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TECHNICAL NOTES

No. IDB-TN-388

March 2012

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2012

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Abstract[2]

This study examines the impact of innovation strategies on employment growth in four Latin American countries (Argentina, Chile, Costa Rica, and Uruguay) using micro-data for manufacturing firms from innovation surveys. Building on the model proposed by Harrison et al. (2008), we relate employment to three innovation strategies: make only (R&D), buy only (external R&D, licensing of patents and know-how, technical assistance, and other external innovation activities) and make and buy (mixed strategy). Firms that conduct in-house innovation activities ("make only") have the greatest impact on employment; the "make and buy" strategy comes in second. Similar results are found for small firms. These results highlight the importance of fostering in-house technological efforts not only for innovation per se, but also to promote growth in firm employment. The impact of "make only" strategies is greater in high-tech industries, whereas "make only" and "make and buy" have a similar impact on employment in low-tech industries. Finally, the study provides evidence of the mechanisms through which innovation strategies affect employment. The findings show that innovation strategies enhance technological innovation, but their impact differs between product and process innovation. Product innovation is mainly motivated by in-house technology investments, followed by mixed strategies, whereas process innovation is basically driven by "buy" strategies.

JEL: O12, O14, O31, O33, O40, J21

Keywords: innovation, employment, external R&D, Latin America, innovation surveys

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[2] This study is part of the research project entitled "Employment Generation, Firm Size and Innovation in Latin America: the Micro-econometric Evidence (KCP-RG 1164)" coordinated by the Science and Technology Division of the Inter-American Development Bank. We are grateful to Jacques Mairesse and Pierre Mohnen for suggestions and advice throughout this project. This paper would not have been possible without the collaboration of the various national researchers participating in this study: Diego Aboal, Paula Garda (CINVE), Conrado Cuevas, Roberto Alvarez (INTELIS), Jose Miguel Benavente (INTELIS), David Giulidori (ECONFOCUS), Bibiana Lanzilotta (CINVE), Ricardo Monge (CAATEC), Jeffrey Orozco (CINPE), Ramiro de Elejalde (ECONFOCUS), and Rodolfo Stucchi (ECONFOCUS).

1. Introduction

Technological innovation—product and/or process innovation—is the result of innovation strategies undertaken by firms. Firms can innovate either by investing in research and development (R&D) or by purchasing technology in the market through R&D contracting, licensing of technology and know-how, contracting technical and engineering services, and acquisition of machinery and equipment related to innovation. Previous research has broadly categorized these channels in two types of innovation strategies: "make" or "buy" (Veugelers and Cassiman, 1999; Cassiman and Veugelers, 2006). Generally, a firm can exclusively implement a "make" or a "buy" strategy, or a combination of the two.

This paper analyzes the impact of innovation strategies on employment at the firm level. Distinguishing between the different impacts of these strategies on employment is important because in developing countries, "buy" strategies are strongly dominated by the adoption of technology imported from developed countries. Globalization and market integration, together with the "dissipation of distance" brought about by information and telecommunication technologies, have made this process not only easier but also faster. However, there is clear evidence that over the last 20 or 30 years, technological change in developed countries has been employment saving and strongly biased towards skilled workers (Berman and Machin, 1998). If this is correct, then an increase in the adoption of imported technologies may not only change labor market conditions in developing countries, but also increase inequality, particularly in regions where inequality is already higher than in developed countries. On the other hand, to the extent that endogenously generated technology is able to internalize locally available factor endowments, and assuming that countries in Latin America are less capital intensive than countries at the technological frontier, locally generated technologies—the "make" strategy—might be more labor augmenting and less skill intensive than externally adopted technologies—the "buy strategy"—with mixed strategies (make and buy) somewhere in between.

To untangle these issues, this study examines the manufacturing sector based on microdata from innovation surveys for manufacturing firms in Argentina, Chile, Costa Rica, and Uruguay. Building on the model proposed by Harrison et al. (2008), we estimated a reduced-form approach in a difference-in-difference setting, which integrates the three innovation strategies as explanatory variables for employment growth. We distinguished between firms following a "make only" strategy, a "buy only" strategy, and a mixed strategy ("make and buy").

We then analyzed the mechanisms through which innovation strategies affect employment by analyzing their impact on product and process innovation.

The results herein show that firms that conduct in-house innovation activities ("make only") generate the highest impact on employment and that the main conducive mechanism is an increase in product innovation. The "make and buy" strategy comes in second, although its impact on innovation differs according to the type of industry and also across countries. We find differences in the way that firms organize innovation in low- and high-tech industries, with differentiated effects on employment and innovation outcomes. The impact of "make" strategies are generally more important to product innovation and employment in high-tech than low-tech manufacturing industries. In contrast, "buy" strategies are more relevant to process innovation, an effect that is stronger in low-tech industries.

The analysis of innovation strategies and their impact on employment remains underdeveloped. We would expect that if "make" strategies ("make" only and "make and buy") enhance endogenous innovation, they should also boost firm employment. As technology purchasing ("buy") is mostly related to capital and equipment, it would be expected to be primarily associated with process innovation, whereas internal R&D would be expected to increase both product and process innovation. If synergistic effects appear between technology purchasing and in-house innovation activities, we would also expect to see that "make and buy" strategies would raise firm innovation and growth more than "buy" only strategies. This means that adding "make" activities to "buy" strategies would allow firms to accelerate the formation of internal technological competencies through *learning by doing* and *learning by using* external technology and adapting it to local conditions. Indeed, as the theory of absorptive capacity advances (Cohen and Levinthal, 1989; 1990; Griffith et al., 2004), having internal R&D competences has a dual role in firm innovation: while it determines the capacity of firms to generate new technological solutions and improvements, it also facilitates screening, assimilation, and exploitation of external technological advances and their optimal integration into firm productive systems, which in turn enhances firm performance.

This study contributes to the literature in three aspects. First, it analyzes developing countries, providing an added perspective to the state of the literature on innovation and employment. Second, it links two strands of the literature by looking at the connection between the research on innovation strategies and the literature on the effects of innovation on employment. To the best of our knowledge, this is the first time that such an analysis has been undertaken. Third, we distinguish high-tech from low-tech industries, identifying important divergences in the way that innovation is organized in these two types of industries and how they translate into differential impacts on employment and skills.

Understanding how firm innovation is organized and how these strategies affect innovation and employment has important implications for both innovation and labor policies. Public policies can affect not only the intensity of innovation activity, but also its organization and direction. Thus, shedding light on the ways in which innovation activities can be organized could be important for the design of public innovation support programs aimed at generating employment. These concerns are the main motivation behind the paper.

The remainder of this paper is organized as follows. Section 2 describes our expectations and discusses previous works in the economic literature. Section 3 describes the model and methodology we follow and Section 4 describes our data. Section 5 reports the results and Section 6 concludes.

2. Background and Literature Review

There is a vast literature evaluating the impact of technological change on employment (see Vivarelli for a survey, 2007; 2011).[3] It has repeatedly been shown that R&D investment can create jobs, although technology can also change the skill composition of employment through enhanced demand for skilled labor. Yet the way that firms innovate and engage in the technology race is complex and is not solely limited to internal R&D.

In order for firms in developing countries to upgrade technology and innovate, they normally do not rely only on their own R&D efforts, which may imply a "re-inventing the wheel" investment (Basant and Fikkert, 1996).[4] In fact, given the technological backwardness, technology imports have long been the main source of technological change and the most important innovation strategy followed by firms in these regions. Indeed, the roles of imitation and technology acquisition have been often found more important than R&D and innovation as

[3]Different definitions have been used for technological change, including productivity growth, R&D investment and patenting, or adoption of technology (i.e. impact of information and communication technologies), among other forms of technology and innovation.

