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INDUSTRIAL POLICY AND DOWNSTREAM EXPORT PERFORMANCE

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ABSTRACT

Industrial policies (IPs) include such varying practices as production subsidies, export subsidies, and import protection, and are commonly used by countries to promote targeted sectors. However, such policies can have significant impacts on sectors other than those targeted by the IPs, particularly when the target sector produces goods that are key inputs to downstream sectors. Surprisingly, there has been little systematic analysis of how IPs in targeted sectors affect other sectors of the economy. Using a new hand-collected database of steel-sector IP use in major steel-producing countries from 1975 through 2000, this paper examines whether steel-sector IPs have a significant impact on the export competitiveness of the country's other manufacturing sectors, particularly those that are significant downstream users of steel. I find that a one-standard-deviation increase in IP presence leads to a 3.6% decline in export competitiveness for an average downstream manufacturing sector. But this effect can be as high as 50% decline for sectors that use steel as an input most intensively. These general negative effects of IPs are primarily due to export subsidies and non-tariff barriers, particularly in less-developed countries.

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1. Introduction

Industrial policies (IPs) to nurture an industry may be motivated by a number of reasons. The first may be an infant industry argument that the country will have a comparative advantage in the sector once firms in the sector are provided help to overcome entry barriers, particularly in an industry where economies of scale or learning-by-doing effects are important.[1] Second, an industry may be seen as a gateway industry, where its development brings crucial knowledge and technologies that provide easier entry into the production of more complex and skill-intensive manufactured goods, spurring economic development. Finally, a domestic industry may be protected from import competition because a country feels the domestic industry can better provide specialized products and service to local downstream industries than import sources.

On the other hand, IPs to encourage domestic production often involve practices, such as protection from imports, which can substantially raise the domestic price of an industry's goods. This raises input costs to downstream sectors and can significantly hinder their development and hurt economic growth. While such effects may be seen as the short-run cost to protect an infant industry, Miyagiwa and Ohno (1999) show that sectors can become dependent long-run on IPs and remain uncompetitive, unless the government has quite a bit of information and can credibly commit to discontinue the IPs after an appropriate time period. This can lead to long-run competitive issues for the downstream industries as well, as seen in this quote from a recent article on South Africa, a long-run user of extensive IPs in the steel sector:

> "South Africa's manufacturing sector… has performed poorly over the past 10 years … One of the reasons for this is monopolistic provision and pricing of key inputs into manufacturing, including steel. Almost 80% of steel sales in South Africa are directed at the manufacturing and construction sectors. In addition, basic iron and steel are significant inputs into one of the chosen sectors of the second Industrial

[1] Melitz (2005) provides a formal model with learning-by-doing effects and shows how quotas can be more likely to be welfare-enhancing in such circumstances than tariffs or production subsidies.

> Policy Action Plan (IPAP2) — metals fabrication, capital and transport equipment. Government thus has a strong interest in ensuring South Africa gets iron and steel at competitive prices."(Financial Mail, March 12, 2010, http://www.fm.co.za/Article.aspx?id=103522)

Using a new hand-collected database of steel-sector IP use in major steel-producing countries, this paper examines whether steel-sector IPs have a significant impact on the export competitiveness of the country's other manufacturing sectors, particularly those that are significant downstream users of steel. Steel products are a significant input to many sectors of the economy, particularly the manufacturing and construction sectors, and are particularly important in the production of investment goods and infrastructure. Thus, availability and quality of steel products can play a major role in the productivity and growth of a country. This is likely a major reason why the steel sector has been a significant focus of industrial policy in both developed and developing economies throughout the history of the industry.

The paper's empirical strategy is to use the combination of cross-country variation in steel-sector IPs and cross-sectoral variation in the importance of steel as inputs to identify the effect of such policies on a sector's export growth. I examine the effect on exports, versus other performance measures of downstream sectors, such as output growth, because of the wide availability and consistent measurement of export data across countries and sectors. In addition, export activity is also seen as an important indicator of growth and development. Unlike studies of input tariffs, there is a wide range of different IPs that countries may employ. These include non-tariff barriers (such as voluntary restraint agreements (VRAs)) that should have similar effects to input tariffs of raising domestic prices on the inputs and hurting downstream export competitiveness. But they also include domestic production subsidies and grants that could lower prices of steel and help export competitiveness of downstream sectors. This makes the issue of the general effect of IPs on downstream competitiveness an important empirical one.

