# Export Subsidies in a Heterogeneous Firms Framework[♣]

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Abstract

We evaluate the impact of firm-specific export subsidies on exports in Colombia. Using a two-stage Heckman selection procedure, we obtain firm-specific predicted subsidy amounts that can be explained by the characteristics that determine the firms' eligibility for the government support and its amount. Drawing on the accounts of the discretionary allocation of subsidies in developing countries, we regard the discrepancy between the predicted and the observed subsidy amounts as a proxy for the firm's ties to government officials. Controlling for observable and unobservable firm characteristics and persistence in exports, we find that although, in general, subsidies exhibit positive impact on export volumes, this impact is diminishing in subsidy size and in the degree of firm's connectedness to government officials.

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## 1. Introduction

*"A great part of the economy is decided in the corridors of the Ministry of Economy and of the Central Bank… It is more profitable to spend time in these corridors than in the manufacturing plant…"*

Quoted in Nogués (1989)

Export subsidies are illegal under WTO regulations. They can trigger retaliatory actions from trading partners, misalign prices and distort the allocation of resources. Even when effective, their impact is small and the direct fiscal costs of keeping them in place can be unjustifiably large. Yet, export subsidies remain common.[1]

The case in favor of export subsidies is based on the argument that they can help a country to achieve export expansion and diversification of the economy towards manufacturing. They encourage a firm to undertake an activity that is costly, yet, assuming positive spillovers from exporting to other firms, socially desirable. One of the practical arguments against the use of export subsidies is that they are very easy to abuse, which renders them ineffective in achieving their original goals (Nogués, 1989).

First, there are government officials pandering to the "connected" firms. Mobarak and Purbasari (2006) use firm-level data for Indonesia and a unique data set identifying the firm's degree of connectedness to President Suharto to investigate the impact of nepotistic relationships on the probability of obtaining import licenses for raw-materials and for commodities for sale in local markets. By conservative estimates, being connected triples the likelihood of receiving a license relative to the firm's competitors, and having a member of the Suharto family on the firm's board of management quadruples the likelihood.

Second, the money is left for the discretionary use by the firm. If appropriate auditing mechanisms are absent, as in most developing countries, firms may fail to spend the

[1] See the WTO World Trade Report 2006 for an overview of the current presence and relevance of export subsidies in the developing world.

additional resources on the activities fostering exports. Noguès (1989) describes a case in which a shipbuilding company drew on government export promotion funds for several years before it became known that the company had not even started its production. Rodrik (1993) cites an article from The Economist (August 14, 1993, 37-38), in which a Kenyan firm, the sole recipient of a license to export gold and jewelry, received $54 million in export subsidies (amounting to 5 percent of Kenya's total exports). Not only did the firm get a subsidy of 35 percent instead of the legally allowed 20, but the foreign buyers of its products either did not exist, or had never heard of the firm.

Third, the export promotion schemes are often complex and this leaves them open to misuse and abuse. Consider a sample list of export promotion measures operating in Argentina during the 1980s: reimbursements for exports produced with sugar (a product with important employment effects in two provinces), for exports going to new markets, for exports shipped through southern ports, for exports coming from Tierra del Fuego, for exports shipped by the customs of Salta and Jujuy, reimbursements to the enterprises who sign a contract with the government for a marginal increase of exports, reimbursements for turnkey exports… Leaving aside defaulting on commitments or re-exports through a promoted port, a firm may establish barely functioning, but legal factories in promoted regions. The only production that takes place there is the sticking of labels. Tax reimbursement claims are, however, for the entire value of the output.

Such a complex system of subsidies and a questionable system to control their allocation and use go a long way toward explaining why researchers have failed to find convincing evidence in favor of export subsidies. To borrow from Rodrik (1993), "the received wisdom on export subsidies is that they have not been effective." We believe that this may, at least partially, be explained by the fact that most of the work on the impact of export subsidies has been done using country- and industry-level data when in reality subsidies are negotiable on a case-by-case basis. As such, these analyses have failed to take

into account the potential misallocation or misuse of export subsidies when looking at their effectiveness.

This study is motivated by the substantial variation in government support received by individual firms in Colombia during 1981-1991: while the median size of subsidies per peso of export sales was around 8-10 percent, they could be as small as two and as high as twenty percent, with a number of firms reporting subsidies in excess of a quarter of export sales. We interpret such variation in subsidy rates as a sign that export subsidies may not have been designed to support the industry or the region as a whole, but to grant assistance to particular firms.

We address the following four questions: (1) what proportion of obtained subsidy amounts can be explained by the publicly available allocation rules, (2) what type of firms obtain export subsidies, (3) whether subsidies induce increases in export volumes and (4) how the effectiveness of subsidies change depending on the discrepancy between the predicted and the observed amounts.

We use a two-stage Heckman selection procedure to obtain firm-specific predicted subsidy amounts that could be explained by the characteristics that determine the firms' eligibility for the government support and its amount. Drawing on the accounts of the discretionary allocation of subsidies in developing countries, we regard the discrepancy between the predicted and the observed subsidy amounts as a proxy for the firm's ties to government officials.

Our evidence suggests that allocation of subsidies is more complex than suggested by the literature based on the industry-level analyses. Subsidies are firm-specific, with different factors affecting the allocation and the amount decisions. Many firm characteristics mentioned in the publicly available allocation rules do not seem important. Finally, we find that although, in general, subsidies exhibit positive impact on export volumes, this impact is diminishing in subsidy size and in the degree of firm's connectedness to government officials.

## 2. Theoretical Framework

Our framework is based on the dynamic model of the participation in export markets in the presence of sunk costs (Roberts and Tybout, 1997), which postulates that a decision to export depends on prior exporting experience.

A subsidy in our model is linked directly to the export volumes and represents an increase in the price and, hence, the attractiveness of exports relative to domestic output (Hoffmaister, 1991). An empirical prediction following from this relationship is that a subsidy will induce an increase in exports of the incumbent exporters.

Although a subsidy is conditional on the participation in export markets, it can, in principle, affect the decision to start exporting. The impact can go through two channels. First, assuming firm-specific sunk costs of entry (for example, due to the different requirements for the product quality upgrading faced by individual firms), the aforementioned increase in relative prices will translate into higher expected profits in export markets for some firms and will induce the marginal non-exporters to enter the export market by loosening their financial constraints. Second, in an environment with limited capacity to monitor the disbursement and the use of the subsidies, some firms will have incentives to report fictitious export sales or even start exporting, if only to obtain access to the government funds. However, it would be difficult to disentangle empirically fictitious exports from those based on the optimal allocation decision of a profit-maximizing firm.

Government funds are available for all exporters. This assumption, however, is based on firm homogeneity and does not agree with the empirical observation that some exporters (approximately 20 percent in our sample) do not receive government support. There are several explanations for the observed pattern. First, in case of limited funds, subsidies may be allocated based on the “first come, first served” rule. In this case subsidies are likely to be given to the firms with better access to the information regarding the availability of the funds.

Alternatively, administrative hassle to obtain subsidies may discourage some firms from applying for government support. We suggest that both access to information and ability to deal with administrative hassles would be highly correlated with the firm's connectedness to government officials distributing the funds and with the obtained subsidies amount. Empirically this would be reflected in differences in firm-specific subsidy rates that cannot be justified by the interactions of various allocation rules.

Hence, we break down the variation in firm-specific subsidy rates into two components. The first, perfectly legal, is driven by the complexity of the existing export promotion schemes. In this case the firms will receive different amounts of subsidies depending on the firm's industry, location, use of imported materials or machinery, or the destination of its exports (see section 4 for the institutional details on the export promotion schemes in Colombia).

The second component stems from the degree of the firm's connectedness to the government officials who distribute the funds. Bergström (1998), Bagella et al. (2003), and Blanes and Busom (2004) link the likelihood of a firm receiving a subsidy to various measures of the firm's political weight (for example, lobbying capacity) and find considerable discretion on the part of policy makers in the allocation decisions. Anecdotal evidence suggests that this component may be particularly important in Colombia. According to Pegurier and Salgado (2002), the policies that gave governments discretionary power to set very uneven tariffs, also allowed for the arbitrary disbursing of subsidies: "There was no real quest for efficiency. Instead, as had happened to protectionist measures for industry, support for exports became the source of rent through wasteful privilege-seeking activities."

There are two assumptions underlying our identification strategy. First, we assume that the amount of the received support is proportional to the degree of the firm's connectedness. That connected firms are not only more likely to receive subsidies but also receive larger subsidies is true even in industrialized countries (Bertrand et al., 2004). We

have also seen above that it was certainly the case in Kenya. In 1998 Colombia's TI Corruption rank was 79 (out of the participating 85 countries) with a score of 2.2 (a perfect 10 describes a totally corruption-free country), thus ranking worse than Kenya with an index of 2.5. Hence, our assumption is not entirely ungrounded.

We also assume that subsidies, assigned at the discretion of the officials disbursing the funds, have no discernible positive impact on export performance. In fact, the impact may be negative if subsidies result in a costly competition among firms, whereby stronger lobbying for a subsidy by one firm requires other firms in the industry to lobby harder to get a given amount of support (Mitra, 2000) or if the firm spends considerable amounts of resources on lawyers or bookkeepers that would be able to decipher the complicated rules of the export promotion schemes and concoct ways of obtaining access to the government funds. How plausible is this assumption? Export subsidies in Korea, for example, were also granted on a case-by-case basis at the discretion of the government officials. Yet Korea represents one of the most successful examples of export promotion policies. One should note, however, that in Korea government officials set firm-specific export targets in exchange for subsidies and remained in nearly daily contact to ensure that those targets were met. This was not the case in Colombia (or any of Latin America).

