indirect contact with these firms.

Spillovers from direct contact

A common form of interaction between foreign and domestic wineries in Chile is today through joint ventures. Such co-operation between a foreign and domestic firm can result in a number of spillover effects. In the case of the Chilean wine industry such a co-operation can and has in some cases introduced new technology to domestic firms. However today this spillover seems to be of less importance than in the early 1990s.

Another, maybe more important spillover effect from such co-operation is the possibility of using foreign distribution channels (Alejandro Mac Cawley, PUC, 2004-10-05). Since export has become a vital factor for Chilean wineries, distribution channels in another country as well as access to their market could be highly beneficial for domestic firms. Because of the size of the wine market, the magnitude of the distribution channels is also of importance for such spillover effects (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). The access to distribution

channels in foreign countries is especially important in the beginning of the export period for a domestic firm (Top wine, José Ignacio Ruiz Tagle, 2004-11-05).

Another important spillover for firms forming joint ventures is the improvement of the image (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). According to Proyeto Chile 2010, image is the most obvious way of improving the wine export for Chilean wineries in the future (Proyeto Chile 2010). Co-operation with a foreign winery is therefore very beneficial for Chilean wineries. Since the so-called old world wine countries still set the standards in the wine market and often have better reputations than new world wine countries, co-operation with wineries from for example European countries raises the chances for such spillovers (Top wine, José Ignacio Ruiz Tagle, 2004-11-05).

At the same time, it has been suggested that joint ventures between foreign and domestic wineries in Chile have not been very successful. Alejandro Mac Cawley argues that there have not been clear spillover effects from such co-operations (Alejandro Mac Cawley, PUC, 2004-10-05). By studying the joint venture between Rocheville and Concha y Toro, which created the winery Almavida, he concludes that the help from the French winery through access to distribution channels did not benefit the domestic winery a great deal (Alejandro Mac Cawley, PUC, 2004-10-05). Another example of a co-operation that has not worked properly according to him, is the joint venture between the Marnier family and Lapostolle (Alejandro Mac Cawley, PUC, 2004-10-05).

There are a number of possible explanations for the above-mentioned problems. One factor that could be important is the power balance between these companies (Alejandro Mac Cawley, PUC, 2004-10-05). Another important factor might be the cultural differences between foreign and Chilean wineries (Alejandro Mac Cawley, PUC, 2004-10-05). Chilean people are known to be individualists in their way of doing business, which in some cases has complicated co-operation between these and foreign firms (Alejandro Mac Cawley, PUC, 2004-10-05). Short-lived co-operations between foreign and Chilean wineries are not always due to co-operation problems, however. In many cases, the objective of the co-operation can be achieved in a short time. In these cases and in other cases where one can observe short lived co-operation, spillover of different kinds could still have occurred.

Another similar form of co-operation is between Chilean wineries and capital partners. A number of wineries belong today to some extent to strong capital partners, in many cases to already successful businessmen in other fields. One example is the San Pedro winery, which is owned by the Luksic family and CCU, a large beer-making company in Chile. Another example is the Santa Rita winery that the financial group Claro is involved in. A large number of these co-operations have nevertheless also encountered problems when entering the wine industry, in many cases due to lack of knowledge about winemaking and wine marketing (Alejandro Mac Cawley, PUC, 2004-10-05). However with time and in many cases reorganization, these wineries have become more successful. The local firms associated with these firms might therefore benefit from such co-operation in the long run.

Another similar arrangement between firms is the co-operation between domestic firms and importers or distributors. Since export has become a vital tool for wine producers such co-operation has proved to be very helpful for a number of local wineries (Alejandro Mac Cawley, PUC, 2004-10-05). Concha y Toro, and its co-operation with the American importer Banfi has for example been very helpful for the Chilean winery (Alejandro Mac Cawley, PUC, 2004-10-05). However, since most small and medium size firms rely on the marketing knowledge and capacity of overseas distributors and importers to manage the winery s wine brand, successful co-operations between importers and distributors with small and medium size wineries should result in even greater spillover effects.