[4] For many firms, investing in R&D remains prohibited as access to finance is limited and highly costly, economic returns are highly uncertain (due to economic shocks and weak appropriation of innovation returns) and human capital for innovation is limited (Navarro, Llisterri, and Zuñiga, 2010; IDB, 2010).

preconditions for learning and catching up in firms from developing countries (Katz, 1986; Bell and Pavitt, 1993). Technology-lagging firms will look to rapidly improve technical and operational efficiency through technology imports, including disembodied technology (contracting R&D, technical and engineering services, software and hardware, etc.) and embodied technology in foreign machinery and equipment, although the latter has frequently dominated foreign technology acquisition.

More recently, however, it has been recognized that having a critical minimum level of internal R&D is important to create absorptive capacities to effectively search for, select, assimilate, and adopt externally generated technology (Cohen and Levinthal, 1989; 1990). Therefore, firms will seek different combinations of internally generated knowledge and technology acquisition in order to innovate. Different externally generated technologies might require more or less locally generated capacities for successful adoption. However, to link the potential impacts of the different innovation strategies with firm performance in term of labor generation, the innovation strategies must first be linked with the different innovation outcomes (product or process innovation), since not all strategies are equally suitable for all types of innovations. Therefore, the effect of innovation strategies on employment growth will critically depend on the type of innovation that each strategy is able to trigger. The next subsection discussea how these mechanisms impact innovation outcomes and how innovation strategies impact firm employment. It briefly summarizes the main discussions in the literature and the available evidence.

2.1 Innovation Strategies and Technological Performance

Innovation can be produced by acquiring technology in different ways: it can be externally sourced ("buy only"), produced in-house ("make only") or a combination of the two ("make and buy"). The literature shows that these ways are not neutral with regard to the innovation that is produced by firms. Internal R&D ("make") has been found to be closely linked to product innovation, while technology purchasing, especially of new machinery and equipment, tends to be mostly related to process innovation (e.g., Conte and Vivarelli, 2007).

Research and development has repeatedly been found to be a main determinant of technological innovation. Further, internal R&D enhances the absorptive capacity of firms, allowing them to better identify, assimilate, and exploit external technology, thereby improving firms' knowledge of the market for technology (Cohen and Levinthal, 1989; 1990; Veugelers, 1997; Griffith, Redding, and Van Reenen, 2004).[5] On the other hand, external R&D can help firms to leverage the productivity of internal research by virtue of specialization and flexibility while helping firms to acquire new technical competencies and expand their pool of knowledge (Arora and Gambardella, 1990; 1994; Cesaroni, 2004). Mixed strategies can therefore have complementary effects on innovation. According to the theory of super-modularity (Vives, 1990; Milgrom and Roberts, 1990; 1995; Cassiman and Veugelers, 2006), this means that the incremental return on implementing any one of the activities is greater if the other one has already been implemented (controlling for other exogenous effects). That is, a pair of economic activities is complementary if, whenever it is possible to implement each activity separately, the sum of the benefits to do just one or the other separately is not greater than the benefit of doing both together. It is also assumed that to be complementary, adopting one strategy does not preclude adopting the other.

For developed countries, most of the research has focused on the interplay between internal and external R&D as an indicator of "buy" strategy, hence using a narrow definition of "buy" strategies. Numerous studies have found an empirical basis for the hypothesis that there are complementarities between "make" and "buy" strategies, narrowly defined. For instance, Cassiman and Veugelers (2006) found evidence of complementarity in the analysis of productivity and statistical significance of the correlation of residuals of individual equations of make and buy, controlling for numerous factors. In general, the effects appear stronger for larger firms (greater market and technology diversification) and predominate basically in high-tech industries, given the faster pace of technological change in these industries and the growing complexity of technologies (Caves and Ukesa, 1976; Arora and Gambardella, 1994; Henderson and Cockburn, 1996; Veugelers, 1997; Kamien and Zang, 2000).[6]

In developing countries, the question of "make and buy" has typically been studied by comparing technology purchasing—imports of capital goods and/or technology licensing—with internal R&D in productivity or innovation equations. Two opposing views are often advanced.

[5] For six Latin American countries, Crespi and Zuniga (2012) report evidence of a positive impact of innovation expenditure on the probability of introduction process or product innovation. Innovation expenditure includes not only R&D but also expenditures related to other innovation activities: technology licensing (in) expenditure and know-how, training and machinery equipment for innovation, software and other ICT infrastructure for innovation.
[6] See also: Branstetter and Sakakibara (1998), Kaiser (2002), and Belderbos, Lokshin,, and Carree (2008), among others.

One view is that a substitute relationship may predominate, as firms will choose either to invest internally or acquire outside technology. For firms lagging behind technologically, acquiring all of their technology externally may constitute the fastest and most economical way to catch up (e.g., Arora, 1995; Basant and Fikkert, 1996) although this may increase their dependence on external (foreign) technology over time. The other view is that complementarities may exist because technology purchasing can serve as a catalyst for domestic R&D and also because imported technology often needs to be adapted to local conditions, facilitated by internal R&D capacity (Lee, 1996). Complementarities might be necessary in a way that enables firms to discriminate among technology options, concentrate, and specialize and by assisting in production (Cessaroni, 2004; Zuniga, Guzman, and Brown, 2007). Moreover, if the imported knowledge or technology is technologically related to firms' existing products, in-house innovation capabilities may complement the imported know-how in a cost-efficient division of labor (Katrack, 1997).

The evidence is, however, less conclusive than in developed countries. Earlier studies report a positive albeit weak relationship between some measure of imported technology and internal R&D (Deolalikar and Evenson, 1989; Lee, 1996; Katrack, 1985; 1997). Using R&D equations, evidence of a complementary relationship is reported by Braga and Willmore (1991) for Brazilian firms, Lee (1996) for Korean firms, and Alvarez (2001) for Chilean firms. In contrast, when evaluating innovation strategies directly in productivity equations, Basant and Fikkert (1996) for Indian manufacturing firms and Zuniga, Guzman, and Brown. (2007) for Mexican pharma-ceutical firms found a substitution effect between internal R&D and technology purchasing (multiplicative term of intensities). They also found that external procurement of technology responds to the search for increased productivity, capital intensity, and company size. Nevertheless, the authors claim that exports may, in fact, underpin the adoption of complementary learning strategies. Basant and Fikkert (1996) found that technology purchasing can play an even more significant role than R&D (the rate of return is much larger on technology purchasing than on R&D). These results suggest that technology purchasing might displace internal innovation efforts in the effort to catch up. Chang and Robin (2006) and Hou and

Monhen (2011), for Taiwanese and Chinese firms, respectively, found a weak effect or no significant effect of the interaction between make and buy on labor productivity.[7]

Studies using innovation equations (rather than productivity equations) also show divergent results across countries. For Chilean firms, Alvarez (2001) found that licensing has no significant effect on technological innovation (product and process innovation) whereas for Brazilian manufacturing firms, Johnson (2002) found evidence of a higher probability of innovation by firms that have previous experience with technology licensing. Goedhuys and Veugelers (2011) also examined Brazilian firms and found that both process and product innovations occur primarily through technology acquisition, which is mostly embodied in machinery and equipment, either alone or in combination with internal technology development. For small and medium-size manufacturing firms in China, Hou and Monhen (2011) found that external R&D has no impact on innovation outcomes and it affects the creation of new products only by working in combination with internal R&D (no effect is found on process innovation). They provide evidence of the existence of complementarities by looking at the significance of the correlation of residuals of the equations of "make" and "buy" in bivariate probit estimation.