Across a sample of 21 steel-producing countries from 1975 through 2000, spanning both developed and less-developed economies, I find strong evidence that steel-sector IPs have a significant negative impact on the export-performance of downstream industries. I find that a one-standard-deviation increase in IP presence leads to a 3.6% decline in export competitiveness for an average downstream manufacturing sector. But this effect can be as high as 50% for sectors that use steel as an input most intensively. My results also suggest that this effect is solely driven by the less-developed countries in my sample.[2] Exploring the heterogeneous effects of different types of IP policies, I find that export subsidies and import protection policies have the most harmful effects on downstream export competitiveness. Government production subsidies and grants have a significant positive effect, but its magnitude is much smaller than the negative impacts of the other IPs.

The paper proceeds first with a review of a prior literature that has focused almost exclusively on the effects of import tariff protection on downstream industries, not the broader range of IPs that this paper will examine. Prior studies are also invariably single-country level studies, unlike this one, which analyzes the extent to which these effects vary across different types of countries. The literature review is followed by section 3, which lays out an empirical strategy for identification of the effect of IPs on downstream export competitiveness and section 4, which details the data used for analysis. Section 5 provides econometric estimates and section 6 concludes.

[2] Less-developed countries in my sample are the largest steel-producing ones of Argentina, Brazil, Mexico, South Africa, South Korea, Spain, Taiwan, and Turkey. The developed countries in my sample are Canada, Japan, New Zealand, and a number of European countries that are major producers of steel.

2. Literature review

Despite an immense literature on the effects of trade protection policies, there are relatively few studies that have examined the effects of protection on downstream sectors. Hoekman and Leidy (1992) and Sleuwaegen et al. (1998) introduce a theory of cascading protection, whereby trade protection in an upstream sector induces a greater likelihood of trade protection in downstream sectors, and detail conditions under which cascading protection is more likely. Feinberg and Kaplan (1993) is the only study to empirically examine this hypothesis directly and finds evidence that U.S. AD and CVD cases are more likely in an industry when an upstream industry has been successful in garnering AD and CVD protection. A couple other papers have examined whether AD or safeguard protection leads to significant downstream effects. Krupp and Skeath (2002) look at downstream effects from U.S. AD investigations as well, and find that such import protection has significant negative impacts on production in the downstream industries. Liebman and Tomlin (2007) conduct an event study of stock market reactions to U.S. steel safeguard events on both steel producers and major steel consumers, including firms in transportation, metal fabrication, and construction. They find there were significant negative effects on downstream-users of steel form the U.S. steel safeguard actions, though secondary regressions do not find a link between the cost share of steel in these sectors and these downstream effects.

Computable general equilibrium (CGE) models often model input-output linkages and can then provides estimates of economic impacts across many sectors from trade liberalization in a particular sector. For example, de Melo and Tarr (1990) estimate the welfare effects of quotas in the U.S. steel, auto and apparel and textile sectors with a CGE model. Among their findings is that simultaneous removal of quotas in these three sectors actually leads to employment and output gains in the automobile sector, which they explain as due to the lower steel prices enjoyed by autos after quota removal in steel. Francois et al. (1996) is another example of a CGE exercise where input-output linkages are important for highlighted results. The study examines the effects of the Jones Act, which restricts the provision of domestic cabotage services (transport of goods between domestic ports) in the U.S. to domestic carriers only. Since cabotage is an important upstream sector for so many other sectors in the economy, their analysis provides not only an overall welfare estimate from removing the Jones Act restrictions, but also the output, employment, export, and import effects for the many downstream sectors in the economy. A final example is USITC (1989), which explores the effects of U.S. steel VRAs on downstream users of steel. With an estimated tariff equivalent of the VRAs around 4% for their focus years, they find only modest effects on downstream output, employment, and exports.

A limitation of CGE models is that one has to come up with an estimate of the market distortion that relies to some extent on information outside of the model. While this is not as problematic with explicit tariffs, it is more difficult for non-tariff distortions.[3] For example, the Francois et al. (1996) study found that outside estimates of the price wedge due to the Jones Act distortion ranged from 100% to 300%, and thus present the reader with three scenarios of possible effects. This contrasts with the empirical regression analysis I use in this paper to estimate an average effect of various non-tariff IPs in my data sample through variables simply indicating the presence of such policies.