In conclusion, direct co-operations between foreign and domestic firms have, to some extent, become important for spillovers in the Chilean wine industry. Even though some of these co-operations have encountered problems, direct co-operation with foreign firms seems to transfer some spillover effects to domestic firms, especially through the access to distribution channel and image.

Spillovers from indirect contact

Spillover effects can also take place through indirect contact between actors in the industry. These spillovers are not as clear-cut as those spillovers mentioned above but can also influence certain domestic firms. One spillover effect from indirect contact that seems to be of importance is the spillover in the form of brand name.[16] According to Alejandro Mac Cawley domestic firms have to some degree been able to benefit from the brand name of multinational firms

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[16] Spillovers from brand name can also come from direct contact with foreign firms.

(Alejandro Mac Cawley, PUC, 2004-10-05). Due to the importance of exporting, such spillovers could help domestic firms enter markets they have not been able to enter before. Producing in Chile and labeling the wine as coming from Chile has also helped some domestic firms sell in these export markets (Top wine, José Ignacio Ruiz Tagle, 2004-11-05). Spillovers through the brand name could also be important in the future. A survey, done by Proyeto Chile 2010, showed that a clear majority wanted to promote Chile as country and in that way promote Chilean wines, when asked which the most important activities of the public sector were concerning development of the wine industry (Proyeto Chile 2010). Such spillovers could therefore benefit not only a large number of domestic wineries but also firms in other industries in Chile.

Another potential source of spillovers from indirect contact could be the closeness between wineries. The majority of all wineries are located in the center of the country. Since only four regions hold more than 75 % of all the wineries, closeness could become an important variable for such spillover effects. Different regions also seem to focus on producing different types of wines, which could make it easier for firms in the same field to interact. Even thought the potential appears to exist for such regional interactions, few domestic firms seem to have contact with foreign firms in the same region (interview with various wineries). The wine producers appear to be fragmented and isolated from each other, which makes it difficult for firms to integrate and hence create spillover effects. According to Farinelli (2003), there appear nevertheless to be two important wine producing clusters in Chile, i.e. Maipo and Maule valley (Farinelli 2003, p 22). In these valleys the concentration of institutes, universities, producers, importers, associations, input and service providers offers some forms of interactions (Farinelli 2003, p 22).

Consequently, there seem to be few spillovers from indirect contact with foreign firms. There could be a number of reasons for the few such spillovers; one might be low absorption capacities of these firms (Alejandro Mac Cawley, PUC, 2004-10-05). This could in particular explain the few spillover effects for small wineries. As mentioned earlier, another explanation could be that wineries are more influenced by large domestic firms than foreign firms. The low level of co-operation between domestic firms as well as with other organizations could also explain low interaction and hence little spillover effects in the industry.

In conclusion, there seem to be few clear spillover effects in the Chilean wine industry. Spillovers from direct contact appear to be the most important spillover effect. Even though such co-operation has encountered some problems, this form of contact with foreign firms seems to have created important spillovers for the industry. Spillovers from indirect contact, especially through brand names and human capital, have also, to some extent, become important for the wine industry.

4.3. Improving spillover effects in the wine industry

Several different factors could be improved to increase spillover effects in the wine industry in Chile. Many argue for example that an increase in the number of foreign firms present in the industry could make spillovers more likely. Since some spillovers seem to come from the use of foreign consultants, an increase in the number of foreign firms present in the industry could consequently result in more spillover effects. Since it is also common for consultants, both from foreign and domestic firms, to start new wineries or to be consulted by different wineries, even more spillovers could take place from such an increase in the foreign presence.

Since the form of interaction between foreign and domestic firms seems to be of importance for the transference of spillovers, the nature of an increase in the foreign presence is also important. Direct co-operation between foreign and domestic firms seems to be the major force behind such spillovers in the Chilean wine industry (Terramater, Christian Isbej, 2004-10-29). As a consequence, one way of improving spillover effects could be to increase the number of such direct co-operations between foreign and domestic firms.

One way such co-operation could benefit the Chilean wine industry is through export. Since Chile is largely dependent on the export sector and its development, distribution channels will become even more important in the future. As a consequence direct co-operation between foreign and domestic firms can become an important factor for future development.