In summary, although there is some evidence that both internally generated knowledge (in this case R&D) and technology adoption (through knowledge and machinery acquisition) could both have some effect on both innovation outcomes and productivity in developing country firms, the evidence with regard to interactions between these two sources of innovation is rather mixed. Some studies found that complementarities are not relevant or that even substitution effects prevail, while other studies found that complementarities may exist. However, many of these studies only focused on the sign and significance of the interaction term.

2.2 Innovation Strategies and Employment

There is a growing body of evidence on the impacts of innovation outcomes on employment. There are two lessons from the literature that can provide insights. One is that product innovation must be distinguished from process innovation. Many studies agree that product innovations

[7] An alternative reason for the existence of substitution between make and buy strategies could be due to the existence of market failures. Although there might be obvious complementarities between both strategies, the existence of indivisibilities and lack of finance might induce the firm to choose just one of them (although the optimum strategy in a world without market failures could be to carry out both) (Gorodnichenko and Schnitzer, 2010).

have a positive impact on employment since they can lead to the birth of entirely new branches of economic activity in which additional jobs are created. By expanding product demand, firm employment is enhanced. In contrast, process innovation is often perceived as a cost-reducing strategy with labor-saving purposes. The hypotheses have been empirically corroborated at the microlevel for firms in both developed and developing countries (Harrison et al., 2008; Bogliacino and Pianta, 2010; Crespi and Tacsir, 2011; Vivarelli, 2011). We would expect "make" strategies to be more strongly correlated with product innovation than "buy" strategies. Tacit knowledge, which is embedded in researchers and technicians, is needed for creating new products, and user-producer interaction is (in some cases) needed for their design. In contrast, technology purchasing ("buy"), which primarily concerns acquisition of new equipment for innovation, is mostly integrated into the productive system and therefore is more likely to affect process innovation (Bogliacino and Pianta, 2010). Although "buy" may also concern acquisition of disembodied technology (e.g., licensing and know-how), the preponderance of this expenditure is concentrates in capital acquisition in Latin American countries (e.g., IDB, 2010).

Fewer papers have explicitly distinguished the impact of innovation strategies on employment at the firm level, for either developed or developing countries. Bogliacino and Pianta (2010) look at this question using microdata aggregated for eight European countries. The authors focus on the impact of two innovation strategies: "technological competitiveness" and "cost competitiveness". They find that the former (measured by the log of R&D expenditure per employee and the share of turnover from new products) has a significant positive effect on the rate of change of work hours (and the rate of growth in the number of employees) whereas the latter (log of expenditure on innovative machinery per employee and labor cost reductions as innovation objectives) has a negative impact. The impact of "technological competitiveness" through product innovation predominates in science-based industries, while the second type of variable has no significant effect. One important finding of this paper, however, is that the results are industry sensitive. [8]

At the macro and industry level, technological change (mostly measured by productivity growth or technology imports) has also been found to have the effect of changing the skill

[8] In contrast, in supplier dominated industries changes in hours worked are the result of the negative effect of labor cost reduction and innovative machinery—reflecting a search for cost competitiveness—and wages. In specialized supplier industries, different mechanisms affecting jobs coexist with weaker positive effects of new products and stronger negative effects on labor-saving process innovation; idem for information-specialized industries.

composition of employment. Berman and Machin (2000), for example, found strong evidence for an increased demand for skills in middle-income countries in the 1980s and related it to the diffusion of skill-biased technological change from developed countries (for developed countries, see, e.g., Berman, Bound, and Machin. (1998) and Machin and Van Reenen, 1998). For developing countries as well, Conte and Vivarelli (2007) found robust evidence that both capital and technology imports represent a source of skill-bias employment in manufacturing industries, which explains, among other factors, the widening employment differentials.

Further insights are offered by studies that have solely evaluated the impact of technological acquisition or technological change (measured by productivity change) on employment. Tan and Batra (1997) for Colombia, Mexico, and Taiwan; Lopez-Acevedo (2002a) for Mexico; and Araujo, Bogliacino, and Vivarelli (2011) for Brazil all provide evidence of skill-biased technological change. The former study compares the effects of R&D, worker training, and exports on the wages of skilled and unskilled workers. It found that technology investments lead to large wage premiums for skilled workers but not for unskilled workers. Acevedo used total factor productivity to measure technological change and found that wages are positively associated with productivity.[9] Looking at Brazilian manufacturing firms, Araujo, Bogliacino, and Vivarelli (2011) found evidence of skill-upgrading effects from imported capital goods. Accordingly, R&D and capital formation are complements for skilled employment; to be used effectively, capital goods would require an upgrading of skills in line with country-of-origin technologies.

3. The Empirical Model

A firm is defined as following a "make" innovation strategy if it conducts R&D aimed at introducing an innovation, and a "buy" innovation strategy if it acquires technology through licensing, R&D contracting, and/or technology licensing and know-how acquisition, consultancy services, or through the acquisition of capital goods, hardware, or software aimed at introducing an innovation. We distinguish between firms following a "make only" strategy, a "buy only" strategy and a mix of make and buy strategies ("make and buy"). Three mutually exclusive dummies are constructed to capture the influence of these three types of strategies.

[9] She also found that skilled labor increases after (external) technology adoption, and wages of skilled and semi-skilled grow more than those of unskilled labor.

We use a reduced form of the model proposed by Harrison et al. (2008) on employment growth. Basically, we modify their model by replacing innovation outcomes (the mechanisms that impact employment) with innovation strategies. We then evaluate the impact of those innovation strategies on innovation outputs. This allows us to identify the mechanisms through which innovation strategies affect firm employment. If internal technological efforts—the "make only" strategy—maximize product innovation, we would expect this strategy to have the largest impact on employment. We also hypothesize that the external acquisition of technology—the "buy only"—if implemented as a unique strategy for innovation, may have less impact on employment than a "make" strategy or a combined "make and buy" strategy. As technology purchasing is mostly related to foreign capital acquisition and is more related to process innovation than to product innovation, we could even expect a displacement effect on employment from this strategy. Lastly, if combined strategies facilitate technology learning and adaptation of the technology to local conditions, we would expect that, when implemented together with "buy" strategies, "make" strategies will compensate any displacement effects of "buy" strategies. These effects would manifest themselves through product rather than process innovation.

3.1 Innovation Strategies and Employment

We adapt the model developed by Harrison et al. (2008) to take into account innovation strategies. Accordingly, employment growth is determined by: (i) the rate of change in efficiency in the production of old products (which affects it negatively), (ii) the rate of growth of production of old products (positive effect), (iii) the expansion in the production due to new products (positive effect), and (iv) the change in efficiency due to process innovation in the production of old products (negative effect).

$$l = \alpha_0 + \alpha_1 d + g_1 + \beta g_2 + \mu \qquad (1)$$

where: l: employment growth rate, d: dummy variable indicating process innovation, g_1: nominal growth rate of sales due to old products, g_2: nominal growth in sales due to new products (computed as new sales to total sales of the previous period)[10], α_0: parameter, (minus) average

[10] By definition, all sales from the previous period are old in the current period.

efficiency growth in the production of old products, α_1: parameter, average efficiency growth for process innovations in the production of old products, β: parameter, relative efficiency of the production of old and new products, μ: unobserved disturbance; which includes productivity shocks, change in prices of old products and, change in prices of new prices with respect to old ones. Notice that the variable g_1 has a coefficient equal to 1 and can thus be subtracted from l on the left-hand side of the equation for estimation, being the new dependant variable l-g_1. This implies that we are estimating a net employment effect.[11]

We follow Griliches (1979) by stating that innovations are the results of a knowledge production function process through which firms combine internally generated with externally available knowledge in order to innovate. Thus, in this regard, innovation outcomes are the results of the different innovation strategies implemented by firms. This allows for the specification of a reduced-form model where we can just substitute the innovation outcomes for the strategies as follows:

$$l - (g_1 - \pi) = \alpha_0 + \alpha_m make\ only + \alpha_b\ buy\ only + \alpha_{mnb} make\&buy + v \tag{3}$$

where $make$ is an indicator of whether the firm follows a *make only strategy*, buy is an indicator of whether the firm follows a *buy only strategy*, $make\&buy$ an indicator of whether the firm follows both *a mix of make and buy strategies*. We control for foreign ownership (dummy equal to 1 if the firm has a capital ownership superior to 10 percent) and localization of the firm (dummy equal to 1 if the firm is located in the capital city). We also control for industry effects.