Based on this framework, we speculate that disproportionately large subsidy rates are the result of nepotistic connections between firms and authorities in charge of the allocation of subsidies and, hence, ineffective. We then test empirically whether the responsiveness of the Colombian exporters to the subsidies is consistent with our conjectures.

## 3. Related Literature

While the theory predicts that export subsidies will increase exports, many practical issues, such as the political environment, administrative capacity to monitor their distribution and

use, etc. may interfere with their impact. The search for evidence on their effectiveness has thus been left to the empirical analyses.

There has been considerable empirical interest in the effectiveness of export subsidies in developing countries (Frank et al.,1975, Low, 1982, Jung and Lee, 1986, Nogués, 1989, Hoffmaister, 1991, Arslan and van Wijnbergen, 1993, Faini, 1994 and Moreira and Figueiredo, 2002). The results of these studies are conflicting, with the verdict overall coming out negative. Low (1982) documents the failure of the subsidy scheme in Kenya. He attributes the disappointing effect of the program to the poor implementation by, and the significant discretionary decision-making of, the bureaucrats in charge of allocating government grants. Arslan and van Wijnbergen (1993) attribute improvements in Turkey's export performance to a depreciation of the exchange rate rather than export subsidies. Nogués (1989) concludes that export subsidies in Argentina only increased allocative inefficiency, reinforced oligopolistic market structures, and provided incentives for rent seeking. While he acknowledges some positive impact of export subsidies in the case of Brazil (later supported by Moreira and Figueiredo (2002)), he argues that the success relied crucially on accompanying macroeconomic stabilization and import liberalization. He also points out that Mexico achieved a comparable positive export performance without relying on costly subsidies. Similarly, Hoffmaister (1991) finds a positive effect of a tax credit scheme in Costa Rica on exports, but concedes that, from a cost-benefit point of view, export subsidies have been a disproportionably costly way of achieving the rise in exports.

All of the aforementioned studies are based on industry-level data. Their major shortcoming is that they do not allow any conclusion with regard to firm-specific characteristics influencing the success of export subsidy schemes. However, firm-level analysis of export subsidies is scarce for developed and non-existent for developing countries. Bernard and Jensen (2004) test the effect of export subsidies on the exports of US firms by including an "export promotion" variable in their empirical specification analyzing firms'

decision to export. Using export promotion expenditures at the state level, they find that subsidies are neither economically important nor statistically significant. Görg et al. (2006) analyze the role of firm-specific subsidies in encouraging export activity in Ireland during 1986-2002 and find that subsidies, when sufficiently large, increase firms' exports but do not influence the decision to export.

One should note that these two studies have been conducted on a set of countries with a business environment unrepresentative of a developing country and a much better administrative capacity to control the distribution of funds. We enrich the existing firm-level evidence by providing an account of the effectiveness of export subsidies in a developing country with a limited capacity to monitor the disbursements of funds and their intended uses.

## 4. The Regulatory Framework for Export Subsidies in Colombia

The export promotion scheme in Colombia during 1981-1991 was complex. Specifically, the range of subsidies that have been available to individual firms included a reimbursement for the firms with exports exceeding the value of the imported raw materials; a reimbursement for firms importing at least 60 percent of the raw materials; a reimbursement for the firms importing machinery and equipment; a reimbursement for the firms exporting over 60 percent of their production; a reimbursement for the firms who have been participating in the export promotion schemes for at least 3 years; a reimbursement for the firms located in the free economic zones (Santa Marta, Barranquilla, Cartagena, Candelaria, Cúcuta, Río Negro, Eje Cafetero, Pacífico, Bogotá and Palma Seca); an additional tax reimbursement in proportion to the total value of indirect taxes. Finally, distinct reimbursements were given to the firms with the exports exceeding 2, 3 or 20 million US dollars. Export promotion funds were also available to the firms operating in domestic market which produced intermediate goods for the exporters. However, their number was very small in our sample (see the data section).

The subsidies were paid in one installment in the period concurrent with the rewarded exporting activity. A small portion of the sample also reports export taxes to be reimbursed by the government. We include those as part of the overall exports incentives package.

The bottom line of this discussion is that the rules varied by industry and location and the exact subsidy amount was identified on a case-by-case basis by the taxation and customs officers. Although our data do not distinguish between the various export promotion measures available to each firm, we attempt to control for most features with the available information.

Before proceeding to the data analysis, we would like to emphasize the scheme's potential for abuse. Díaz and Escudero (2002) report that the introduction of the Tax Reimbursement Certificate CERT in 1983 was motivated mainly by the fraud opportunities (reimbursement on fictive exports) provided by the former certificate. Although we do not have citations on other export promotion measures, it is nevertheless plausible that they were just as prone to abuse. Moreover, it is unlikely that the new tax reimbursement certificate was immune to fraud.

## 5. Data, Sample Selection and a Preliminary Look at the Data

Our data come from the 1981-1991 panel of the Annual Manufacturing Surveys (AMS). The AMS data covers all manufacturing plants with ten or more workers.[2] Among other things, the AMS reports values of production, domestic and foreign sales, imported and domestically purchased intermediate inputs, wage bills by skill category, capital stocks, ownership,

[2] The manufacturing industries used in this study and their respective ISIC codes are: 311 (food products), 312 (other food products), 321 (textiles), 322 (clothing and apparel), 323 (leather products, excluding clothing and shoes), 324 (leather shoes), 241 (paper), 342 (printing and publishing), 351 (industrial chemicals), 352 (other chemicals), 356 (plastic products), 362 (glass products), 369 (other products of non-metallic minerals), 381 (metal products), 382 (machinery), 383 (electronic machinery and equipment), 384 (transportation equipment), 390 (miscellaneous manufacturing, such as jewelry, musical instruments, sporting goods, etc.).

location, and subsidies. Roberts and Tybout (1996) provide a more comprehensive description of the data.

A look at the raw data reveals several patterns regarding the provision of subsidies in Colombia. With the exception of food production, each of the export-oriented industries is heavily subsidized – 70 to 80 percent of all exporters receive government assistance and the percentage of exporters receiving subsidies remains fairly stable across years. Graphs 1-3 suggest substantial variation in government support received by individual plants: while the median size of subsidies per peso of export sales is around 8-10 percent, it can be as small as 2 and as high as 20 percent, with many firms reporting subsidies amounting to more than a quarter of export sales[3]. The increase in the subsidy rates in 1984 and 1985 (Graph 2) is due to a significant change in the composition of government support during these years. Tax rebates and export pre-financing became unimportant, whereas direct subsidies received greater weight (Ocampo and Villar, 1995). Note that it is also during these two years that the subsidy rates exhibited the largest variability, probably reflecting different rates at which the firms complied with the new rules.

The large number of outliers jumps to an eye. Although we clean the data to exclude erroneous observations and extreme outliers, we use a rather relaxed rule to define outliers and choose to keep the information on the plants receiving unusually generous amounts of subsidies relative to their export sales as depicted in Graphs 1-4.[4] The main reason behind this decision is reports on unclear and often discretionary rules to obtain export subsidies in Colombia. We want to know whether such, potentially inappropriate, discretionary handouts from the government affect the recipient's exporting behavior (and we anticipate the answer to be negative).

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[3] In this part we present the data on subsidies in terms of subsidy rates, i.e. the amount of government support per peso of export sales. Since numerous factors determine absolute subsidy amounts, looking at their variation without taking those factors into account, would be pointless.

A closer look at Graph 3 suggests that location may play a role in whether a plant is likely to obtain a disproportionately high subsidy – Bogota and Medellin seem to have the highest number of "outliers". Both areas, of course, are the epicenter of economic activity in the country and have the largest number of plants both exporting and non-exporting. The ratio of exporters to non-exporters, or percentage of exporters receiving subsidies, however, does not make these cities stand out from the rest of the country. Considering that Bogota is the capital city of the country and Medellin is the second largest city, very close to Bogota geographically, one may not eliminate the possibility that it is in these cities where the decisions on public funding are of most politicized and discretionary nature.

The data set contains 1423 firms who have exported at some point during the sample period. Only 146 of those have never received any subsidies. The rest have obtained subsidies at some point, although not necessarily during each year of foreign market participation – 301 plants report zero export subsidies along with positive export volumes. Summary characteristics of the key variables are provide in Tables 1 and 2. Apart from the variation in the subsidy rates, there appears to be no difference between the firms in our sample.

## 6. Empirical Strategy

In this paper we strive to answer the following questions: (1) what proportion of obtained amounts can be explained by the publicly available allocation rules, (2) what type of firms obtain government support, and (3) how the receipt of disproportionately high subsidies affects their effectiveness in stimulating exports. We explain below how we tackle each of the questions.

*A. How Much Variation in Subsidies Is Explained by the Allocation Rules?*

[4] We define an outlier according to the rule "Q1-2*IQR" or "Q3+2*IQR".