Another form of direct co-operation that could facilitate spillover effects is the co-operation with suppliers in the Chilean market. According to Terramater, few spillovers from foreign suppliers have occurred since the relationship between them and domestic firms has been insufficient (Terramater, Christian Isbej, 2004-10-29). Improving these relationships could therefore raise the chances for spillovers as well as increase access to suppliers and lower their costs (Terramater, Christian Isbej, 2004-10-29).

Enhanced co-operations between foreign and domestic firms could however also increase the concentration of the industry and hence decrease competition. In the long run, this could affect a large number of firms, especially small ones. However, a more concentrated global wine market could force Chilean wineries to start cooperating with each other or to use other measures to be able to survive.

Even though spillovers seem to be transferred to a larger extent through direct contact between foreign and domestic firms, improvements in the indirect contact between these firms are also of importance for the development of the Chilean wine industry. To enhance spillovers through indirect contact one potential improvement is to increase the co-operation between domestic firms. By co-operating with each other, knowledge as well as information about distribution channels, employees and capital can be spread. Increased co-operation with other domestic wineries could also help in developing tourism opportunities at the local or regional level. Co-operation could further help, in particular small wineries, to become less dependent on large wineries. Due to problems selling the wine, many producers have been forced to sell to big companies (Alejandro Mac Cawley, PUC, 2004-10-05). Co-operation could therefore diminish the dependency on larger firms.

Another important improvement for such spillover effects could be to develop the marketing of Chile as a country and of its regions. Since one of the most important spillover effects through indirect contact is through the brand name, such an effort could benefit a large number of wineries in Chile, especially the small ones. Due to the fact that wineries produce more often for high quality and for export, one has also been able to observe an increased production with denomination origin. Due to this, a development of the denomination regions could become important for future success. Another way to develop the marketing of Chile is through wine tourism. Since smaller wineries need to achieve larger sales from direct marketing, i.e. tourism, an improvement in wine tourism could especially be beneficial for small firms (wine seminar, PUC, 2004-10-20). Such tourism could also increase the domestic demand, which also would benefit smaller wineries (wine seminar, PUC, 2004-10-20). In general, wine tourism could also benefit from better infrastructure. Chile has had many successful projects in leasing airports and ports to private investors. Nevertheless, the country needs more improved infrastructure for future development (Central Bank, César Caldéron, 2004-10-18). Better infrastructure could also attract more foreign firms, which could increase potential spillover effects.

Another form of co-operation that could facilitate spillover effects is co-operation between universities and wineries. Today there is a wide co-operation between these actors. For example Pontificia Universidad Católica de Chile contributes knowledge through direct consulting as well as through seminars and get-togethers where local wine producers can get information about how to export more efficiently and how wine tourism can be improved. Increased interaction between different actors in the wine industry could benefit the industry in many ways. As argued before, there seem to be potentials for regional spillover effects. An increased interaction between universities and wineries as well as with other organizations, in all regions in Chile, could therefore create regional spillover effects.

The industry could also benefit from an improvement in education in Chile. Even though access to educated employees has increased, there is still a large demand for educated employees in the wine industry (Proyeto Chile 2010). The most important employees, according to a study made by Proyeto Chile 2010, are: technicians and operators in the viticulture and winemaking areas, professionals in the commercialization and management areas and postgraduates in commercialization. Professionals specialized in viticulture and in winemaking, and postgraduates in winemaking and management are also very important according to this study (Proyeto Chile 2010). Better wine education from the domestic universities could therefore be beneficial for the industry as a whole. In general, better education can also improve the relatively low level of R&D and hence make Chile less dependent on other countries to provide them with new technology (Sofofa, Javier Fuenzalida, 2004-10-22).

Education quality is also said to be important to attract foreign firms, which in the long run could matter for potential spillover effects. As argued before, some level of education is often needed for multinationals to invest in a particular country. Since, however, only a few educated employees are needed in wineries, it is often possible for the parent company to support this. Due to this, the education level does not seem to be of great importance in attracting foreign firms to the Chilean wine industry.