More recently, a number of studies have used micro-level data to examine the impact of lower input prices from tariff liberalization on firm- or plant-level productivity. Using Indonesian data, Amiti and Konings (2007) finds that lower input tariffs leads to productivity gains of downstream firms (not just better competitiveness from lower input costs), and that these productivity gains from input liberalization are greater than those

[3] Of course, estimation of tariff effects still requires estimates (outside the model) of key elasticities and related parameters, which is another common critique of CGE model analysis.

from liberalization of the output market. Topalova and Khandelwal (2011) finds similar results using Indian data. Goldberg et al (2010a; 2010b) focuses on how lower input tariffs lead to the introduction of new input varieties, which proves to also be an important source of downstream productivity gains in the sample of Indian plants they examine. Chavassus-Lozza et al. (2010) uses firm-level data of French food processing firms and examines the impact of input tariff liberalization on downstream export firm behavior. They develop a model that suggests that input liberalization may help the high-productivity exporting firms at the expense of the lower-productivity exporters, and their empirical analysis finds that input liberalization leads to significant exit of the lowest productivity exporters.

Relative to this previous literature, this study has two main con

tributions. First, unlike previous studies, I examine the effects of an entire array of IPs, not just tariffs, on the economic performance of downstream industries. Thus, I analyze a much fuller set of policies that distort market outcomes, as well as examine heterogeneity in the effect of these various IPs. Second, I do this in the context of a panel of countries, not just a single country. Previous studies have been single-country studies of firm- or plant-level data, which focus exclusively on less-developed countries, such as Chile, India, and Indonesia. I make the trade-off of exploring more aggregate product-level data, but across a variety of countries – both developed and less-developed. The steel sector has been subject to significant and changing IP policies across many countries, allowing analysis of heterogeneous effects across different types of countries in a consistent framework.

3. Empirical specification

As a starting point, one can estimate the impact of IPs on downstream export performance with the following empirical specification:

$$T_{cit} = \beta_1 IP_{ct} + \beta_2 StSh_{cit} + \beta_3 (IP_{ct} \times StSh_{ci}) + \beta_4 GDP_{ct} + \eta_i + \eta_c + \eta_t + \varepsilon_{cit} \qquad \textbf{(1)}$$

where T_{cit} is the log of the value of country *c*'s exports in year *t* in sector *i*, IP_{ct} is a country-time measure of steel sector IPs, $StSh_{ci}$ is the share of steel in sector *i*'s output in country *c* in time *t*, GDP_{ct} is a country-time measure of GDP, the η terms are country-, sector-, and time-fixed effects, and ε_{cit} is a mean-zero error term.[4] The focus would obviously be on the third term on the right-hand side and the sign and significance of β_3, with a positive sign suggesting that IPs have helped export competitiveness and a negative sign indicating that they have had a deleterious effect.

I choose to estimate a specification that is simpler, but even more demanding on the data than equation (1), for identification:

$$T_{cit} = \beta_1(IP_{ct} \times StSh_{ci}) + \eta_{ic} + \eta_{ct} + \varepsilon_{cit} \qquad \textbf{(2)}$$

In equation (2), I replace the country-, sector, and time-fixed effects with sector-country and country-time fixed effects, η_{ic} and η_{ct}, respectively. The country-time fixed effects (η_{ct}) subsume the independent effects of the IP and GDP terms on exports, as well as any other observed or unobserved country-time effects on exports, such as exchange rate movements. The sector-country fixed effects (η_{ic}) subsumes the independent effect of the steel share term ($StSh_{ci}$), as well as any other observed or unobserved sector-country effects on exports, such as country-specific endowments that determine the underlying long-run comparative advantage of a country's sector.

Endogeneity concerns seem fairly minimal with this specification. The steel-share is an input-output relationship, which is related to technological requirements of production. The use of these input-output relationships from the final year of sample (2000), when IP

[4] This specification (and associate identification strategy) is analagous to that used by Rajan and Zingales (1998) and, more recently, Manova (2008). In their settings, they use heterogeneity in external financial dependence across sectors to identify the effects of financial policies and events at the national level on growth. Here, I use heterogeneity in a sectors' requirements of steel inputs to examine the impact of national-level IPs on downstream export competitiveness.

presence was lowest for most countries, further ensures the likely exogeneity of this variable across the many years in the sample. The decision on IPs in the steel sector are also likely reasonably exogenous to exporting behavior in other sectors. As the quote in the introduction from South Africa suggests, policymakers are unlikely to consider extra-sectoral consequences very much when making sectoral policy decisions. Third factors, such as GDP growth of the economy or exchange rate movements could induce spurious correlation from omitted variable bias, but these will be controlled for with the use of country-time and sector-country fixed effects.