From the previous discussion, our working hypothesis is that since innovation strategies should be influenced by the relative factor endowments of the place where they are implemented, we expect dissimilar effects between "make" and "buy" strategies. Given that capital intensity is higher in frontier technology countries, "buy only" strategies, which refer mostly to imported innovations, should have a more damaging effect on employment than locally generated ones. In other words, "make" ("make only" and "make and buy") strategies should be more labor generating than "buy only" innovation strategies. This would be particularly true if the impact of product innovation, which is expected to be strongly influenced by in-house technological efforts

[11] Identification and consistency depend on the lack of correlation of the variables representing innovation (g2 and d) and the error term, or on the availability of instruments uncorrelated with the error term (for further details see Harrison et al., 2008 and Crespi and Tacsir, 2011 for the application of this model in Latin American countries).

(e.g. Harrison et al., 2008), dominates the efficiency-generating effects in the production of old products (process innovation). Therefore, we would expect the following ordering of the parameters: $\alpha_m>0$, $\alpha_b<0$ and $\alpha_{mb}>0$. The last coefficient implies that the adaptation/absorptive capacities effects of in-house generated knowledge are strong enough to reverse the labor displacement effect of externally generated technology.

The reduced form approach only provides information on whether the different strategies have a labor-creating or displacement effect on employment. To understand the transmission mechanism through which these effects are channeled, we need to look at how the different strategies affect the innovation outcomes. We will then evaluate the impact of innovation strategies on product and process innovation. Following Harrison et al. (2008), we use sales due to product innovation as a variable for product innovation (in the most recent period), and this estimation is estimated with ordinary least squares. Process innovation (dummy) is estimated with a Probit model (marginal effects are reported).

4. The Data

We used microdata from innovation surveys matched with economic surveys to complement employment data. The innovation surveys contain detailed information on firm characteristics, innovation activity, and employment—both the number of employees and employment composition by education and length of the labor contracts. Importantly, they also have detailed information on the composition of sales, which allows us to compute the percentage of sales corresponding to new products. However, in some surveys, the questions on employment refer to the same period of occurrence as innovation activities. For this reason, and to correctly evaluate the impacts of innovation, we need employment data for subsequent periods.

For Argentina, we use the Second National Innovation Survey (ENIT01) conducted in 2003 by the National Institute of Statistics and Census (INDEC) and collected retrospective information for each year between 1998 and 2001. The panel is short, comprising four years of data. The firms surveyed are the same firms surveyed in the Annual Industrial Survey—

manufacturing firms with 10 or more employees.[12] The response rate was 76 percent; questionnaires were distributed to 2,229 firms, and 1,688 responded to the questionnaire.[13]

For Chile, we use the 2007 Innovation Survey, matching it with information from the National Annual Manufacturing Survey (ENIA) using a plant identification number. The total number of firms used for the analysis is 835. For Costa Rica, we use the Innovation Survey covering the years 2006–07. This survey is based on a statistically representative sample of the manufacturing, energy, and telecommunications sectors. The sample is composed of 566 firms distributed over all sectors. Using this sample, and limiting the analysis to the manufacturing sector, we ended up with a sample of 208 firms.[14] CINPE conducted the survey for the Ministry of Science and Technology (MICIT).

For Uruguay, we use four waves of the Manufacturing Firms Innovation Survey (MIS): 1998–2000, 2001–03, 2004–06, and 2007–09. Information on employment was completed with the annual Economic Activity Surveys (EAS) for the period 1998–2007. The MIS data was collected by the National Bureau of Statistics (INE) in parallel with the EAS. The same sampling model was used in both surveys, but the final list of firms is not the same. For the MIS, all firms with more than 49 workers are of mandatory inclusion. Units with 20 to 49 employees and with fewer than 19 workers were selected using simple random sampling within each economic sector at ISIC 2-digit level up to 2005. The response rate was nearly 90 percent.[15] The final number of observations (firm/period) used in the estimations was 2,532.[16] For these data, we included time dummies in the regressions.

Table 1 displays the main descriptive statistics, including employment growth rates and innovation outcomes (our dependent variables). Table 2 presents frequency rates for each of the innovation strategies (independent variables). We classified firms in mutually exclusive

[12]The population for the sample design of the Annual Manufacturing Survey is the National Economic Census 1994 conducted by INDEC.
[13] The sampling frame includes 23 industries, 22 of which correspond to industries classified according with two digits of ISIC-Rev3 and the rest include firms with special characteristics.
[14] After eliminating firms from energy and telecommunications sectors, and also any manufacturing firms with less than 10 employees for comparability reason with other international studies, we ended with a sample of 208 firms.
[15] Random strata are then defined for those units with fewer than 50 workers within each economic sector at the ISIC 4-digit level. The number of firms included in the samples for the 1998–2000, 2001–03, 2004–06 and 2007–09 surveys were 761, 814, 839, and 941 respectively.
[16] Firms with missing information on sales or employment were also excluded (704 firms). Also excluded were the percentile 1 and 99 of variables employment growth to avoid outliers, and 3 negative values of the variable product innovation sales (97 firms): 722 from the 1998-2000 MIS, 627 from the second MIS (2001–2003), 737 from the third one (2004-06), and 446 from the last available survey.

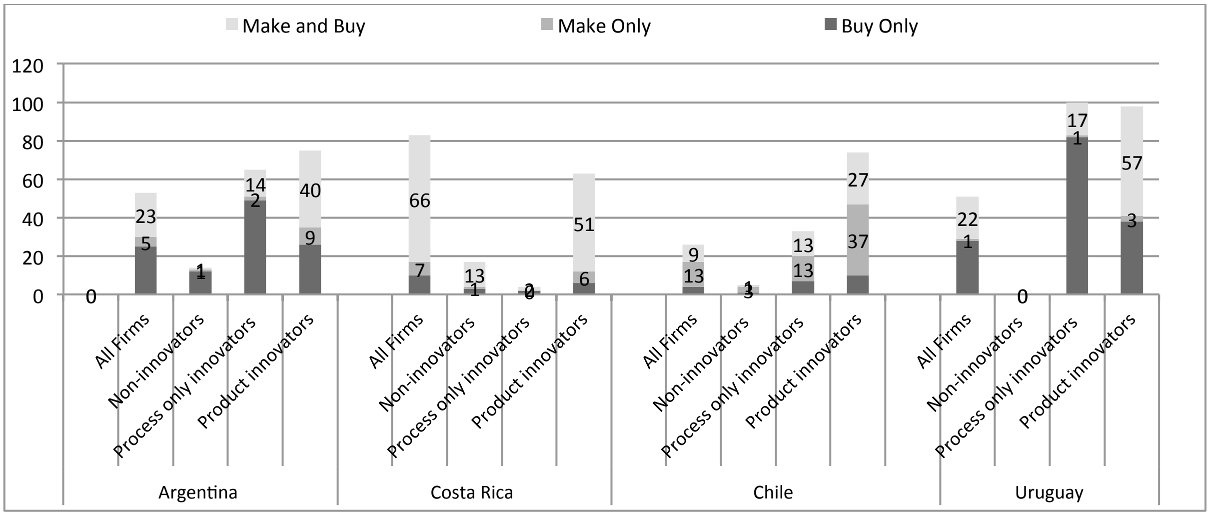
categories according to their innovation status: product innovators, process only innovators, and non-innovators. Product innovators are firms that have introduced product innovations. Process only innovators are firms that have introduced process innovations or organizational change innovations excluding product innovators. Non-innovators are firms not classified as either product or process innovators.