We use analysis of variance (ANOVA) to determine the proportion of the total variation that can be explained by the various allocation criteria. We apply ANOVA stepwise: we start by the most obvious characteristic, exporting status; we continue by considering other common criteria such as industry, location and year; we then add firm-specific characteristics described in the session on the subsidies allocation rules in Colombia; finally, we add firm specific fixed effects to see how much of additional variation can be explained by time invariant firm specific unobservable factors. Each step tells us how much of the total variation is subsidies can be attributed to the addition of the relevant allocation rule. The goal of this exercise is to illustrate the degree of the explanatory power contained in the various criteria.

*B. Allocation of Export Subsidies*

To determine which firms obtain subsidies we model the allocation rule as follows:

$$\ln Subsidy_{ijt} = \beta_0 + \beta_1 \ln Exports_{ijt} + \beta_2 \ln Exports_{ijt}^2 + \gamma Z_{ijt} + \varepsilon_{ijt} \qquad (1)$$

Vector Z contains information on the extent to which each firm satisfies the eligibility requirements for the various reimbursements. Thus, to account for the features of the export promotion scheme described earlier, we use a ratio of export volumes over the amount of the imported raw materials; the amounts of purchased and used foreign raw materials and the share of foreign raw materials in total (since different allocation rules apply to these three characteristics); the amount of imported machinery and equipment and export intensity of the firm. Although we have information on the exact threshold exports amounts, beyond which the firms qualify for different subsidy amounts, we find that including a linear and a quadratic terms on export volumes is a better alternative to a set of dummy variables identifying various thresholds. We use industry dummies to account for the possibility that the government may have differential stimuli for some goods (for example, “non-traditional exports”), as well as for the possibility that the subsidies in some industries were introduced to neutralize the

effects of tariffs. Moreover, we use year dummies to control for the occasional modifications in the existing export promotion measures.

Since the receipt of subsidies is conditional on being an exporter, we use Heckman two-stage selection model to estimate the allocation rule. The basic idea is that the subsidy is only observed for currently exporting firms. Hence, in the first stage a dichotomous variable, equal to 1 for exporters and 0 otherwise, determines the non-zero value for the subsidy. In the second stage, we model an expected value of the subsidy given that a firm has exported in a given period. Along with the variables described above, the first stage equation also contains an indicator variable equal to one for the firms who were exporting in the previous period. Given high persistence in exporting behavior, firms who exported a year ago are very likely to export in the current period, i.e. to satisfy the main qualification for obtaining subsidies. The knowledge about the exporting status of the firm in the past, however, tells us nothing about the export volume, i.e. the main determinant of the subsidy amount.

The implicit assumptions here are that (1) the allocation of subsidies is a two-stage decision, (2) the allocation decision may be fundamentally different from the amount decision and (3) if exporters with zero reported subsidies applied for government support, they would have obtained it.

*C. Estimating Connectedness*

Ideally, we would like to have exact information on the nepotistic and political connections between the firms' managers and the government officials distributing the funds. Unfortunately, such information is unavailable to us. Different proxies of the firm's connectedness have been proposed in the literature for the data sets similar to ours, i.e. void of the exact identifier for the firm's connectedness. Bergström (1998) and Bagella et al. (2003), for example, use firm's labor force to proxy for the firm's lobbying capacity. The results from Chaney et al. (2007) suggest that the variation in the firm's reported sales can act as a

good proxy for the firm's political connectedness as politically connected firms provide significantly lower quality sales data than their unconnected peers.

We do the following. From the Heckman estimation described in part B above, we obtain predicted values for the export subsidies and compare those to the observed subsidy amounts. We do so by taking the ratio of the observed to the predicted subsidies amount. This is our proxy for "connectedness" to be used in the rest of the analysis. By construction, the ratio is normally distributed with the mean of 1, however, it is skewed to the right because of unusually high subsidy amounts obtained by some firms. How do we explain the fact that about half of the observations obtain less than what should be granted to them based on their characteristics and the allocations rules? We explain it by incomplete information regarding the allocation rules and it is more than plausible that lack of information is linked to the firm's connectedness: the better connected the firm, the more it is aware of its eligibility for government support and the best connected firms are able to receive more than what they qualify for.[5]

*D. Estimating the Impact of Subsidies on Export Performance*

To answer the question of how the receipt of disproportionately high subsidies affects their effectiveness in stimulating exports, we estimate an equation that models future exporting behavior as a function of current government support:

$$\ln Y_{ijt} = \alpha_0 + \alpha_1 \ln Y_{ijt-1} + \beta_1 \ln Subsidy_{ijt} + \beta_2 \ln Subsidy_{ijt}^2 + \beta_3 Connectedness_{ijt} + \beta_4 Subsidy_{ijt} * Connectedness_{ijt} + \delta X_{ijt} + \eta_j + \varphi_t + \mu_{ijt} \quad (2)$$

Volume of exports for firm i in industry j and year t is regressed on the subsidy amount, the interaction term identifying the connected firms and firm characteristics. We draw on the extensive literature on firms' export supply to select additional controls for equation1. $X_{ijt}$ is a vector of variables that have been suggested as potentially important

[5] We will also report the findings obtained by releasing this assumption.

determinants of exporting behavior and includes measures of plant's size (logarithm of employment), labor productivity (real output per worker), market share (firm's sales as a percentage of total industry's sales), and dummy variables to identify the firm's ownership structure, its location, industry and year effects.

The coefficients $\beta_1$ and $\beta_2$ measure incremental returns to attracting government support, whereas $\beta_4$ measures how the impact of the subsidies on the export promotion depends on the firm's connectedness. The overall impact of subsidies on exports is $\beta_1 + 2\beta_2 * \text{Subsidies}_{mean} + \beta_4 * \text{Connectedness}_{mean}$. In case connectedness reduces the effectiveness of subsidies in promoting exports, $\beta_4$ will be negative.

The presence of the lagged dependent variable on the right hand side of the estimating equation determines our choice of the estimation procedure. Following the convention, we use System GMM. An additional advantage of using System GMM is that it allows the right hand side variables to be endogenous to the past and present (but not future) values of the dependent variable. Given that subsidies is a direct function of exports, this is particularly important in our case.

## 7. Results

Table 3 reports the findings from the ANOVA analysis and breaks down the total variation in subsidy rates in separate components. Thus, forty six percent of total variation can be explained by the exporting status of a firm. Once we concentrate on exporters only, exports are very bad at explaining the variation in the subsidy rates (adjusted R-squared of 0.00). Industry and region are not much better. It is when we include the year effects that the adjusted R-squared increases to 13 percent. The next biggest contributor to the explanation of the total variation in subsidy rates is unobserved plant-specific fixed effect which increases the total amount of explained variation to 31 percent. The point of this exercise is to show that

much of the variation in subsidy rates remains mystery and cannot be accounted for by the linear relationship with the observable firm characteristics.

Table 4 reports our more detailed findings regarding the factors that affect the allocation process. In column (1) we report the findings from the OLS regression that ignores the censored nature of the dependent variable and the potential selection bias. In column (2) we report the findings from the probit regression in which we model the decision of the firm to apply for export subsidies, with an additional regressor – previous period's exporting behavior – that we believe to affect the receipt of the subsidies, but not their amount. In column (3) we re-estimate the OLS regression with the Inverse Mills Ratio obtained from the probit regression in column 2 as an additional regressor. In columns (4) and (5) we report the results of the Heckman Maximum Likelihood estimation. For comparison, in colums (6) and (7) we report the findings from the Heckman Two-Step procedure. The Two-Step Heckman estimates a probit in the selection stage and OLS in the regression stage and, even if the model is correctly specified, the Two-Step model may be inefficient compared to the full maximum likelihood counterpart. Apart from comparison to the ML model, the Two-Step model provides the test for the presence of the selectivity bias. If the null hypothesis of no selectivity bias is rejected, it is recommended to use the ML estimation (Davidson and McKinnon in Johnston and DiNardo 1997:450). In our case, the Wald Test strongly rejects the hypothesis that the correlation coefficient between the selection and regression stage equals zero, which confirms the validity of the Heckman selection.

For the sake of completeness, we also conduct estimations using Tobit and find that, with few exceptions, the significance and sign of coefficients are not qualitatively different from those obtained by the Heckman Selection models. We estimate both a simple Tobit and a Random Effects Tobit. A comparison of those results indicates that the panel-level variance component is important and that the panel estimator is different from the pooled estimator.

The variables that consistently increase the propensity to receive export subsidies are past exporting experience, current volume of exports (although the return to export volumes is decreasing, as indicated by a negative and significant coefficient on the squared term), amount of indirect taxes (which may be indicative of a tax refund element of the export subsidy scheme), ownership status (limited partnerships, and in some specifications corporations, are more likely to obtain subsidies than other ownership forms), and firm's location in the two of the four largest cities of the country – Medellin and Bucaramanga – or in the rest of the country where some of the free economic zones are located (we cannot identify more precisely the location of firms in the free economic zones listed in the section on the allocation rules of subsidies in Colombia).

The impacts of the aforementioned factors are distinct in the two stages of the allocation decision. The firms with a smaller market share, for example, are less likely to receive subsidies, however, those that do, they receive larger amounts than bigger firms. Firms paying higher indirect taxes, are more likely to receive subsidies, but the amounts obtained are smaller. Firm's location is important for the propensity to receive subsidies, but not for the obtained amounts. In years 1983-1985 firms are no more likely no obtain subsidies than in 1981, but an average recipient gets substantially higher amounts. Starting in 1987, there is some evidence of the decreasing subsidy amounts, which corresponds to the government attempts to reduce, if not eliminate, export subsidies. By 1990, the amounts decrease below the 1981 level and, by 1991, fewer firms apply and/or qualify for subsidies.