4. Data

There are three important sources of information that I use to implement estimation of the empirical specification in equation (2): industrial policy measures, export data, and data on the importance of steel in the manufacture of various downstream sectors.

The dependent variable is the value of country *c*'s exports in year *t* in sector *i*. These data come from the United Nation's COMTRADE database (retrieved via the World Bank's World Integrated Trade Solution (WITS) database) at the 5-digit Standard International Trade Classification (SITC), Revision 1, level for the years 1975 through 2000. I drop the steel sector from my sample, as my focus is on the effect of steel IPs on downstream sector competitiveness, which should have the opposite effect as that on the steel sector itself. As discussed below, the sample of countries is determined by the availability of IP data. Given the skewness of the data, I take the natural log of the export variable.[5]

The key independent variable is the interaction of the IP measure and the input share of steel in a sector. I begin by describing my measure of IPs (IP_{ct}), as it was the most

[5] I add the value of "1" to each trade value before logging so that I do not lose observations with zero trade in my sample.

difficult to collect, and limitations in its availability put tighter constraints on the data sample than the other data necessary for estimation. Simply put, there is no common source of data on various countries' IPs in various sectors. And this is typically true even when searching at an individual country level. I was able to overcome this with respect to steel sector IPs by relying on three main sources of information. The first is Howell et al. (1988), which is a rich source of information with well-documented case-study information on steel-sector IPs for the major steel-producing countries going back through the decades prior to the late 1980s. In order to have data beyond the late 1980s, I had to supplement with other sources.

The first supplemental source comes from a European Commission publication, *European Commission Report on Competition Policy*, which provides information on IPs across sectors for the member European countries, many of which are important world steel producers. This source allowed me to supplement up to the year 2000 for these countries. A second supplemental source of information comes from the detailed reports on foreign government subsidization programs published in the U.S. *Federal Register* by the International Trade Administration (ITA) of the U.S. Department of Commerce in their notices of their U.S. countervailing duty (CVD) investigations. The U.S. steel industry has been a major user of antidumping and CVD investigations since 1980 against virtually all countries exporting steel to the United States. In a CVD investigation, the ITA investigates any and all government programs, policies, and other interventions that may constitute government subsidization of an industry. Their reports document their findings on these programs, including a short history of the policy going back in time, including the initiation of the program. This detail in ITA reports, which includes a timeline of various programs, is crucial for my use here.

A critical feature of the history of U.S. steel CVD investigations is that the steel industry has been very comprehensive in filing these CVD cases across virtually all import sources, particularly in three distinct time periods. The first time period was the early 1980s, when hundreds of AD and CVD cases were filed and ultimately led to the imposition of comprehensive VRAs on U.S. imports of steel. The second time period was after the VRAs were allowed to expire in 1992, which was quickly followed by (again) hundreds of AD and CVD cases. A final period was in the late 1990s, after the Asian Financial Crisis led to a significant import surge of "cheap" steel, sending many U.S. steel firms into bankruptcy by 2000. This period also saw scores of AD and CVD cases filed by the U.S. steel industry. These three events then give us a fairly comprehensive snapshot of non-U.S. government IPs through the ITA CVD reports accompanying the investigations. Blonigen and Wilson (2010) provide more detail on U.S. CVD activity in the steel sector and similarly use the ITA reports to construct measures of foreign government subsidization, which they then use to estimate the impacts of such foreign subsidization on the U.S. steel industry.

I use these three sources of information to categorize the annual presence of various steel-sector IPs in 21 major steel-producing countries from 1975 through 2000.[6] In particular, I create indicator variables for the presence of the following IPs in a country's steel sector in a given year: 1) export subsidies, 2) government production subsidies (typically in the form of grants or favorable loans), 3) government ownership, 4) national or regional cartel arrangements, and 5) non-tariff barriers on imports, such as voluntary restraint agreements (VRAs). While there is sometimes information that relates to the magnitude of the IP (e.g., whether government ownership is full or partial), it is not reported in a consistent or frequent enough fashion to employ in my sample of countries

[6] The countries are Argentina, Austria, Belgium, Brazil, Canada, Finland, France, Germany, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, South Africa, South Korea, Spain, Sweden, Taiwan (1989-2000 only), Turkey, and the United Kingdom.

and years. For my base specifications, I use a measure of total IP presence that adds up these five IP indicator variables, but then later examine whether there are differences in the effects across these various types of IPs.