In the Argentinean sample, the average firm has 233 employees; 20 percent are foreign firms and more than 64 percent are located in Buenos Aires. The average Chilean firm has an average of 128 workers per plant; 5 percent of the plants are foreign, and 40 percent of the plants are located in the Metropolitan Region of Santiago. In the Costa Rican sample, the average firm has 177 employees; 15 percent are foreign, and 58 percent are located in San Jose. Lastly, in the Uruguayan sample, the average firm size is 91; 13 percent of firms are foreign and 80 percent are located in the capital of the country.

The "buy only" strategy is the most frequent way to acquire technology in Argentinean and Uruguayan firms (25 and 28 percent respectively), followed closely by "make and buy" (23 and 22 percent of firms). Figure 1 displays the share of firms involved in each strategy, in total samples and per type of innovator. In Costa Rica, in contrast, make and buy is the most frequent strategy with 66 percent of firms conducting such a strategy; 10 percent of the firms are engaged in "make only," while just 7 percent do "buy only". Within product innovators, "make and buy" is the most frequently used strategy in Argentina, Costa Rica, and Uruguay. Within process-only innovators (non-product innovators), the "buy only" has the largest share of firms in Argentina and Uruguay. In Costa Rican firms, on the other hand, this strategy was used as frequently as "make and buy": 2 percent of firms respectively implement this mode of innovation.

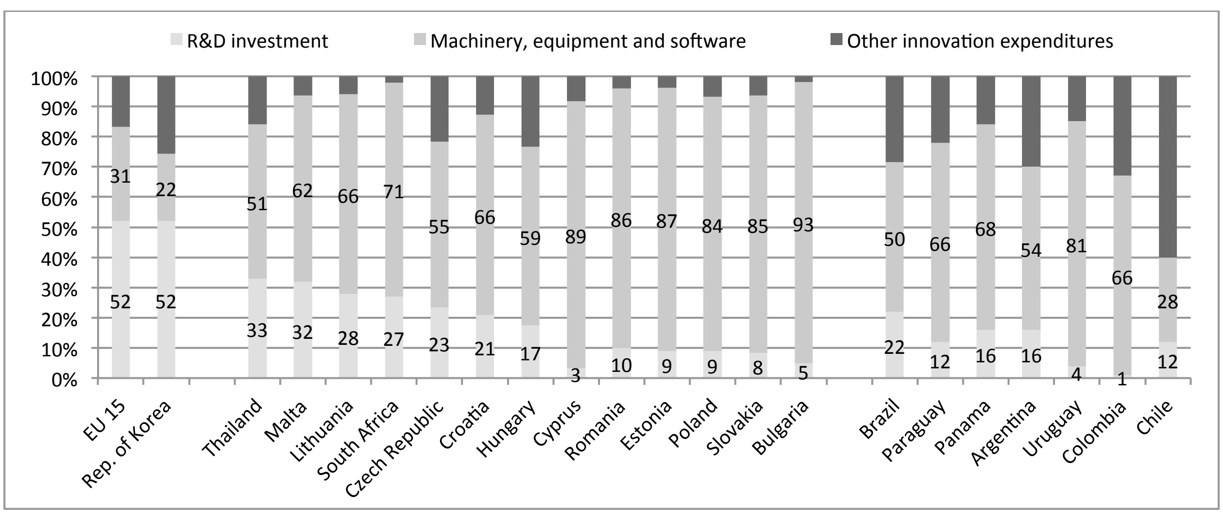
Figure 2 shows the importance of innovation strategies expressed as shares of total innovation expenditures. Three types of expenditures are considered: R&D investment ("make"), machinery, equipment and software ("buy"), and other innovation expenditures (which can be make or buy, or both). Compared to manufacturing firms in advanced countries (European and South Korea), the lion's share of innovation expenditure in Latin American manufacturing firms is concentrated in machinery and equipment (above 50 percent in most countries, except for Chile) while in advanced countries, this item represents 30 percent (22 percent in South Korea) on average. The main innovation expenditure in those countries concerns R&D investment (50 percent on average). The share of R&D expenditure in total innovation expenditures is even lower than in Thailand and South Africa and some Eastern European countries.

Figure 1: Innovation Strategies: Share of firms Pursuing each Type of Strategy by Type of Firm in Manufacturing Industries *(in percent)*



Source: Innovation surveys, Manufacturing firms.

Figure 2: Allocation of Innovation Expenditures in Manufacturing Industries *(average per firm)*



Sources: Innovation Surveys. Data for EU-15 countries are from Eurostat Chronos (Innovation surveys 2006); completed with data from OECD (2009) for Germany, South Korea and United Kingdom. For Estonia, Bulgaria, Cyprus, Lithuania, Hungary, Malta, Poland, Romania, Slovakia, Croatia and Turkey, data are from Eurostat Chronos, 2006.
Note: Indicators refer to the Manufacturing Industry except for South Africa and Thailand whose indicators reported refers to manufacturing and services industries. EU (15): The indicator is the average share across countries.

5. Results

Table 3 shows the results using linear regression with a set of industry dummy variables (industry classification at 2 digits ISIC). The three innovation strategies are significantly different from zero and positive in Argentinean and Uruguayan firms: firms that are involved in innovation activities generate more employment compared to firms than do not implement any. In the case of Costa Rica, only "make only" is statistically significant and with a positive coefficient. The "make only" strategy has the largest impact on employment growth across these three countries. Chilean firms behave differently: the "make only" strategy is not significant and "buy only" and "make and buy" have a similar impact on employment growth albeit with a much lower effect than their counterparts in Uruguay and Argentina.

The percentage difference with respect to firms that do not conduct any innovation strategies is extremely high in Costa Rica, Uruguay, and Argentina: firms conducting internal R&D as an exclusive strategy for technology have 30 percent higher employment growth. In general, the lowest impact corresponds to the "buy-only" strategy. The Sargan test confirms that innovation strategies are orthogonal with respect to the residual, that is, they are exogenous to the dependent variable (employment growth).

We also find dominance of "make only" and "make and buy" as boosters of employment for small firms (with less than 50 employees), albeit with slightly higher coefficients for all strategies. Results are available upon request. The "make only" has the largest impact on employment growth in the four countries, followed by "make and buy". Contrary to the total sample, small firms in Chile now join the rest of the group in showing that the "make only" strategy has the largest effect on employment, followed by mixed strategies.

5.1 Skilled vs. Unskilled Employment

Table 4 reports regressions for two types of employment growth: skilled and unskilled. We would expect that "make only" and "make and buy" would demand employment with a higher level of skills—including researchers and engineers, who are necessary to undertake innovation activities. By their impact on product innovation, "make" strategies are expected to enhance skilled employment more than unskilled employment, and to a greater extent than "buy" strategies. Recent studies confirm this result for Chile and Uruguay (Aboal et al., 2011) and

Alvarez et al. (2011), respectively), in line with those reported for developed countries by Harrison et al. (2008). An alternative view suggests that a minimum level of skilled labor is needed for efficiently appropriating and exploiting purchased technology; this would imply an updating of skills in accordance with imported technology and skills in the rest of the world (e.g., Robbins and Gindling, 1999; Lee and Vivarelli, 2006).[17] However, if "buy only" mainly affects process innovation, we would expect that this strategy might even displace employment, especially unskilled, if process innovation focuses on labor-saving technological change (integrated with machinery and industrial equipment).