Curiously, none of the factors that we know to be part of the allocation rules, apart from the volume of exports, affects the propensity to obtain subsidies and only few affect the obtained amounts. The amount of foreign raw materials is positively correlated with the obtained amounts, but the share of the foreign raw materials in total is negatively correlated with the obtained amounts. This finding is in sync with the allocation of subsidies to the firms who satisfy the minimal requirements on the use of imported raw materials, but still favor

domestic suppliers. This rule is common in developing countries, where governments attempt to reinforce the backward and forward linkages between the industries.

Overall, we find that although firm characteristics explain variation in subsidy amounts (Adjusted R-squared from the OLS regression is 0.87 percent), many of the anticipated effects are insignificant. In graph 5 we plot the predicted subsidy amounts from the Heckman ML estimation against the observed amounts and in graph 6 we provide a box plot of the ratio of the observed subsidies over the predicted. By construction, the ratio is centered around 1, with a long positive tail. The positive outliers indicate the observations where the firms obtain unusually high subsidy amounts compared to what they should be getting based on their characteristics.

As explained earlier, we use this difference between the observed and predicted subsidy amounts as a proxy for firm's connectedness to government officials. An implicit assumption that we are making here is that all firms receiving subsidies are connected to the government officials, although to a varying degree. That is, the observations indicated as blobs in the lower part of graph 6 are those firms who, although connected enough to get some support, are not connected enough to obtain full information about the availability of the funds and the allocation requirements, and hence, do not receive the amounts that are due to them based on their characteristics.

Having constructed the ratio of the observed subsidies over predicted, we use it as a proxy for connectedness to estimate equation 2.[6] The results of this analysis are reported in Table 5, column (1). First, we confirm the strong persistence nature of the exporting behavior – the coefficient on the lagged dependent variable is positive and highly significant.

[6] We end up excluding other explanatory variables, such as plant's size, labor productivity, and market share from our final regressions reported in Table 5 because of low significance levels.

You will notice that we estimate the immediate and the lagged effects of subsidies on exports. This specification is driven primarily by the finding that without contemporaneous AND lagged subsidy amounts on the right hand side of the equation, we fail the Arellano-Bond test of second-order autocorrelation, which must be absent from the data for the estimator to be consistent. We find that subsidies have an immediate positive impact on exporting behavior, this impact is decreasing in the amount of the subsidy, and it is short-lived. In line with our hypothesis in section 6 of the paper, $\beta_4$, the coefficient on the interaction term, is negative. That is, the effectiveness of subsidies decreases as the gap between the observed and the predicted subsidy amounts increases.

Since we are predominantly interested in the unusually high subsidy rates, we have repeated the analysis in which we truncated the ratio of the observed subsidies over predicted at 1. That is, we have allowed "connectedness" to exist only for the firms whose observed amounts are higher than the predicted. There is a serious issue with this procedure, however. We need to make an arbitrary decision as to how to treat the firms with lower than predicted subsidy amounts. If we assign the value of zero for every firm that is reporting a ratio below 1 (Column (2)), we assume that there is no difference between the firms not receiving any subsidies or receiving less than what they should. Making a distinction between them requires that we chose a different value. We could pull the value of the ratio down to the minimum observed ratio, 0.01, for all firms with the ratio less or equal to one (Column (3)). Alternatively, we could pull the ratio up to 1 (Column (5)). Experimenting with various truncation points supports our findings that subsidies have a positive immediate impact on exports and that the impact becomes smaller as subsidies increase. The coefficient on the interaction term, however, loses its significance.

## 8. Conclusions

We find that subsidies have a positive impact on export performance, but it is decreasing in the amount of the received assistance and depends negatively on the degree of the firm's connectedness to the government officials. Economists are mostly opposed to export subsidies because they are (1) not well targeted, (2) not easy to administer, and (3) open to rent-seeking. In this paper we have explored the allocation of export subsidies in Colombia. Our evidence suggests that one or all the conjectures put forward by economists could be in action. First, allocation of subsidies is more complex than suggested by the literature based on the industry-level analyses. Subsidies are firm-specific, with different factors affecting the allocation and the amount decisions. Many firm characteristics mentioned in the publicly available sources regarding the allocation rules do not seem important. Finally, there is a lot of unexplained variation in the subsidy rates obtained by various firms.

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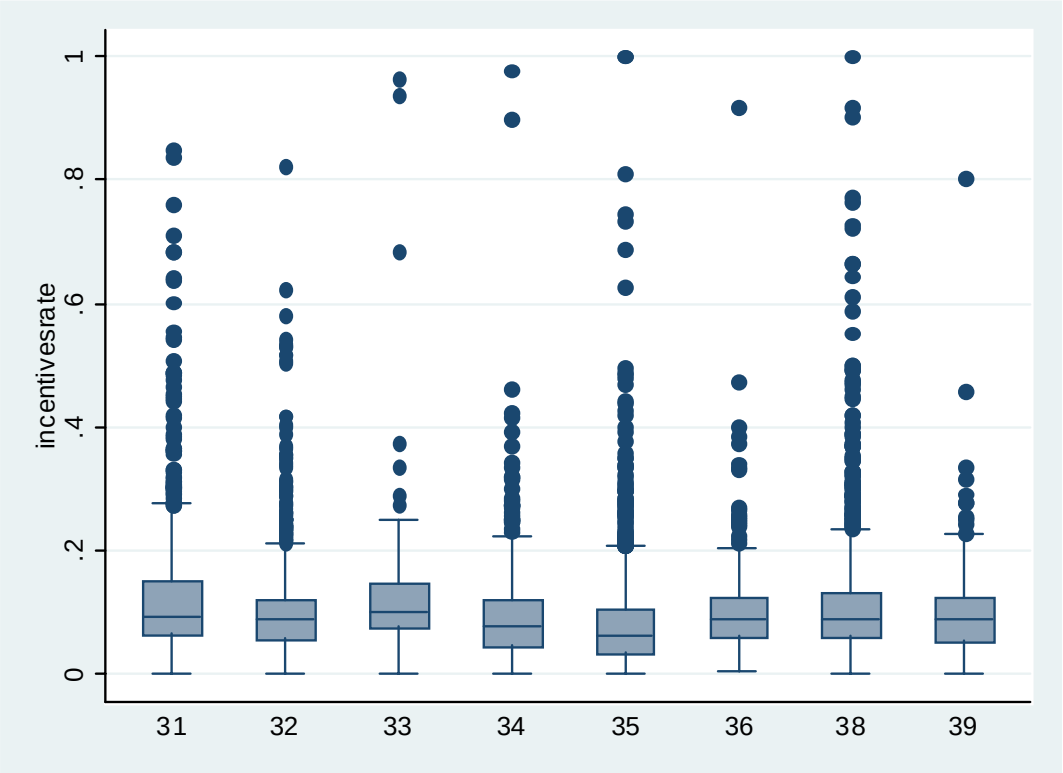
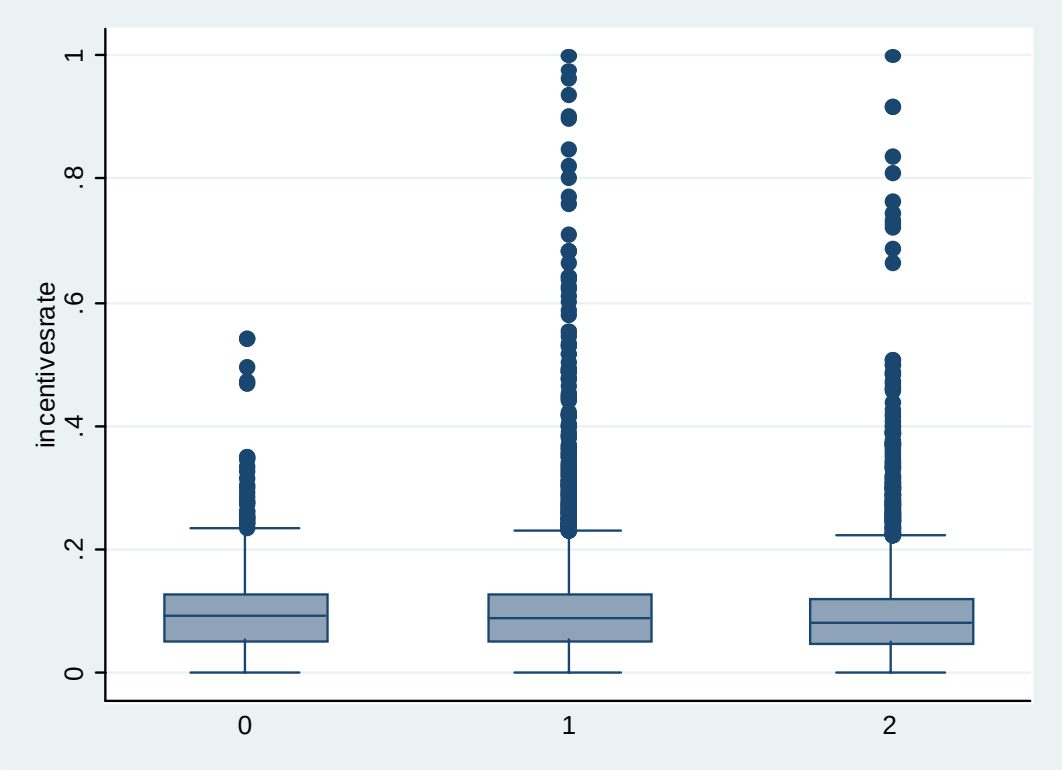
Graph 1: A box plot of export subsidy rates by 2-digit SIC industry