Table 1 provides descriptive statistics of these IP indicator variables. As one can see, IP usage is quite high for this sample of countries. Each type of IP is present in at least 22% of my sample's observations, with government grants or loans (69%), non-tariff measures (65%) and government ownership (57%) each present in over half of the observations. The sample also displays rich variation in IP presence over time and across countries. Figure 1 displays the average number of steel IP types present in countries over time. It averages around 2.5 out of 5 possible IP program types at the beginning of the sample in 1975, rises to above 3 by the mid-1980s, then sees a significant drop in the late 1980s to around 2. By the end of the sample the average number of steel IP types per country is less than 1.5. Figure 2 displays the substantial variation in the presence of IPs across countries during the sample years. On one side is Taiwan and New Zealand with 0 and 0.5 annual steel IPs. In contrast, the main developed European countries (Belgium, France, Germany, and Italy), average 3.5 or more annual steel IP types during the sample years. There is no discernible correlation between the presence of IPs and the development level of the country.

Data on the input share of steel in a sector ($StSh_{ci}$) comes from country-level input-output tables available from the OECD Structural Analysis (STAN) database. These data are reported on an infrequent basis, with the most recent data coming from the year 2000 for most of the countries in my sample. Importantly, the STAN database provides these data at a consistent level of detail (48 sectors) for each country. Given the limited data availability, I apply the steel share of input usage for each sector taken from these country-specific input-output tables from the year 2000 to all the years in my sample, making the common assumption that these input-output ratios are fixed within a country. Across my sample the input share of steel in a sector ranges from 0.00 to 0.43, with a mean of 0.03 and a standard deviation of 0.06.

I create the main independent variable by multiplying the total IP measure with the input share of steel ($IP_{ct} \times StSh_{ci}$). Greater IPs in steel should decrease export competitiveness, particularly for sectors that use steel more intensively. For consistency with the dependent variable and ease of interpreting coefficient estimates, I also take the natural log of this interaction term, though all my statistical results below are qualitatively identical when I do not take natural logs of my variables. Since there are a number of observations with zeros for each of these variables being interacted, I also add the value of "1" to each variable before interacting and taking natural logs. Table 2 provides descriptive statistics for these two variables.

On a final note, the Trade Analysis and Information System (TRAINS) database, available through the WITS database of the World Bank, has country- and sectoral-level data on import tariffs and non-tariff measures (NTMs) which could be of potential use as measures of IPs. Unfortunately, the years of coverage of the NTM measures was of much too limited availability to useful for this sample of countries and years. There is also a question of controlling for input tariffs. Tariff protection is ubiquitous amongst the countries during this time period, so an indicator variable will not have any necessary variation for identification. The TRAINS dataset has steel-sector tariff data for only about 1/6 of my sample's observations, which covers primarily developed countries in the latter third of my sample. Inclusion of an input tariff variable interacted with the input share of steel in a sector has virtually no impact the estimated IP effect, though this is not a representative portion of my sample.

5. Results

Column 1 of Table 3 provides results when I estimate equation (2) using the full sample of 319,419 annual observations across 21 countries from 1975 through 2000. F-statistics reject the hypothesis that the set of country-industry and country-time fixed effects are jointly zero at the 1% significance level and the R-squared of the equation is 0.87. My focus variable, the interaction of an IP presence measure with the input share of steel in the sector is estimated to be approximately -2.2 and highly statistically significant. This is consistent with the hypothesis that IPs raise costs to downstream industries and harm their export competitiveness.

Given how we have specified the variables in logarithms, the elasticity of export value with respect to the IP presence variable can be calculated as the coefficient on the interaction term times the log of one plus the steel input share. Thus, for an average steel input share industry where steel accounts for 3% of input costs, the relevant elasticity is -0.066. This means that a one-standard deviation change in IP presence (54%) is associated with a 3.6% lower export value. Of course, some of the downstream sectors have steel input shares as high as 0.43 in the sample (namely, Fabricated Metal Products in South Africa), for which the estimates suggest that a one-standard deviation increase in IP presence is associated with a 51.1% lower export value. As a robustness check, I also estimated equation (2) in levels (not logarithms) and get quantitatively similar estimates of these marginal effects. In summary, there is strong evidence that IPs have a statistically and economically significant deleterious average effect on the export competitiveness of downstream industries.