The education level could however have other impacts on the industry and on the economy. Education has for example made the wine industry less dependent on foreign firms, which could explain the few negative spillovers. Today domestic firms can choose to use a domestic or foreign consultant or both (Top wine, José Ignacio Ruiz Tagle, 2004-11-05).

The economy as a whole could also, according to some, benefit from implementing subsidies for foreign investors. In the case of the Chilean wine industry such subsidies could attract more foreign firms, which in the long run could increase spillover effects. Chile has however taken a stand against these kinds of subsidies. The argument is that they create more distortions than positive effects (Sofofa, Javier Fuenzalida, 2004-10-22). According to Andrés Colagovsky at the Foreign Investments Committee, complaints about foreign direct investments in Chile are few (Foreign Investments Committee, Andrés Colagovsky, 2004-10-19). One could therefore argue that such a policy, where both domestic and foreign firms have the same incentives, creates few negative spillovers.

Finally, foreign investors often choose Chile for its stable and secure economy. Thus, Chile has been able to attract new capital and new technology. Since the country is largely dependent on both capital coming in and access to markets, external factors affecting the stability could cause severe problems for Chile. A stable government and a stable economic growth should therefore be seen as important factors not only for spillover effects but also for the development of the economy as a whole.

5. SUMMARY AND CONCLUSIONS

Even though spillovers appear to be of less importance today in Chile than after the liberalization period, spillover effects from the presence of foreign firms still seem to matter. Regression analysis finds significant spillover effects of foreign firms on domestic firms productivity. The most important spillover effect is sector spillover, a variable that is significant in most of the regressions. Hence, the presence of foreign firms in one sector appears to influence the productivity of domestic firms located in the same sector. In contrast, regional spillovers seem to be less important for firms in the Chilean manufacturing sector.

This result is in many ways different from results obtained in a number of earlier micro-level studies. As has been argued in chapter two of this paper, many of these studies have found a negative correlation between the productivity of domestic firms and the presence of foreign firms.[17] Such negative correlation has however been regarded as depending on a number of factors in the host country. Controlling for differences between foreign and domestic firms, I can also conclude that such differences matter for spillover effects.

Among other factors, differences in ownership structure seem to be of great importance for spillover effects, a result that has also been emphasized in earlier papers. However, contrary to a number of studies, minority-owned foreign firms are not found to be important in transferring spillover effects.[18] In a similar fashion, differences in export activity are also found to influence the transference of spillovers. In this study, spillovers appear to be transferred more often from non-exporting foreign firms than from exporting foreign firms; a result that is somewhat different from earlier papers.[19]

Taking a closer look at the Chilean wine industry, few clear spillover effects can be found. Maybe the most important one came from the entrance of Miguel Torres, who introduced new technology and ideas to the industry. Today, however, there seem to be few clear spillover effects from foreign wineries on domestic firms productivity. The most obvious ones seem to come through direct contact with foreign firms. Spillovers in the form of distribution channels and the image of the wine are of particular importance in such co-operations.

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[17] See for example Haddad and Harrison (1993) and Aitken and Harrison (1999)
[18] See for example Dimelis and Louri (2002); Barrios et al (2002).
[19] See for example Belderbos et al (2001).

However, since the wine industry is such an open industry, where travel and contacts are important factors, spillovers from multinationals seem to be of less importance today. This result also shows similarities with results obtained from regression analysis, in which only non-exporting domestic firms seem to benefit from spillover effects. For the very small wineries however, the presence of multinationals can play an important role, especially through spillovers in the form of brand name and from indirect contact.

Several factors can be improved to increase spillover effects in the wine industry as well as in the economy as a whole. Since direct contact appears to be of some importance for spillovers, more co-operation and access to foreign firms could increase spillover effects. Nevertheless, such change would mainly benefit few firms, especially large, already established ones. Instead, by emphasizing co-operation between domestic firms as well as between domestic firms and organizations, a large number of firms, both small and large ones, could benefit from spillover effects.