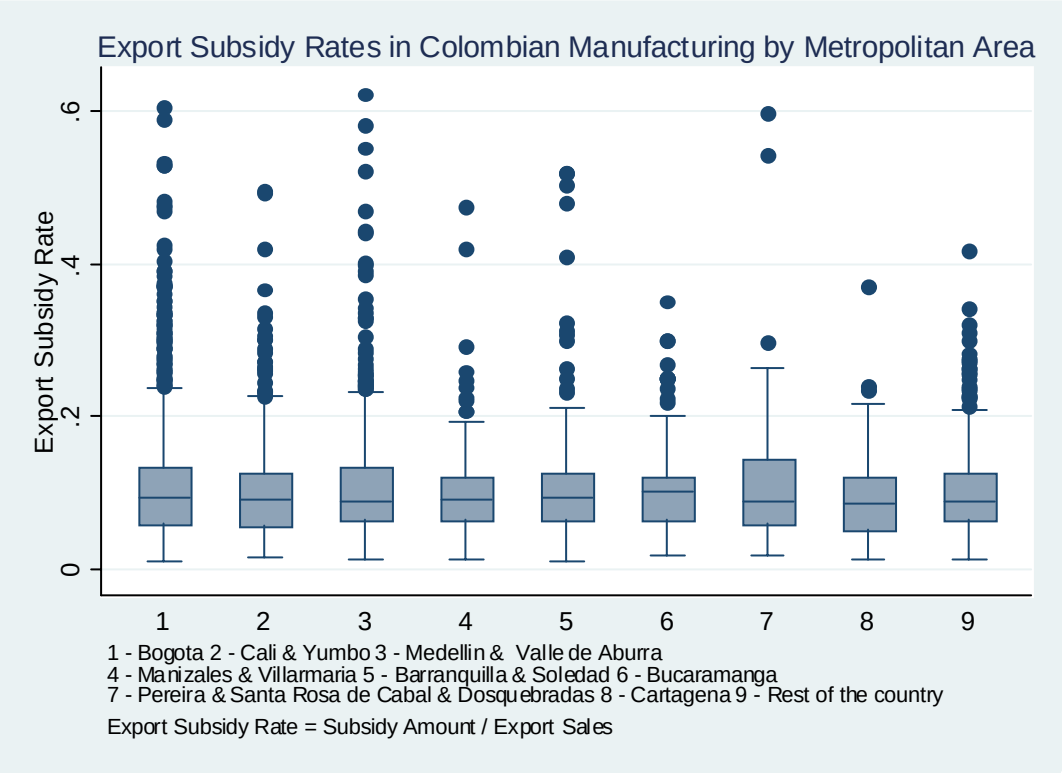



Graph 2: A box plot of export subsidy rates by ownership with outliers identified as blobs

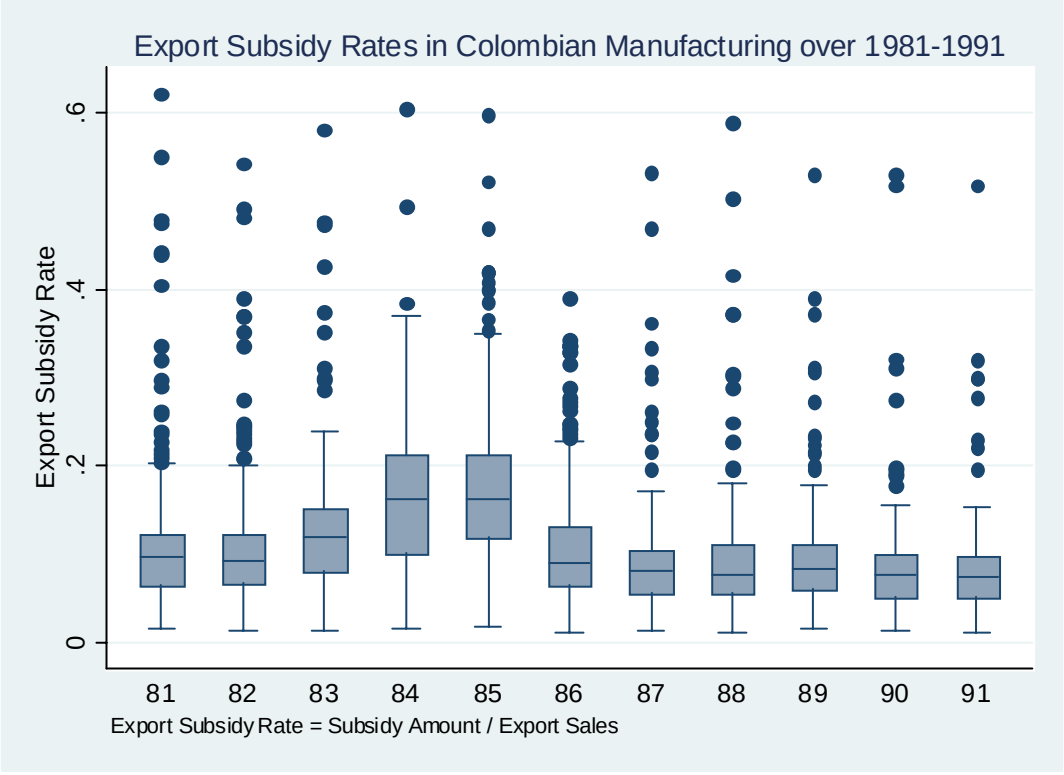



1 – limited partnership, 2 – corporation, 0 – other.

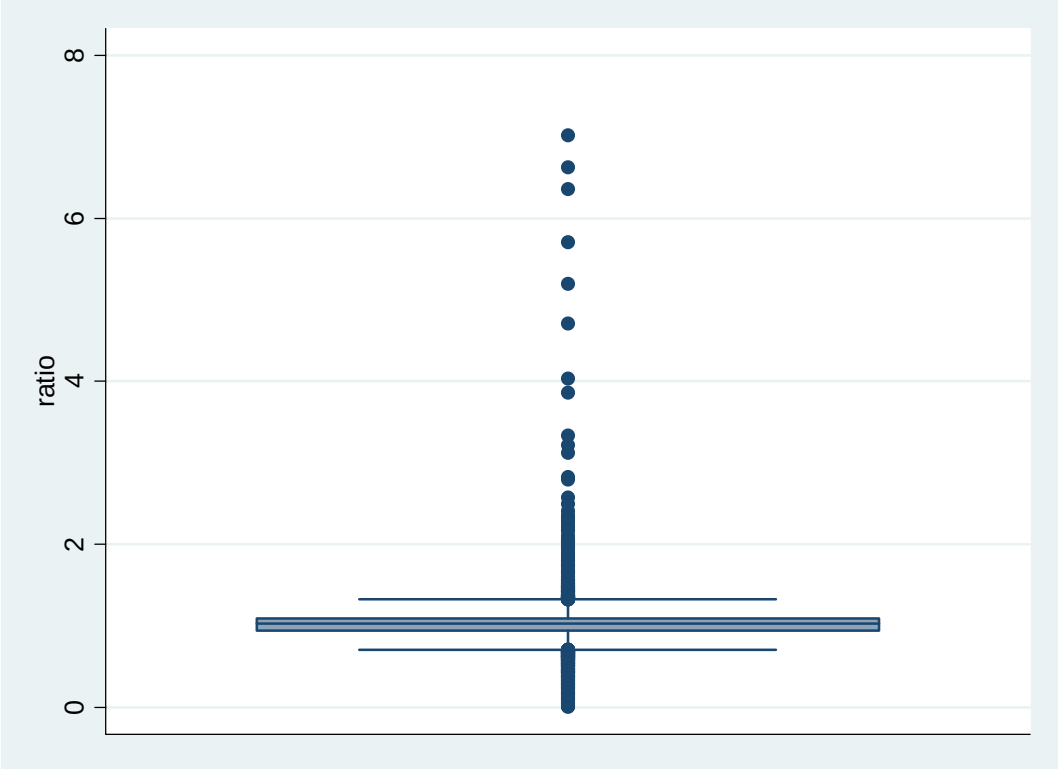
Graph 3: A box plot of export subsidy rates by metropolitan area with outliers identified as blobs




Graph 4:



Graph 5: A box plot of the ratio of observed subsidies over predicted




Graph 6

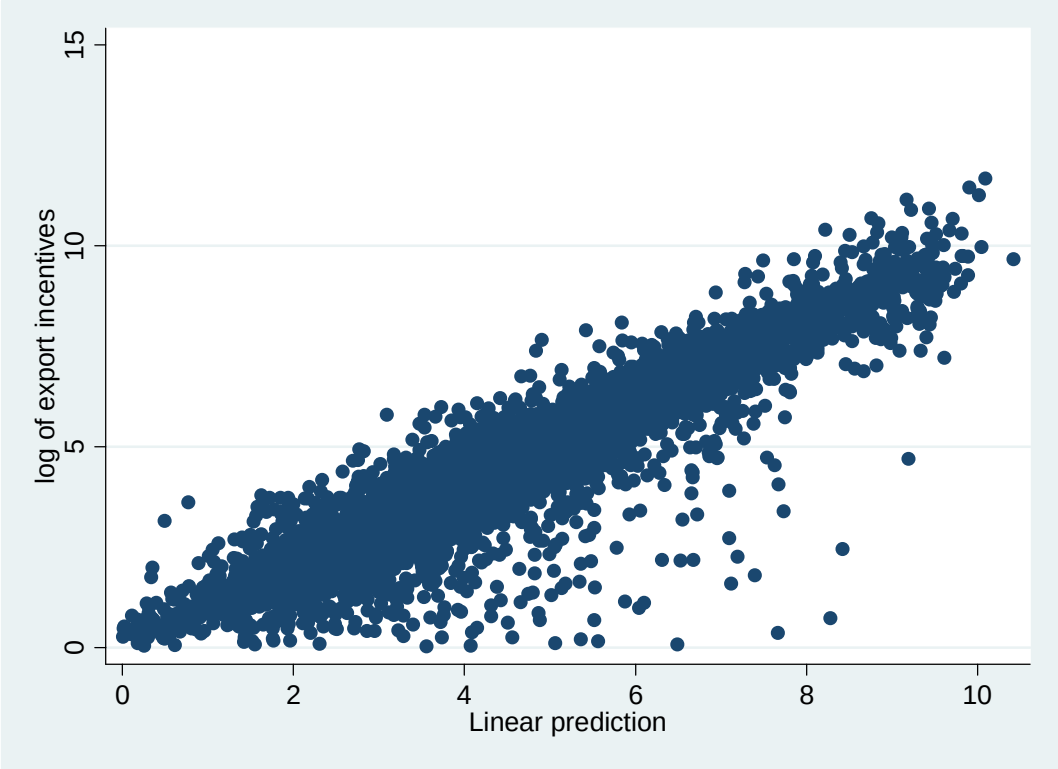


Table 1: Summary Statistics (N, mean, standard deviation)

| | **Exporters with Subsidies** | | | **Exporters Without Subsidies** | | |
|---|---|---|---|---|---|---|
| Ln(Incentives) | 6033 | 4,695 | 2,126 | 831 | 0,000 | 0,000 |
| Ln(Exports) | 6033 | 7,206 | 2,122 | 831 | 6,435 | 2,714 |
| Ln(Total Labor) | 6033 | 4,609 | 1,225 | 831 | 4,440 | 1,204 |
| Ln(Indirect Taxes) | 6033 | 7,194 | 2,324 | 831 | 6,195 | 3,132 |
| Market Share | 6033 | 0,022 | 0,053 | 831 | 0,025 | 0,076 |
| Ln(Purchases of New Machinery) | 6033 | 4,763 | 3,072 | 831 | 4,413 | 3,103 |
| Ln(Purchases of Foreign Raw Materials) | 6033 | 4,969 | 4,366 | 831 | 3,929 | 4,340 |
| Ln(Use of Foreign Raw Materials) | 6033 | 9,047 | 1,759 | 831 | 9,106 | 1,935 |
| Ratio of Exports Over Imports | 6033 | 2,721 | 2,919 | 831 | 1,368 | 1,126 |
| Share of Foreign Raw Materials | 6033 | 0,242 | 0,299 | 831 | 0,189 | 0,287 |
| Export Intensity | 6033 | 0,212 | 0,273 | 831 | 0,195 | 0,315 |
| Ln(Labor Productivity) | 6033 | 5,276 | 1,080 | 831 | 5,461 | 1,312 |
| | | | | | | |
| | **Subsidy Rate Under 0.20** | | | **Subsidy Rate Above 0.20** | | |
| Ln(Incentives) | 5481 | 4,632 | 2,103 | 552 | 5,319 | 2,247 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ln(Exports) | 5481 | 7,275 | 2,093 | 552 | 6,517 | 2,278 |
| Ln(Total Labor) | 5481 | 4,626 | 1,231 | 552 | 4,442 | 1,162 |
| Ln(Indirect Taxes) | 5481 | 7,263 | 2,255 | 552 | 6,514 | 2,834 |
| Market Share | 5481 | 0,022 | 0,054 | 552 | 0,018 | 0,043 |
| Ln(Purchases of New Machinery) | 5481 | 4,829 | 3,071 | 552 | 4,107 | 3,006 |
| Ln(Purchases of Foreign Raw Materials) | 5481 | 5,033 | 4,364 | 552 | 4,333 | 4,335 |
| Ln(Use of Foreign Raw Materials) | 5481 | 9,053 | 1,765 | 552 | 8,986 | 1,700 |
| Ratio of Exports Over Imports | 5481 | 2,831 | 3,021 | 552 | 1,629 | 1,582 |
| Share of Foreign Raw Materials | 5481 | 0,245 | 0,301 | 552 | 0,213 | 0,276 |
| Export Intensity | 5481 | 0,213 | 0,269 | 552 | 0,209 | 0,317 |
| Ln(Labor Productivity) | 5481 | 5,270 | 1,066 | 552 | 5,333 | 1,209 |

Table 2: Plant characteristics (N, mean, standard deviation) by Subsidy Category

| | Subsidy Rate Under 0.05 | | | Subsidy Rate Above 0.05 and Below 0.10 | | | Subsidy Rate Above 0.10 and Below 0.15 | | |
|---|---|---|---|---|---|---|---|---|---|
| Ln(Incentives) | 1342 | 3,702 | 2,007 | 2341 | 4,880 | 2,035 | 1350 | 4,935 | 2,034 |
| Ln(Exports) | 1342 | 7,373 | 2,013 | 2341 | 7,435 | 2,099 | 1350 | 7,011 | 2,103 |
| Ln(Total Labor) | 1342 | 4,609 | 1,191 | 2341 | 4,690 | 1,262 | 1350 | 4,519 | 1,203 |
| Ln(Indirect Taxes) | 1342 | 7,514 | 2,258 | 2341 | 7,394 | 2,237 | 1350 | 6,870 | 2,174 |
| Market Share | 1342 | 0,022 | 0,058 | 2341 | 0,023 | 0,055 | 1350 | 0,019 | 0,048 |
| Ln(Purchases of New Machinery) | 1342 | 5,166 | 2,954 | 2341 | 5,011 | 3,096 | 1350 | 4,315 | 3,045 |
| Ln(Purchases of Foreign Raw Materials) | 1342 | 5,953 | 4,363 | 2341 | 5,096 | 4,309 | 1350 | 4,094 | 4,266 |
| Ln(Use of Foreign Raw Materials) | 1342 | 9,290 | 1,744 | 2341 | 9,139 | 1,768 | 1350 | 8,707 | 1,732 |
| Ratio of Exports Over Imports | 1342 | 2,804 | 29,074 | 2341 | 2,991 | 36,074 | 1350 | 2,882 | 23,834 |
| Share of Foreign Raw Materials | 1342 | 0,323 | 0,328 | 2341 | 0,235 | 0,291 | 1350 | 0,193 | 0,279 |
| Export Intensity | 1342 | 0,183 | 0,239 | 2341 | 0,214 | 0,264 | 1350 | 0,244 | 0,296 |
| Ln(Labor Productivity) | 1342 | 5,484 | 1,110 | 2341 | 5,303 | 1,048 | 1350 | 5,033 | 1,034 |

| | Subsidy Rate Above 0.15 and Under 0.20 | | | Subsidy Rate Above 0.20 and Below 0.25 | | | Subsidy Rate Above 0.25 and Below 0.30 | | |
|---|---|---|---|---|---|---|---|---|---|
| Ln(Incentives) | 448 | 5,205 | 2,107 | 234 | 5,148 | 1,987 | 114 | 5,077 | 2,146 |
| Ln(Exports) | 448 | 6,942 | 2,156 | 234 | 6,632 | 2,034 | 114 | 6,354 | 2,182 |
| Ln(Total Labor) | 448 | 4,661 | 1,243 | 234 | 4,462 | 1,210 | 114 | 4,481 | 1,051 |
| Ln(Indirect Taxes) | 448 | 7,006 | 2,405 | 234 | 6,752 | 2,378 | 114 | 6,917 | 2,543 |
| Market Share | 448 | 0,024 | 0,055 | 234 | 0,018 | 0,038 | 114 | 0,014 | 0,022 |
| Ln(Purchases of New Machinery) | 448 | 4,411 | 3,134 | 234 | 4,005 | 3,068 | 114 | 4,286 | 2,744 |
| Ln(Purchases of Foreign Raw Materials) | 448 | 4,775 | 4,357 | 234 | 4,131 | 4,366 | 114 | 4,883 | 4,225 |
| Ln(Use of Foreign Raw Materials) | 448 | 8,936 | 1,749 | 234 | 8,798 | 1,724 | 114 | 9,031 | 1,611 |
| Ratio of Exports Over Imports | 448 | 1,925 | 11,306 | 234 | 2,934 | 23,986 | 114 | 1,010 | 4,298 |
| Share of Foreign Raw Materials | 448 | 0,223 | 0,283 | 234 | 0,212 | 0,287 | 114 | 0,229 | 0,285 |
| Export Intensity | 448 | 0,200 | 0,280 | 234 | 0,208 | 0,293 | 114 | 0,176 | 0,287 |
| Ln(Labor Productivity) | 448 | 5,175 | 0,974 | 234 | 5,145 | 1,106 | 114 | 5,341 | 1,018 |

| | Subsidy Rate Above 0.30 and Below 0.40 | Subsidy Rate Above 0.40 |
|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Ln(Incentives) | 106 | 5,528 | 2,292 | 98 | 5,783 | 2,783 |
| Ln(Exports) | 106 | 6,597 | 2,334 | 98 | 6,345 | 2,828 |
| Ln(Total Labor) | 106 | 4,463 | 1,220 | 98 | 4,326 | 1,114 |
| Ln(Indirect Taxes) | 106 | 6,420 | 3,061 | 98 | 5,577 | 3,626 |
| Market Share | 106 | 0,020 | 0,046 | 98 | 0,020 | 0,063 |
| Ln(Purchases of New Machinery) | 106 | 4,304 | 3,001 | 98 | 3,928 | 3,171 |
| Ln(Purchases of Foreign Raw Materials) | 106 | 4,377 | 4,318 | 98 | 4,129 | 4,417 |
| Ln(Use of Foreign Raw Materials) | 106 | 9,167 | 1,740 | 98 | 9,186 | 1,678 |
| Ratio of Exports Over Imports | 106 | 0,832 | 3,181 | 98 | 0,095 | 0,316 |
| Share of Foreign Raw Materials | 106 | 0,193 | 0,248 | 98 | 0,217 | 0,269 |
| Export Intensity | 106 | 0,222 | 0,339 | 98 | 0,234 | 0,378 |
| Ln(Labor Productivity) | 106 | 5,481 | 1,303 | 98 | 5,611 | 1,461 |