5.1. Heterogeneity across countries

It is interesting to examine whether there is systematic heterogeneity in these effects across different types of countries. A common distinction is developed versus less-developed countries (LDCs). One might expect that governments of LDCs have less resources to analyze the effects of policies, and therefore may apply IPs in such a way that they create more harmful effects for downstream industries. In columns 2 and 3 of Table 3, I separate the sample into developed countries and LDCs and find evidence consistent with this hypothesis. The elasticity of downstream export competitiveness with respect to the degree of IP presence continues to be negative and is 70% larger in absolute value, while the elasticity for developed countries is positive, though quite small in magnitude. Another distinction I examine is the effect for Asian countries. There seems to be a popular notion that Asian countries were particularly effective and intelligent in their use of IPs with respect to their manufacturing sector. However, estimates in column 4 of Table 3 suggest that IP use in the three Asian countries in my sample (Japan, South Korea, and Taiwan) were just as harmful to downstream export competitiveness as the sample of LDCs.

To examine heterogeneity across countries further and address any worry that one or two countries may be driving results, Table 4 provides estimates of the IP effect when I run my specification for each country's observations separately.[7] Of the 20 countries, 16 show a negative effect of steel IPs on downstream sectors' export competitiveness, with 9 of these statistically significant at standard confidence levels despite relatively small numbers of observations.

5.2. Export values versus export quantities

Export value is a product of price and quantity. Thus, the results to this point using export value as the dependent variable may confound the effect of steel IPs on downstream export prices and quantities. On one hand, one would expect that higher input costs would affect downstream sectors' quantities much more than prices if these downstream sectors

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[7] We cannot identify this coefficient for Taiwan as it never had steel IPs present during the sample years.

face highly competitive export sectors and/or produce relatively homogeneous goods (e.g., Cournot oligopoly). If this is true, then the effect of IPs on downstream export values is primarily the effect of IPs on downstream export quantities. However, if firms in the export sector have market power, they may adjust prices as well as quantities in response to higher input costs. Raising prices in response to higher input costs could mean that export value does not fall (in percentage terms) as does export quantity. Another possibility is that higher steel input costs cause adjustments in the downstream sector (such as substitution to lower-quality substitute inputs for steel) that may affect prices more than quantities. In this case, export value may fall (as prices are lowered) more than export quantity.

The COMTRADE data I use has quantity data for almost 99% of the observations. Thus, in Table 5 I rerun the specifications in Table 3 using the log of export quantity of the downstream sector rather than the log of export value. In the overall sample (estimates in column 1), the coefficient of interest is not much different when measuring exports in quantities (-1.86) versus in value (-2.24). The lower coefficient in the quantity regression suggests that the effect of steel IPs has a stronger effect in lowering prices of exports in the downstream sector than in lowering quantities. The difference is even more inconsequential when I split the sample into developed and less-developed countries. The effect of IPs is insignificant for the developed countries in my sample regardless of whether I measure exports in quantities or values, and almost identical in magnitude for the sample of less-developed countries. An interesting difference emerges in the Asian sample, however. The much larger coefficient in the export values regression suggests that downstream sectors' export prices fall much more than export quantities due to steel IPs. As mentioned, one possible reason for this may be substitution into alternative inputs.

5.3. Heterogeneity across IP types

A final analysis I undertake is to estimate separate effects of various IP programs. For these purposes, I group IPs into four different composite categories: 1) Export subsidies, 2) Government production subsidies, 3) Government ownership of production, 4) Cartel arrangements, and 5) Non-tariff import protection. Standard trade theory would suggest that export subsidies and non-tariff import protection should raise domestic prices of steel, hurting downstream sectors' export competitiveness. Likewise, cartel arrangements in steel, if effective, should raise the domestic price of steel. On the other hand, government subsidization should lower steel prices and help downstream sectors' export competitiveness. Its ambiguous whether government ownership would have an impact *per se*, as government ownership is often linked with less efficient management, but may also include implicit subsidization of operations.

Columns 1 and 2 of Table 6 provide the separate estimates of these five types of IP programs for the full sample and for LDCs in my sample, respectively. Results are quite consistent across the full sample and that of the less-developed countries, and the signs accord well with theory. Export subsides and non-tariff barriers have large negative and statistically significant effects on export competitiveness. The magnitude of these effects is similar to that found for the overall effect of all IPs. The harmful effect of non-tariff barriers is estimated to be particularly large in less-developed countries, with a coefficient around -7.0, which is over three times larger than that of the other negative IP effects. In contrast, I estimate a positive effect of government subsidies and grants on export competitiveness, though the magnitude of these effects is significantly smaller (0.475 in the full sample and 0.859 for the less-developed country sample), and only statistically significant for the less-developed countries. Government ownership has a negative and significant effect in the full sample, but is not statistically significant for the less-developed countries. Finally, cartel arrangements do not have any statistically significant effects in either sample.