In conclusion, spillovers appear to influence the productivity of domestic firms in Chile, but differences between industries and firms seem to matter. One can therefore conclude that the nature and dynamics of spillover effects are not unambiguous. Depending on the factors that are studied, data and methods used, as well as other differences between sectors, industries and firms, different results will probably be found. More detailed investigations concerning spillover effects are therefore called for.

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7. APPENDICES

7.1. Appendix A - Econometric analysis

Table A.1. Variable definition

Variables and groups used in regressions analysis	Definitions
Dependent variable:	
ln VA	Value added per year for firm i.
Explanatory variables:	
ln C	Capital is calculated as the fixed assets at the end of each year.
ln M	Material used in firms i per year.
ln L	The number of employees in firm i.
Exp	Total income from export.
FSsec	The number of foreign employees to the total number of employees in the sector. The variable is computed at the 4-digit level. Foreign firms are defined as firms with at least 10 % foreign ownership.
FSreg	The number of foreign employees to the total number of employees in the region. The variable is computed at the 4-digit level. Foreign firms are defined as firms with at least 10 % foreign ownership.
Groups:	
Foreign ownership structure	Spillover variables, *FSsec* and *FSreg* are measured using foreign firms with 10-49 % or 50-100 % foreign ownership.
Foreign export activities	Spillover variables *FSsec* and *FSreg* are measured using exporting or none-exporting foreign firms. Foreign firms are here defined as firms with at least 10 % foreign ownership.
Size	Domestic firms are divided into two groups: firms with less than 50 employees and firms with at least 50 employees.
Export vs. no export	Domestic firms are divided into two groups: non-exporting and exporting firms.
More or less export	Domestic firms are divided into two groups: firms that export less than 25 % of their total income and firms that export at least 25 % of their total income.
Foreign presence in sector	Domestic firms are divided into two groups. The first group consists of domestic firms present in sectors with at least 15 % foreign employees compared to the total number of employees in the sector. The second group consists of firms present in sectors with less than 15 % foreign employees compared to the total number of employees in the sector. Foreign firms are defined as firms with at least 10 % foreign ownership.
Foreign presence in region	Domestic firms are divided into two groups. The first group consists of firms present in region with at least 15 % foreign employees to the total number of employees in the region. The second group consists of firms present in regions with less than 15 % foreign employees to the total number of employees in the region. Foreign firms are defined as firms with at least 10 % foreign ownership.

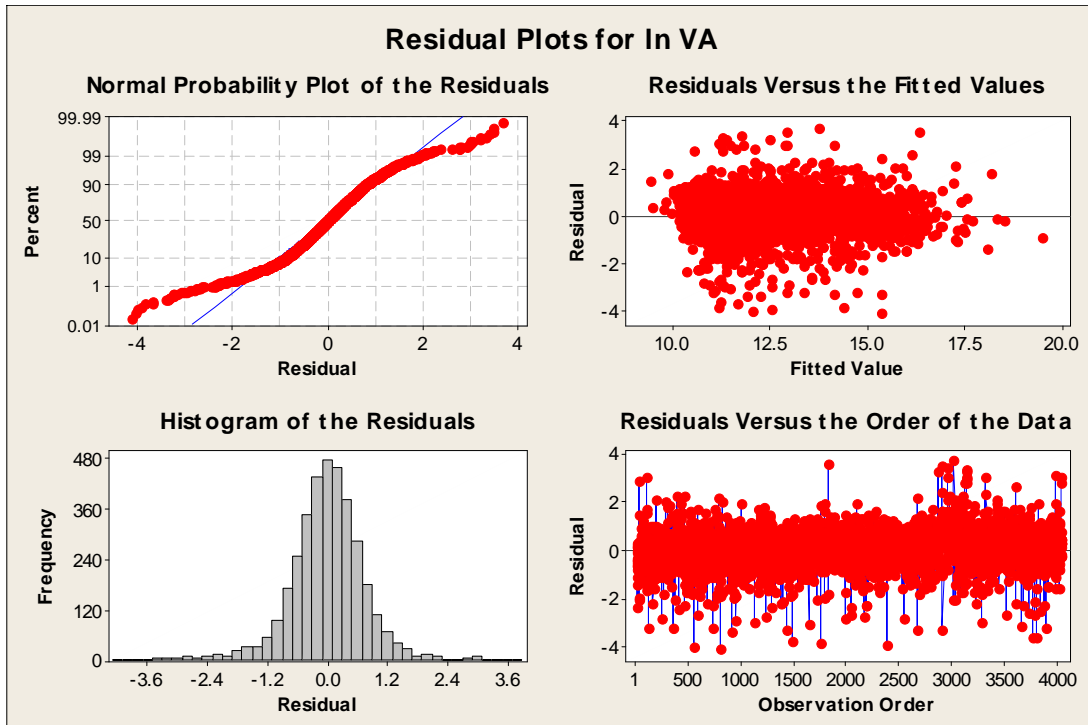Table A.2. Residual plots from regression analysis using total material