Table 3: Proportion of total variation in subsidy rates explained by the criteria from the allocation rules
(Factors not significant at 10% level are indicated in cursive)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Variation in Ln(Subsidy Rate) | 110.09 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 | 58.95 |
| Residual Variation | 58.95 | 58.93 | 57.61 | 57.00 | 56.67 | 56.09 | 50.36 | 47.91 | 46.19 | 44.95 | 29.48 |
| Adjusted R-squared | 0.46 | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.13 | 0.14 | 0.15 | 0.17 | 0.31 |
| Number of Obs. | 55415 | 6864 | 6864 | 6864 | 6864 | 6864 | 6864 | 6864 | 6864 | 6864 | 6864 |
| COEFFICIENTS FROM ANOVA: | | | | | | | | | | | |
| Exporting Status | 51.14 | | | | | | | | | | |
| Export Intensity | | 0.02 | *0.01* | 0.03 | 0.03 | *0.01* | *0.01* | *0.01* | *0.01* | *0.01* | *0.01* |
| 3-digit Industry | | | 1.32 | 0.81 | 0.82 | 0.80 | 0.91 | 0.95 | 0.97 | 0.74 | 0.16 |
| Export Intensity * 3-digit Industry | | | | 0.60 | 0.54 | 0.46 | 0.50 | 0.50 | 0.49 | 0.49 | 0.26 |
| Region | | | | | 0.33 | 0.64 | 0.66 | 0.64 | 0.44 | 0.34 | 0.22 |
| Export Intensity * Region | | | | | | 0.58 | 0.66 | 0.61 | 0.34 | 0.34 | 0.32 |
| Period | | | | | | | 5.73 | 1.92 | 0.59 | 0.44 | 0.36 |
| 3-digit Industry * Period | | | | | | | | 2.45 | 2.26 | 2.29 | 2.23 |
| Region * Period | | | | | | | | | 1.73 | 1.82 | 1.60 |

| | | |
|---|---|---|
| Purchases of New Machinery | *0.01* | *0.01* |
| Use of Foreign Raw Materials | 0.05 | 0.00 |
| Ratio of Exports to Imports | *0.00* | *0.00* |
| Share of Foreign Raw Materials in Production | 0.10 | *0.00* |
| Recipient of Subsidies for 3 or more years | 1.15 | 0.13 |
| Plant | | 15.50 |

Table 4: The Effect of Subsidies on Exporting Intensity

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| Ln(Exports) | 0.37*** | 0.96*** | 0.38* | 0.34*** | 0.91*** | 0.52*** | 0.96*** | 1.61*** | 1.44*** |
| | (0.04) | (0.03) | (0.22) | (0.05) | (0.03) | (0.05) | (0.02) | (0.03) | (0.03) |
| Ln(Exports Squared) | 0.03*** | -0.06*** | 0.03 | 0.03*** | -0.05*** | 0.02*** | -0.06*** | -0.05*** | -0.04*** |
| | (0.01) | (0.00) | (0.02) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Ln(Total Labor) | 0.03 | -0.01 | 0.03 | 0.01 | -0.01 | 0.01 | -0.01 | -0.00 | -0.18*** |
| | (0.04) | (0.05) | (0.06) | (0.02) | (0.04) | (0.02) | (0.03) | (0.03) | (0.04) |
| Ln(Indirect Taxes) | 0.12*** | 0.11*** | 0.13*** | -0.05*** | 0.07** | -0.03** | 0.11*** | 0.21*** | 0.20*** |
| | (0.02) | (0.03) | (0.04) | (0.02) | (0.03) | (0.01) | (0.02) | (0.02) | (0.02) |
| Ln(Market Share) | -0.05 | -0.13** | -0.04 | 0.08*** | -0.12*** | 0.07*** | -0.13*** | -0.12*** | -0.10** |
| | (0.03) | (0.05) | (0.05) | (0.02) | (0.04) | (0.02) | (0.03) | (0.03) | (0.05) |
| Ln(Purchases of New | -0.00 | -0.01 | -0.00 | -0.00 | -0.01 | -0.00 | -0.01 | -0.01 | -0.01 |

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| Machinery and Equipment) | | | | | | | | | |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.00) | (0.01) | (0.01) | (0.01) |
| Ln(Imports of Raw Materials) | 0.02** | 0.02 | 0.02 | -0.01 | 0.02 | -0.00 | 0.02** | 0.04*** | 0.03*** |
| | (0.01) | (0.01) | (0.02) | (0.01) | (0.01) | (0.00) | (0.01) | (0.01) | (0.01) |
| Ln(Use of Imported Raw Materials) | -0.11*** | -0.09* | -0.13** | 0.04* | -0.04 | 0.02 | -0.09*** | -0.17*** | -0.03 |
| | (0.03) | (0.05) | (0.06) | (0.02) | (0.04) | (0.02) | (0.03) | (0.03) | (0.04) |
| Ratio of Exports Over Imports | -0.00 | 0.00 | -0.00 | -0.00 | 0.00 | -0.00*** | 0.00 | -0.00 | -0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Share of Imported Raw | -0.21* | 0.04 | -0.30* | -0.26*** | 0.12 | -0.26*** | 0.04 | -0.30*** | -0.21 |

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| Materials in Production | | | | | | | | | |
| | (0.11) | (0.18) | (0.18) | (0.08) | (0.16) | (0.05) | (0.11) | (0.12) | (0.15) |
| Export Intensity | 0.50** | 0.02 | 0.55** | 0.40*** | 0.00 | 0.39*** | 0.02 | 0.46*** | 0.30* |
| | (0.24) | (0.22) | (0.26) | (0.10) | (0.22) | (0.07) | (0.15) | (0.14) | (0.18) |
| Limited Partnership | 0.32*** | 0.25** | 0.60*** | 0.04 | 0.21** | 0.07* | 0.25*** | 0.67*** | 0.44*** |
| | (0.11) | (0.11) | (0.21) | (0.06) | (0.10) | (0.04) | (0.08) | (0.08) | (0.12) |
| Corporation | 0.39** | 0.20 | 0.70** | 0.09 | 0.09 | 0.12*** | 0.20** | 0.68*** | 0.55*** |
| | (0.17) | (0.13) | (0.28) | (0.08) | (0.12) | (0.05) | (0.08) | (0.09) | (0.14) |
| Location - Cali | 0.06 | 0.19 | 0.07 | 0.01 | 0.14 | 0.03 | 0.19*** | 0.17** | 0.24* |
| | (0.07) | (0.13) | (0.13) | (0.05) | (0.11) | (0.04) | (0.07) | (0.08) | (0.14) |
| Location - Medellin | 0.15*** | 0.45*** | 0.11 | -0.07 | 0.35*** | -0.02 | 0.45*** | 0.38*** | 0.40*** |
| | (0.05) | (0.09) | (0.10) | (0.04) | (0.08) | (0.03) | (0.07) | (0.06) | (0.12) |
| Location - Manizales | 0.10 | -0.00 | 0.29 | 0.10 | -0.11 | 0.12* | -0.00 | 0.24* | 0.06 |

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| | (0.18) | (0.23) | (0.25) | (0.10) | (0.20) | (0.07) | (0.13) | (0.14) | (0.27) |
| Location - Barranquilla | 0.18** | 0.13 | 0.17 | 0.00 | 0.11 | 0.01 | 0.13 | 0.24*** | 0.35** |
| | (0.09) | (0.17) | (0.16) | (0.06) | (0.14) | (0.04) | (0.09) | (0.09) | (0.16) |
| Location - Bucaramanga | 0.24*** | 0.50*** | 0.23* | -0.01 | 0.33*** | 0.03 | 0.50*** | 0.43*** | 0.55*** |
| | (0.06) | (0.14) | (0.12) | (0.05) | (0.12) | (0.05) | (0.11) | (0.11) | (0.18) |
| Location - Pereira | 0.21 | 0.26 | 0.18 | 0.10 | 0.16 | 0.12 | 0.26* | 0.28* | 0.51* |
| | (0.17) | (0.18) | (0.28) | (0.09) | (0.15) | (0.07) | (0.15) | (0.15) | (0.28) |
| Location - Cartagena | 0.18 | 0.27 | 0.28 | 0.06 | 0.09 | 0.10 | 0.27* | 0.42*** | 0.29 |
| | (0.32) | (0.22) | (0.37) | (0.09) | (0.17) | (0.07) | (0.15) | (0.14) | (0.27) |
| Location - Rest of the Country | 0.18** | 0.37*** | 0.26* | -0.05 | 0.30*** | -0.01 | 0.37*** | 0.41*** | 0.46*** |
| | (0.09) | (0.13) | (0.16) | (0.06) | (0.11) | (0.04) | (0.08) | (0.08) | (0.15) |