5.4. Further robustness checks

I undertook a number of additional robustness tests. First, I experimented with a variety of lags of my focus variable, the interaction of IPs with the share of steel in the downstream sector. There is no evidence of lagged effects, indicating that the impact of IPs on downstream export competitiveness is quite immediate. I also explored heterogeneity of the IP effect across sectors. While the effect is a bit stronger in the sectors that use steel most (fabricated metals, machinery, and transport equipment), it has a significant average negative impact even for the sectors that have below-average use of steel inputs. Finally, I split my sample into years prior to 1990 and years after 1990, since there is a fairly significant drop in IP use after the late 1980s. I estimate a negative and significant effect of IPs in both periods, though the effect is about 50% larger in the earlier period.

6. Conclusion

Throughout history, governments have used IPs to guide the development of key sectors in their economies and spur general economic development. However, many of the IPs typically used will raise prices of the protected sector in the country, potentially hurting the competitiveness and development of the downstream sectors that use the protected sectors' products as inputs. Nevertheless, governments often make extensive use of IPs on sectors that are key inputs in the economy, presumably because the IPs will lead to a highly competitive sector in the long-run that no longer needs IPs and deliver low-cost inputs to the rest of the economy.

Despite the large stakes involved we don't know very much about how IPs affect other sectors, particularly the downstream sectors that rely on their products for inputs. The prior literature has focused exclusively on tariffs. In contrast, this paper examines a full range of IP programs that were used by various steel-producing countries during my sample period from 1975-2000. The evidence I find suggests that IPs have a statistically and economically harmful effect on the export competitiveness of downstream sectors after controlling for a full set of country-industry and country-time fixed effects. These effects are driven primarily by the LDCs in my sample, and estimates suggest that export subsidization and non-tariff import protection are the primary IPs, leading to reduced export competitiveness of the downstream sectors.

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Table 1
Descriptive statistics for the IP indicator variables

	Mean	Standard deviation	Minimum	Maximum
Export subsidies	0.22	0.42	0	1
Government production subsidies	0.69	0.46	0	1
Government ownership	0.57	0.50	0	1
Cartel arrangements	0.36	0.48	0	1
Non-tariff barriers	0.65	0.48	0	1
Total IPs	2.49	1.35	0	5

Notes: *Statistics based on the full sample of 319,419 observations. The total IPs variable is a sum of the five indicator IP variables for each observation.*

Table 2
Descriptive statistics for dependent variable and main independent variable

	Mean	Standard deviation	Minimum	Maximum
Log of export value	7.46	3.14	0	16.76
Log(1+ Steel industrial policies) × Log(1+ Steel input share)	0.03	0.07	0	0.57

Notes: *Statistics based on the full sample of 319,419 observations.*

Table 3
Steel industrial policies have significant negative impacts on downstream sectors' export competitiveness measure in export value

	Full sample	Developed countries	Less-developed countries	Asian countries
Log(1+ Steel industrial policies) ×				
Log(1+ Steel input share)	-2.242	0.199	-3.390	-3.395
	(0.025)	(0.038)	(0.043)	(0.041)
Country-industry fixed effects	Yes	Yes	Yes	Yes
Country-year fixed effects	Yes	Yes	Yes	Yes
F-statistic	55.36	245.76	327.12	361.86
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	319419	206363	113056	42483

Notes: *Dependent variable is the log of the value of a sector's exports. Standard errors, clustered by country-industry pair, are in parentheses.*

Table 4
Country-by-country effect of steel IPs on downstream sectors' export competitiveness

	Estimated IP effect	Number of observations
Argentina	3.676 (1.718)	14430
Austria	4.839 (1.004)	14982
Belgium	-0.920 (0.952)	16833
Brazil	-1.046 (1.038)	16545
Canada	-2.933 (1.552)	11355
Finland	-0.333 (1.147)	15388
France	-2.288 (0.776)	16981
Germany	-4.527 (2.608)	18230
Italy	-1.710 (0.704)	16974
Japan	0.817 (0.458)	17800
Luxembourg	-4.908 (1.118)	16339
Mexico	-4.275 (0.898)	15448
Netherlands	-0.308 (0.831)	16775
New Zealand	1.505 (1.421)	13382

South Africa	-0.768 (0.548)	12383
South Korea	-20.791 (2.027)	16758
Spain	-0.474 (0.726)	16846
Sweden	-1.320 (2.445)	14575
Turkey	-2.692 (0.601)	12721
United Kingdom	-1.839 (0.825)	16746