Our results differ across countries and are therefore difficult to generalize. It is hard to define a specific pattern with respect to the impact of innovation strategies on the quality of employment. Local conditions, such as institutional factors and education, influence the supply and demand of white collar employment. They are different from one country to another. The role of skilled human capital in innovation activities may therefore differ across countries. "Make only" has a larger impact on skilled than unskilled employment in Uruguayan firms but the opposite occurs in Argentinean firms. In the latter, the mixed strategy (make and buy) has the largest impact on skilled employment. For Chilean firms, "make only" and "make and buy" have similar effects on skilled labor, but these effects are lower in Argentina and Uruguay. Only the "make and buy" strategy significantly increases firm demand for unskilled employment. In Costa Rican firms, the "make only" strategy impacts to a similar extent the two types of employment and is in fact the only statistically significant strategy.

In summary, "make" strategies (only and in combination) appear more significantly associated with increases in skilled employment, although they also enhance unskilled employment to a lesser extent. In Costa Rican and Uruguayan firms, the "make only" strategy has the largest impact on both types of employment. In Uruguayan firms, in both skilled and unskilled employment, make and buy comes in second place and its effect is twice or three times the impact of "buy only".

[17]Some authors argue that technology transfer resulting from imported embodied technologies in capital goods induces an adaptation to the modern skill-intensive technologies used in advanced economies, which leads to a higher demand for skilled labor in the importing country (Robbins and Gindling, 1999).

5.2 High Tech vs. Low Tech

In this section we distinguish between high- and low-tech industries. Table 5 display regressions for Argentina, Chile, and Uruguay. Due to limitations in sample sizes, this industry distinction was not possible for the Costa Rican sample. Industries were classified by calculating innovation expenditure over turnover. Those sectors below or at the median are classified as low-tech, while the rest are classified as high-tech. In consequence, the classification between high- and low-tech industries varies across countries.

It has been argued that high-tech manufacturing industries are characterized by a dominant role of product innovation and by more effective "compensation mechanisms" fostered by increasing demand (e.g. Harrison et al., 2008), while more traditional manufacturing sectors are characterized by prevailing process innovation and decreasing demand, at least in relative terms. Further, it has been stressed that high-tech and low-tech industries differ substantially in the way that innovation and the innovation process are organized. In high-tech industries, internal innovation competencies are more important than external ones, contrary to low-tech sectors. Likewise, the rate of technological change and the need to bring new products to market changes faster in high-tech than in low-tech industries (Pavitt, 1984). Pavitt (1984) explained that supplier-dominated industries (traditional manufacturing, e.g., textiles and agriculture) rely mostly on sources of innovation external to the firms. In contrast, science-based industries (pharmaceuticals and electronics) rely on R&D from both in-house and external sources of knowledge, and have a high degree of appropriability of innovations (from patents, secrecy, and tacit know-how). [18]

According to the results for Argentinean and Uruguayan manufacturing firms, there is a notable difference in the way innovation strategies impact employment between the two types of industries. Whereas "make only" appear to have the largest impact among the three innovation strategies in high-tech industries, the impact of this strategy is pretty much equal to "make and buy" in low-tech industries. The "buy only" strategy has the weakest impact on both types of

[18] The two other categories are "scale-intensive" and "specialized suppliers". The former are characterized by large firms, such as the automotive sector, producing basic materials and consumer durables. In these sectors, sources of innovation may be both internal and external to the firm with a medium level of appropriability. In the latter group of industries, firms are specialized in producing technology (R&D and engineering services) for others. There is a high level of appropriability due to the highly tacit nature of knowledge.

industries. In other words, in low-tech industries, conducting internal innovation efforts, or combining internal innovation efforts with external technology, both affect employment growth positively and to a similar extent. This finding suggests that acquisition of external technology, when combined with an internal R&D effort, facilitates technological change and economic performance in mature and more traditional industries more than in high-tech industries, where conducting internal R&D has primacy in spurring product innovation and firm growth.

As in previous regressions, Chile behaves differently. In high-tech industries, the "make only" strategy has no effect on employment, whereas mixed strategies and "buy only" strategies increase employment to a similar extent. A different picture emerges for low-tech industries. Only the "make and buy" strategy significantly enhances firm employment in sectors such as textiles, food, wood and paper, and metal-mechanics.

5.3 Impact Mechanisms

This section analyzes the mechanisms though which innovation strategies impact employment. As explained earlier, innovation strategies may trigger different types of technological innovation and the latter may affect employment in dissimilar ways. It has been recurrently found that "make" strategies are more strongly associated to product innovation whereas "buy" strategies are more prone to affect process innovation. Recent studies for Latin American manufacturing firms have corroborated the differentiated impact of product and process innovation on employment (Aboal et al., 2011; Alvarez et al., 2011; De Elejalde, Giuliodori, and Stucchi, 2011; Monge et al., 2011): product innovation is positively and significantly related to employment growth, whereas process innovation has a negligible effect or negatively impacts employment.[19] We interpret these findings as supporting the idea that internal innovation efforts (exclusive or in combination with "make") enhance employment more than relying exclusively on external acquisition of knowledge, because they lead the firm to introduce new and/or improved products. This effect can be larger in high tech than in low-tech in industries, due to the fact that product innovation comes associated with higher demand displacement effects in industries that are highly knowledge intensive.

[19] The larger employment growth due to product innovation effect more than compensates for the lower employment growth due to sales of old products. Process (only) innovation is only significant but with negative coefficient in the Uruguayan firms, indicating that process innovation is associated with a reduction in the growth rate of labor.

Table 6 reports OLS and probit regressions for product innovation sales and process innovation (following the model of Harrison et al., 2008), respectively. The results confirm that innovation strategies affect product and process innovation differently. In Argentina, Costa Rica, and Uruguay, manufacturing firms that use the "make only" strategy are the ones with the highest product innovation performance, followed by firms using the "make and buy" strategy. In Chilean firms, "make only" and "make and buy" have equal impact in terms of enhancing product innovation. For process innovation, however, the "buy only" strategy has the greatest effect, although coefficient on this strategy is not significant in Costa Rican firms. In Argentinean firms, "buy only" is actually the only strategy that is statistically significant with respect to process innovation, whereas in Costa Rican firms, none of the strategies is significant. With the exception of the results for Costa Rican on process innovation, overall these findings are in line with our expectations. In Uruguayan and Argentinean firms, the impact of "make only" on product innovation is more than twice the impact of "buy only", which illustrates the importance of investing internally in technological competencies for the creation of new goods and services, which in turn translates into new economic advantages and firm performance.

Table 7 shows regressions for high- and low-tech-intensive industries for Argentina, Chile, and Uruguay. In general, there is no substantial difference in the ranking order of the impact of innovation strategies on technological innovation between high- and low-tech industries. As in the total samples, "make only" is the most important strategy increasing product innovation, whereas "buy only" is the main driver of process innovation, and this pattern is similar in the two types of industries.