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| _Idatayear_82 | -0.10** | -0.23*** | -0.45*** | | -0.09 | | -0.23** | -0.17 | -0.13 |
| | (0.04) | (0.09) | (0.09) | | (0.09) | | (0.11) | (0.12) | (0.09) |
| _Idatayear_83 | 0.16*** | 0.00 | 0.00 | 0.27*** | 0.00 | 0.31*** | | 0.39*** | 0.38*** |
| | (0.05) | (0.00) | (0.00) | (0.06) | (0.00) | (0.05) | | (0.12) | (0.09) |
| _Idatayear_84 | 0.26*** | -0.02 | 0.28*** | 0.54*** | -0.05 | 0.57*** | -0.02 | 0.60*** | 0.65*** |
| | (0.05) | (0.09) | (0.09) | (0.06) | (0.08) | (0.05) | (0.11) | (0.12) | (0.09) |
| _Idatayear_85 | 0.28*** | -0.03 | 0.32*** | 0.63*** | -0.02 | 0.66*** | -0.03 | 0.63*** | 0.65*** |
| | (0.06) | (0.09) | (0.10) | (0.06) | (0.08) | (0.05) | (0.11) | (0.12) | (0.09) |
| _Idatayear_86 | 0.06 | 0.08 | -0.13 | 0.08 | 0.16* | 0.11** | 0.08 | 0.25** | 0.25*** |
| | (0.06) | (0.09) | (0.10) | (0.07) | (0.09) | (0.05) | (0.11) | (0.11) | (0.09) |
| _Idatayear_87 | -0.01 | -0.00 | -0.28*** | -0.05 | 0.02 | -0.02 | -0.00 | 0.07 | 0.12 |
| | (0.06) | (0.10) | (0.09) | (0.06) | (0.09) | (0.05) | (0.11) | (0.11) | (0.09) |

| | | | | | | Heckman Selection (Two-Step) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **OLS** | **Probit** | **OLS+IMR** | **Heckman Selection (ML)** | | | | **Tobit** | **RE Tobit** |
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| _Idatayear_88 | 0.01 | 0.02 | -0.25*** | -0.04 | 0.10 | -0.02 | 0.02 | 0.11 | 0.17* |
| | (0.06) | (0.09) | (0.10) | (0.06) | (0.09) | (0.05) | (0.11) | (0.11) | (0.09) |
| _Idatayear_89 | -0.06 | 0.04 | -0.33*** | -0.07 | 0.05 | -0.04 | 0.04 | 0.00 | 0.07 |
| | (0.06) | (0.09) | (0.09) | (0.06) | (0.09) | (0.05) | (0.10) | (0.11) | (0.09) |
| _Idatayear_90 | -0.23*** | 0.13 | -0.53*** | -0.24*** | 0.17* | -0.21*** | 0.13 | -0.15 | 0.02 |
| | (0.06) | (0.10) | (0.09) | (0.06) | (0.09) | (0.05) | (0.10) | (0.11) | (0.09) |
| _Idatayear_91 | -0.27*** | -0.32*** | -0.54*** | -0.20*** | -0.26*** | -0.19*** | -0.32*** | -0.31*** | -0.09 |
| | (0.06) | (0.09) | (0.09) | (0.06) | (0.09) | (0.05) | (0.10) | (0.11) | (0.09) |
| Exporting Status in Previous Year | | 0.58*** | | | 0.56*** | | 0.58*** | | |
| | | (0.06) | | | (0.05) | | (0.05) | | |
| Inverse Mills Ratio | | | -1.19*** | | | -0.37*** | | | |
| | | | (0.30) | | | (0.12) | | | |
| Constant | -0.90* | -4.15*** | -0.36 | 0.92*** | -3.95*** | -4.15*** | | -6.52*** | -6.52*** |

| | OLS | Probit | OLS+IMR | Heckman Selection (ML) | | Heckman Selection (Two-Step) | | Tobit | RE Tobit |
|---|---|---|---|---|---|---|---|---|---|
| | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Receipient of Incentives | Ln(Incentives) | Ln(Incentives) |
| | (0.47) | (0.75) | (1.20) | (0.34) | (0.63) | (0.46) | | (0.49) | (0.70) |
| Observations | 12081 | 10655 | 10655 | 10655 | | 10655 | | 12081 | 12081 |
| R-squared | 0.784 | . | 0.577 | . | . | . | . | | |
| athrho | | | | -1.22*** | | | | | |
| | | | | (0.09) | | | | | |
| lnsigma | | | | -0.18*** | | | | | |
| | | | | (0.04) | | | | | |
| sigma_u | | | | | | | | | 1.30*** |
| | | | | | | | | | (0.04) |
| sigma_e | | | | | | | | | 1.40*** |
| | | | | | | | | | (0.01) |

Table 5: The Effect of Export Subsidies on Exports

| Dependent Variable: Log(Exports) | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| Log(Exports) t-1 | 0.23* | 0.19 | 0.28** | 0.24* |
| | [0.13] | [0.17] | [0.13] | [0.13] |
| Log(Subsidies) t | 4.70*** | 2.66*** | 2.25*** | 2.82* |
| | [0.65] | [0.25] | [0.25] | [1.56] |
| Log(Subsidies) t-1 | -0.52 | -0.65 | -0.67* | -0.65* |
| | [0.38] | [0.52] | [0.40] | [0.37] |
| Log(Subsidies) Squared t | -0.14*** | -0.19*** | -0.14*** | -0.12** |
| | [0.04] | [0.05] | [0.04] | [0.06] |
| Log(Subsidies) Squared t-1 | 0.04 | 0.05 | 0.05 | 0.05 |
| | [0.03] | [0.05] | [0.04] | [0.03] |
| Connectedness t | -2.30*** | | | |
| | [0.83] | | | |
| Connectedness*Log(Subsidies) t | -2.16*** | | | |
| | [0.68] | | | |
| Connectedness_truncated | | 1.57 | | |
| *truncated at 0 if Predicted Subsidies<=Observed Subsidies* | | [1.57] | | |
| Connectedness_truncated*Log(Subsidies) | | -0.35 | | |
| | | [0.25] | | |
| Connectedness_truncated | | | -1.64*** | |
| *truncated at 0.01 if Predicted Subsidies<=Observed Subsidies* | | | [0.63] | |
| Connectedness_truncated*Log(Subsidies) | | | 0.03 | |
| | | | [0.13] | |
| Connectedness_truncated | | | | 2.89** |
| *truncated at 1 if Predicted Subsidies<=Observed Subsidies* | | | | [1.33] |

| | | | | |
|---|---|---|---|---|
| Connectedness_truncated*Log(Subsidies) | | | | -1.33 |
| | | | | [1.44] |
| Year 1982 | 0.00 | -0.32** | -0.13 | -0.35** |
| | [0.14] | [0.15] | [0.12] | [0.15] |
| Year 1983 | -0.53*** | -0.71*** | -0.64*** | -0.68*** |
| | [0.12] | [0.13] | [0.10] | [0.12] |
| Year 1984 | -0.73*** | -0.68*** | -0.72*** | -0.62*** |
| | [0.15] | [0.16] | [0.14] | [0.14] |
| Year 1985 | -0.74*** | -0.63*** | -0.71*** | -0.56*** |
| | [0.16] | [0.14] | [0.14] | [0.14] |
| Year 1986 | -0.22 | -0.48*** | -0.32*** | -0.49*** |
| | [0.14] | [0.15] | [0.12] | [0.14] |
| Year 1987 | -0.09 | -0.43*** | -0.25** | -0.43*** |
| | [0.13] | [0.14] | [0.11] | [0.12] |
| Year 1988 | -0.11 | -0.43*** | -0.26*** | -0.41*** |
| | [0.12] | [0.12] | [0.10] | [0.11] |
| Year 1989 | -0.09 | -0.40*** | -0.22** | -0.37*** |
| | [0.11] | [0.11] | [0.09] | [0.10] |
| Year 1990 | 0.14 | -0.18* | 0.07 | -0.15 |
| | [0.10] | [0.10] | [0.10] | [0.09] |
| Constant | 1.85*** | 0.93*** | 1.72*** | 0.93*** |
| | [0.53] | [0.30] | [0.46] | [0.27] |
| Observations | 10655 | 10655 | 10655 | 10655 |
| R-squared | . | . | . | . |
| Number of plants | 1423 | 1423 | 1423 | 1423 |

| | | | | |
|---|---|---|---|---|
| AR(1) | 0.000 | 0.002 | 0.000 | 0.000 |
| AR(2) | 0.934 | 0.483 | 0.415 | 0.353 |
| | | | | |
| Sargan | 0.015 | 0.044 | 0.013 | 0.009 |
| Hansen | 0.648 | 0.529 | 0.277 | 0.067 |

W-corrected standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.10