Table A.3. Domestic firms export activities

	Domestic firms that export a relatively small part					Domestic firms that export a relatively large part				
Group	Total	Majority	Minority	Exp act	No exp act	Total	Majority	Minority	Exp act	No exp act
Predictor	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF	Coef (P-value) VIF
Constant	5.1717 (0.000)	5.1874 (0.000)	5.1893 (0.000)	5.1996 (0.000)	5.2015 (0.000)	5.3251 (0.000)	5.3498 (0.000)	5.4529 (0.000)	5.3346 (0.000)	5.4402 (0.000)
ln C	0.20829 (0.000) 2.1	0.20964 (0.000) 2.1	0.21011 (0.000) 2.0	0.21090 (0.000) 2.0	0.20564 (0.000) 2.1	0.17568 (0.000) 2.4	0.17701 (0.000) 2.4	0.17361 (0.000) 2.4	0.17627 (0.000) 2.4	0.17738 (0.000) 2.4
ln M	0.23300 (0.000) 2.6	0.23369 (0.000) 2.6	0.23510 (0.000) 2.6	0.23440 (0.000) 2.6	0.23387 (0.000) 2.6	0.28121 (0.000) 2.6	0.28283 (0.000) 2.6	0.28758 (0.000) 2.6	0.28922 (0.000) 2.6	0.28218 (0.000) 2.7
ln L	0.64160 (0.000) 2.7	0.63859 (0.000) 2.7	0.63258 (0.000) 2.7	0.63441 (0.000) 2.7	0.64222 (0.000) 2.7	0.47374 (0.000) 2.0	0.47134 (0.000) 2.0	0.47689 (0.000) 2.0	0.46183 (0.000) 2.0	0.48283 (0.000) 2.0
Exp	0.00000004 (0.000) 1.1	0.00000004 (0.001) 1.1	0.00000004 (0.000) 1.1	0.00000004 (0.000) 1.1	0.0000004 (0.000) 1.1	0.00000002 (0.000) 1.4	0.00000002 (0.000) 1.4	0.00000002 (0.000) 1.4	0.00000002 (0.000) 1.4	0.0000002 (0.000) 1.4
FSsec	0.3435 (0.234) 1.0	0.2445 (0.425) 1.0	1.0232 (0.214) 1.0	0.1587 (0.605) 1.0	0.7266 (0.186) 1.0	1.1322 (0.071) 1.0	1.0653 (0.118) 1.0	0.879 (0.567) 1.0	0.8657 (0.179) 1.0	0.907 (0.375) 1.0
FSreg	0.1170 (0.706) 1.0	0.0445 (0.896) 1.0	0.3491 (0.612) 1.0	-0.0451 (0.907) 1.0	0.6764 (0.301) 1.0	0.4632 (0.236) 1.0	0.4821 (0.284) 1.0	0.2382 (0.789) 1.0	0.5618 (0.199) 1.0	0.389 (0.721) 1.1
R-sq(adj)	75.1%	75.0%	75.1%	75.0%	75.1%	70.9%	70.8%	70.3%	70.7%	70.4%
DW	1.62041	1.61026	1.61751	1.61120	1.62178	2.06994	2.07207	2.03159	2.06148	2.04262
P-value from F-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
n	427	427	427	427	427	240	240	240	240	240