Notes: *The table reports the coefficient on variable Log (Steel industrial policies × Steel input share) when estimating equation (2) for a particular country's observations.*

Table 5
Steel industrial policies have significant negative impacts on downstream sectors' export competitiveness measured in export quantity

	Full sample	**Developed countries**	**Less-developed countries**	**Asian countries**
Log(1+ Steel industrial policies) × Log(1+ Steel input share)	-1.860	0.465	-3.449	-1.979
	(0.032)	(0.377)	(0.046)	(0.685)
Country-industry fixed effects	Yes	Yes	Yes	Yes
Country-year fixed effects	Yes	Yes	Yes	Yes
R^2	0.85	0.88	0.78	0.77
F-statistic	21.10	15.43	34.51	3.78
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	291911	191586	100325	40977

Notes: *Dependent variable is the log of the quantity of a sector's exports. Standard errors, clustered by country-industry pair, are in parentheses.*

Table 6
Negative impacts of steel IPs on downstream sectors' export competitiveness by IP types

	Full sample	**Less-developed countries**
Log(1+EXPORT SUBSIDIES) × Log(1+Steel input share)	-2.130	-1.962
	(0.320)	(0.344)
Log(1+GOVERNMENT PRODUCTION SUBSIDIES) × Log(1+Steel input share)	0.475	0.859
	(0.283)	(0.341)
Log(1+GOVERNMENT OWNERSHIP) × Log(1+Steel input share)	-1.446	0.443
	(0.296)	(0.394)
Log(1+CARTELS) × Log(1+Steel input share)	-0.029	-0.254
	(0.328)	(0.477)
Log(1+NON-TARIFF IMPORT PROTECTION) × Log(1+Steel input share)	-2.841	-7.041
	(0.465)	(0.668)
Country-industry fixed effects	Yes	Yes
Country-year fixed effects	Yes	Yes
R^2	0.87	0.80
F-statistic	52.93	49.11
(p-value)	(0.000)	(0.000)
Observations	319419	113056

Notes: *Dependent variable is the log of the value of a sector's exports. Standard errors, clustered by country-industry pair, are in parentheses.*

Figure 1: Average number of steel IP types for each country

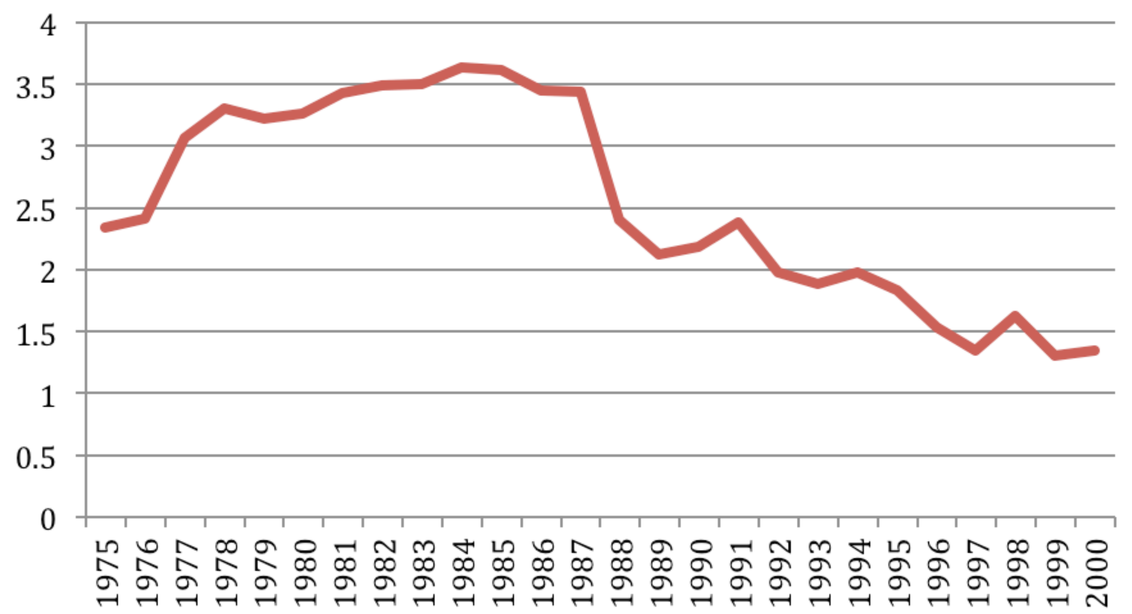

Figure 2: Average number of steel IP types by country over 1975-2000 period