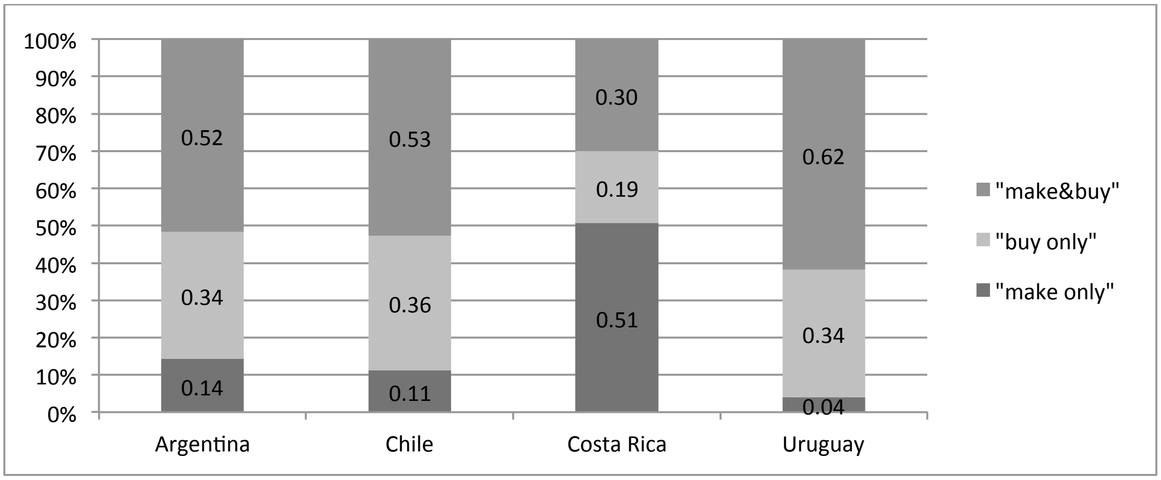
The extent of the impact differs between industries and across countries. For Argentinean firms, "make only" and "make and buy" have no significant impact on process innovation in high tech industries, whereas "make only" affects negatively this type of innovation in low-tech sectors. In Chilean firms, "make and buy" has the largest effect on product innovation in high-tech industries, whereas in low-tech sectors, "make only" and "make and buy" have the same impact on this type of innovation. In Uruguayan firms, there is also a noteworthy difference between industries: "make only" has no impact on process innovation (but this is mostly due to the limited number of firms conducting such strategy) in low-tech industries, but it has a positive impact in high-tech industries. Interestingly, for this country, the impact of "make and buy" on product innovation is much larger in low-tech than in high-tech industries. This result may suggest that combining internal and external technology speeds innovation performance more in more traditional industries, where investment in technology is lower.

5.4 Employment Effect Decomposition

Figure 3 displays employment effects of innovation strategies. We display the share per strategy in total effects due to innovation strategies. We use coefficients from regressions (Table 3) and average shares of firms per strategy (Tables 1 and 2) to estimate total impacts. We thus take into consideration the distribution of firms per innovation strategy. Considering that the "make only" strategy (investing in R&D) is the least frequent in the four country samples, the vibrant effect of "make only" previously suggested in regressions is attenuated: excepting for Costa Rica, the largest contribution to employment is given by "make and buy" (Figure 3). Mixed strategies appear to be the most important in affecting total employment in manufacturing industries, given their higher occurrence in firms' innovation strategies. Fifty percent of employment growth due to innovation strategies is due to "make and buy' in Argentina and Chile, whereas in Uruguay the figure is 62 percent. "Make and buy" increases employment growth by 5 to 6 points in Argentina and Uruguay (the average growth rates of employment were negative in these two countries: -4 and -1 percent, and displacement effects are explained by growth of sales of old products) and by 1.16 points in Chile (about a third of employment growth rate in Chile (3.13) is therefore explained by mixed strategies). In Costa Rica, it is the "make only" the strategy that contributes the most to firm employment growth; 51 percent of employment growth related to innovation strategies is due to "make only". If we consider that the employment growth rate was 3.3 percent, this means that for the average firm, about 60 percent of employment expansion is explained by the decision to invest in R&D.

Figure 3: Impact of Innovation Strategies on Employment in Manufacturing Industries

(In total effects due to innovation strategies)



Source: Authors' calculation using estimates of regressions. The shares are computed as percent of effects in total effects related to innovation strategies (sum of effect is 100 percent).

6. Conclusions

This study evaluates the impact of innovation activities on employment. It looks at the organization of innovation activities by firms and distinguished "make" and "buy" strategies and how they affect employment via their contribution to innovation outcomes. For this purpose, we have adapted the framework proposed by Harrison et al. (2008) and used firm innovation strategies as explanatory variables for the equations of product and process innovation.

Our results show that undertaking innovation activities internally (in-house) and/or in combination with technology purchasing ("make") maximizes economic performance due to product innovation, thereby enhancing firm employment. There are some variations in impact across the three countries, and in the way that innovation strategies impact innovation outcomes in high- and low-tech industries.

Our results underscore the importance of stimulating both in-house innovation activity and technology acquisition, not only for the purpose of firm innovation but also to encourage employment. Innovation policies, targeting both sources of knowledge for firms, can exert a positive influence on Latin American job creation.

This analysis is not without caveats and limitations. In particular, as in other micro level studies, in order to have robust conclusion of net effects of innovation on the economy, an evaluation at the industry level must be made. It is important to detect whether innovation effects prompt a reallocation of employment across economic sectors and to quantify net effects on total employment. Our future research will focus on these questions.

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Appendix

Table 1: Innovation Strategies in Manufacturing Firms

Share of firms pursuing each type of strategy by type of firm (percent)	Buy Only	Make Only	Make and Buy
Argentina			
All Firms	25	5	23
Non-innovators (no process or product innovations)	12	1	1
Process only innovators (non-product innovators)	49	2	14
Product innovators	26	9	40
Costa Rica			
All Firms	10	7	66
Non-innovators (no process or product innovations)	3	1	13
Process only innovators (non-product innovators)	2	0	2
Product innovators	6	6	51
Chile			
All Firms	14	5	15
Non-innovators (no process or product innovations)	4	2	2
Process only innovators (non-product innovators)	41	7	24
Product innovators	27	11	51
Uruguay			
All Firms	28	1	22
Non-innovators (no process or product	0	0	0
Process only innovators (non-product innovators)	82	1	17
Product innovators	38	3	57

Notes: Make innovation strategy: the firm does R&D aimed at introducing an innovation. *Buy innovation str* acquired technology through licensing and/or through R&D contracting and/or through consultancy services and acquisition of capital goods, hardware or software aimed at introducing an innovation. *Product innovators* are introduced product innovations. *Process only innovators* are firms that have introduced process innovations or change innovations excluding product innovators. *Non-innovators* are firms not classified as product or process inn

Table 2: Descriptive Statistics

	Mean	Standard deviation
Argentina 1415 firms		
Number of employees at the beginning of (each) survey	233	556
Foreign ownership (10 percent or more)	0.20	0.40
Located in the capital of the country	0.64	0.48
Employment growth (percent) (yearly rate)	-4.00	12.3
Distribution of firms (percent)		
Non-innovators (no process or product innovations)	0.36	
Process only innovators (non product innovators)	0.15	
Product innovators	0.48	
Chile 1178 firms		
Number of employees at the beginning of (each) survey	128	297
Foreign ownership (10 percent or more)	0.05	0.23
Located in the capital of the country	0.40	0.49
Employment growth (percent) (yearly rate)	3.13	19.86
Distribution of firms (percent)		
Non-innovators (no process or product innovations)	0.59	
Process only innovators (non product innovators)	0.06	
Product innovators	0.20	
Costa Rica 208 firms		
Number of employees at the beginning of (each) survey	177	397
Foreign ownership (10 percent or more)	0.15	0.36
Located in the capital of the country (percent)	0.58	0.50
Employment growth (percent) (yearly rate)	3.30	10.9
Distribution of firms (percent)		
Non-innovators (no process or product innovations)	0.22	
Process only innovators (non product innovators)	0.04	
Product innovators	0.74	
Uruguay 2532 firms		
Number of employees at the beginning of (each) survey	91	157
Foreign ownership (10 percent or more)	0.13	0.34
Located in the capital of the country (percent)	0.81	0.39
Employment growth (percent) (yearly rate)	-1.00	15
Distribution of firms (percent)		
Non-innovators (no process or product innovations)	0.48	
Process only innovators (non product innovators)	0.19	
Product innovators	0.32	