7.2. Appendix B - The Chilean wine industry

Table B.1. Map of wine regions in Chile

Table B.2. Multinational wine companies in the Chilean wine industry

Miguel Torres (Spain)
Domaines Barons Philippe de Rothschild (Laffite)   Viña los Vascos (France)
Chateau Larose Trintaudon   Viña de Larose (France)
Baron Philippe de Rothschild Maipo Chile (France)
Produits Marnier Lapostolle   Casa Lapostolle (France)
Soc. Du Vignoble William Fevre   Viña William Fevre Chile (France)
Franciscan State Selection (United States)
Kendell Jackson (United Stated)
Viña Domaine Oriental en el Valle del Maule (France)
Villard Fine Wine (France)
Château Los Boldos (Viña Santa Amalia) (France)
Viña Aquitania (Domaine Paul Bruno) (France)
The Robert Mondavi Corporation (United States)
Mildara Blass (Australia)
Viña Selentia S.A. (England and Spain)
Odfjell Vineyards S.A. (Norway)

Source: Chilevid (2002)

Table B.3. Foreign companies and their investments in the Chilean wine industry (thousand US$, nominals)

Year	Canada	United Stated	France	Spain	Holland
1989			1017	40	
1990			193	40	1810
1991			174		973
1992			357		849
1993	4344		49		455
1994		18,412	2120		80
1995		350	2541		189
1996	700	7420	2618		
1997	497	2816	2585		86
1998	15,257	617	3144		56
1999		22,708	5516		155
2000		6918	548		104
2001		1021	192		
Total since 1974	20,798	64,012	21,054	2120	4757

Source: Farinelli (2003)

Table B.4. Joint ventures between foreign and Chilean wineries (in 2001)

Name	Domestic firm	Foreign firm	Country of origin	FDI (thousand US$)	Region (hectares)	Year
Veramonte	Augustin Huneeus	Franciscan State Vineyards	USA	9,443	Casablanca (450 hs)	1991
Caliterra	Viña Errazuriz	Robert Mondavi Corporation	USA	5,925	Colchagua (430 hs)	1996
Los Vascos	Viña Santa Rita	Baron Philippe de Rothschild-Laffite	France	5,708	Rapel (400 hs)	1988
Casa Lapostolle	Familia Rabat	Marnier Investissement	France	5,559	Rapel (350 hs)	1994
De Larose	Granella Family	Soc. du Chateau Larose Trintaudon	France	2,578	Cachapoal (100 hs)	1994
Selentia	Mayol Buchon	Bodegas y Bebidas	Spain	5,000	San Fernando (150 hs)	1999
Almaviva	Concha y Toro	Baron Philippe de Rothschild-Mouton	France	1,989	Maipo (41 hs)	1997
William Fevre	Victor Pino	Soc. du Vignoble William Fevre	France	2,000	Maipo (60 hs)	1991
Aquitania	Felipe de Solminhac	Bruno Prats, Paul Pontallier	France	518	Maipo (25 hs)	1990
Dallas Conté	Santa Carolina	Mildara Blass	Australia	*	Rapel	2000
Villard Estate	Santa Emiliana	Thierry Villard	Spain	*	Casablanca (18 hs)	1989
Grandes Vinos Corpora-Boisset	Gracia y Porta	Boisset	France	*	Casablanca (30 hs)	2002
William Cole Wineries	Gomez Soffia Family and Fernando Braun	William S. Cole	USA	6,000	Casablanca (131 hs)	2001
Guelbenzu Jardin	Viñas Peralillo	Guelbenzu	Spain	4,000	*	2002
Terravid	Viña Portal del Alto	MataRomera	Spain	2,000	*	2002
Santa Eliana	Jaime Izquierdo	Vinedos de Jalon	Spain	2,000	*	2002
Conde de Aconcagua	Viñas Mercede, Estampa, Cantera	Gonzales Byass, Comercial Engel	Spain	20,000	*	2002
Pirque/Antinori	Haras de Pirque	Marchese Antinori	Italy	*	*	2003

Source: Vergara (2001), * no information available.