Table 3: Innovation Strategies and their Impact on Employment Growth (Ordinary Least Squares)

	Argentina	Chile	Costa Rica	Uruguay
Constant	14.899***	3.348***	65.554***	2.134***
	(1.27)	(1.21)	(11.43)	(0.65)
Make only (dummy)	30.430***	4.961	28.379*	30.075***
	(4.85)	(3.35)	(16.59)	(3.81)
Buy only (dummy)	14.589***	6.105***	-7.597	9.914***
	(2.51)	(2.34)	(17.72)	(1.19)
Make & Buy (dummy)	23.972***	7.713***	1.78	22.814***
	(2.57)	(1.97)	(11.21)	(1.30)
R-squared	0.128	0.07	0.15	0.15
Sargan test	2.91	0.29	NA	7.78**
Industry dummies	Yes	Yes	Yes	Yes
Number of firms	1209	1178	208	2532

Note: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.1. Linear regression with a industry dummy-variable set. Uruguay also includes year dummies.

Table 4: Innovation Strategies and Skill Composition of Employment Growth (Ordinary Least Squares)

	Argentina		Chile		Costa Rica		Uruguay	
	Skilled	**Unskilled**	**Skilled**	**Unskilled**	**Skilled**	**Unskilled**	**Skilled**	**Unskilled**
Constant	16.93***	13.40***	2.93*	6.508***	67.70***	65.35***	-1.538	0.37
	(1.32)	(2.62)	(1.71)	(2.10)	(11.45)	(11.59)	(2.43)	(1.60)
Make only	17.89***	29.62***	8.56**	6.03	28.89*	32.38*	45.27***	27.85***
	(4.77)	(5.08)	(4.82)	(7.09)	(16.73)	(17.30)	(12.09)	(9.23)
Buy only	15.51***	14.86***	3.53	5.77	-8.06	-2.84	12.46***	5.52***
	(2.54)	(2.53)	(3.14)	(4.33)	(17.87)	(18.41)	(2.71)	(1.84)
Make & Buy	24.30***	23.72***	9.97***	5.25*	3.63	6.67	28.94***	23.52***
	(2.66)	(2.62)	(3.27)	(3.02)	(11.35)	(11.45)	(3.01)	(2.13)
R-squared	0.13	0.13	0.04	0.07	NA	NA	0.12	0.18
Sargan test	1.25	0.51	0.58	0.57			4.31	0.031
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	1209	1209	1152	949	208	208	1037	1037

Note: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.1. Linear regression with a industry dummy-variable set. Uruguay also includes year dummies.

Table 5: Innovation Strategies and their Impact on Employment Growth (Ordinary Least Squares): High-Tech vs. Low-Tech Industries

	Argentina		Chile		Uruguay	
	High Tech	**Low**	**High Tech**	**Low Tech**	**High Tech**	**Low**
Constant	15.226***	14.582***	1.683	4.061***	2.459***	2.075**
	(1.64)	(1.98)	(2.649)	(1.303)	(0.87)	(0.96)
Make only (dummy)	31.933***	28.316***	1.489	6.752	28.379***	31.993***
	(6.30)	(7.56)	(4.626)	(4.696)	(4.34)	(8.01)
Buy only (dummy)	18.734***	8.138*	9.917***	4.89*	8.262***	11.775***
	(3.21)	(3.95)	(3.833)	(2.903)	(1.55)	(1.86)
Make & Buy (dummy)	19.444***	28.311***	6.86**	8.039***	20.126***	28.003***
	(3.40)	(3.80)	(3.180)	(2.517)	(1.51)	(2.44)
R-squared	0.13	0.14	0.07	0.08	0.14	0.17
Sargan test	1.348	2.109	2.57	0.24	6.33**	2.01
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	650	559	382	796	1464	1068

Note: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.1. Linear regression with a industry dummy-variable set (areg). Uruguay also includes year dummies.

Table 6: Innovation Strategies and Innovation Outputs (Probit and/or Probability Linear Model): Impact on Product and Process Innovation

	Argentina		Chile		Costa Rica		Uruguay	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Constant	11.433*	0.114*	1.396*	0.146*	64.10*	0.06	0.22	-
	(0.74)	(0.01)	(0.350)	(0.016)	(9.34)	(0.04)	(0.47)	(0.00)
Make only (dummy)	30.833*	-0.051	9.068*	0.138*	40.38*	-0.07	27.455	0.132*
	(4.43)	(0.03)	(2.384)	(0.060)	(17.39	(0.04)	(3.04)	(0.06)
Buy only (dummy)	15.222*	0.195*	6.463*	0.373*	8.02	0.08	12.697	0.557*
	(2.12)	(0.03)	(1.131)	(0.041)	(18.25	(0.09)	(0.77)	(0.02)
Make & Buy (dummy)	25.599*	-0.013	10.468	0.153*	16.7	-0.02	24.959	0.149*
	(1.97)	(0.02)	(1.489)	(0.036)	(10.91	(0.04)	(0.87)	(0.02)
2-digit industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared/Pseudo-R-	0.114	0.058	0.14	0.14	0.11	0.09	0.27	0.416
Number of firms		1,415		1,178		208		2,511
F-test	14.45**	3.23**	24.40*	18.37*	NA	NA	484.30	303.59

Note: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.1. *a*: Product innovation, *b:* Process innovation.

Table 7: Innovation Strategies and Innovation Outputs: Impact on Product and Process Innovation

High-Technology-Intensive Industries vs. Low-Technology-Intensive Industries

	Argentina				**Chile**				**Uruguay**			
	High Tech		**Low Tech**		**High Tech**		**Low Tech**		**High Tech**		**Low Tech**	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Constant	10.413	0.095*	12.636	0.135*	2.259*	0.135*	0.984*	0.151*	0.025	0.004	0.879	-0.001
	(1.14)	(0.02)	(0.99)	(0.01)	(0.75)	(0.03)	(0.380)	(0.019)	(0.65)	(0.00)	(0.67)	(0.00)
Make only	31.115	-0.009	30.476	-	7.86**	0.059	9.987*	0.1941	30.24*	0.193*	38.316	-0.001
	(5.66)	(0.05)	(7.48)	(0.01)	(3.66)	(0.09)	(3.145)	(0.080)	(5.71)	(0.08)	(6.13)	(0.02)
Buy only	20.000	0.209*	7.980*	0.175*	6.30**	0.329*	6.463*	0.389*	10.18*	0.594*	13.152	0.571*
	(2.28)	(0.04)	(2.54)	(0.04)	(2.44)	(0.08)	(1.276)	(0.048)	(1.51)	(0.02)	(1.15)	(0.01)
Make & Buy	22.553	-0.008	28.451	-0.018	10.99*	0.114*	10.241	0.174*	22.12*	0.175*	30.737	0.106*
	(3.22)	(0.03)	(2.51)	(0.02)	(2.80)	(0.06)	(1.767)	(0.044)	(1.67)	(0.02)	(1.49)	(0.03)
2-digit industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2/Pseudo-R2	0.116	0.071	0.13	0.05	0.11	0.1	0.13	0.16	0.25	0.38	0.33	0.45
F-test	21.49*	9.39**	18.71*	7.59**	5.64**	4.30**	14.43*	16.329	48.72*	115.69	86.78*	59.06*
Number of firms	743	743	672	672	382	382	796	796	1464	1464	1068	1068

Note: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.1 . *a*: Product innovation, *b:* Process innovation.