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Input reallocation within multi-product firms☆

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ABSTRACT

This paper studies within-firm input reallocation, resulting from trade protection on imported raw material inputs used in firm-level production. Indian antidumping cases show that firms significantly lower their use of protected inputs from abroad, relative to other inputs in response to import protection. We develop a firm-level input-output correspondence, to identify outputs produced with protected inputs and find significant output losses relative to sales of other outputs. For India this corresponds to an aggregate annual output loss of up to 10% of Indian manufacturing output growth. The paper contributes to the misallocation debate by providing micro-foundations underlying more aggregate misallocations.

1. Introduction

One of the most important insights in recent years is that the misallocation of resources is a potential explanation for differences in output growth of countries and sectors (Hsieh and Klenow, 2009; Jones, 2011; Oberfield, 2013). Policies that influence the resource allocation across productive units can substantially impact aggregate output growth (Restuccia and Rogerson, 2008). The effect of trade policy shocks on the resource allocation across firms within an industry is now well understood (Melitz, 2003). But trade policy shocks may additionally result in within-firm reallocation of inputs. A misallocation of raw material input resources within firms, then adds to the output losses of sectors. Hence, not considering within-firm misallocation of inputs underestimates the true cost of trade protection, especially in a world in which inputs to production processes are frequently supplied across borders (Antràs and Chor, 2013).

The contribution of this paper is to document within-firm reallocation effects from import protection on raw material inputs, which has not been done before. At a time when protection is on the rise, it is particularly relevant to fully assess the impact of trade protection. But this immediately brings to mind a number of difficulties that typically prevent researchers from addressing this important question.

A first hurdle is that most firm-level datasets do not give information on what inputs are used in the production of their outputs. While firms often use multiple raw material inputs in their production, the expenses on these inputs are typically reported as one aggregate number at the firm level without any breakdown by input,

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such that input reallocation cannot be studied. In this paper we use a novel and unique dataset for India, that provides information on the quantity and value of each individual raw material input that a firm uses in production. These data allow us to identify very disaggregate inputs such as "cotton yarn" and "nylon yarn" used in the production of shirts, or "caustic soda" used in the production of soap. Given this detailed breakdown of raw material inputs in production, we are able to study whether trade protection on inputs results in raw material input reallocation within firms.

A second hurdle to overcome when studying input reallocation is that most firm-level datasets do not provide a firm level input-output correspondence, making it impossible to study output reallocation resulting from input reallocation. We therefore construct our own firm level input-output correspondence and identify outputs produced with protected inputs. For every affected firm we create a binary link between protected inputs and outputs that are produced with them. Once the input-output structure is in place, we can examine whether the reallocation of inputs induced by trade protection, also results in a reallocation of outputs within firms.

A third hurdle in addressing our research question, is the measurement of input reallocation. In the theoretical framework, we define input reallocation as a reduction in the quantity share of protected inputs in total inputs. However, in the empirical data, inputs can be very different, and are reported in different quantity units, which makes a quantity share at the firm level not meaningful. Empirically, we therefore measure raw material input reallocation both in quantities and in values. We study firm-level shares of protected inputs in total raw material expenditures before and after protection in treated and control firms, using double differencing. In addition, we also consider input reallocation at the more disaggregate firm-input level. This then requires a triple differencing procedure, where we compare the change in protected input use versus unprotected input use in treated versus control firms.

The trade shocks on the input side that we use for identification are Indian antidumping measures on the imports of raw material inputs. Since the early 2000s, India is one of the heaviest users of antidumping measures worldwide (Bown and Tovar, 2011). We study all 500 Indian antidumping cases that were initiated between 1992 and 2007, each involving one or several products resulting in 1300 different firm-inputs that were subject to antidumping measures. These antidumping measures are in the vast majority of cases tariffs, similar to traditional product level import tariffs, with an average tariff value over all cases of 62%.[1] In more than 90% of Indian antidumping cases, the protected goods classify as inputs into production as opposed to final goods. Antidumping measures on a particular input are discriminatorily imposed against selected trading partners, but 86% of Indian antidumping cases cover at least one of the three most important source countries of imports, making it very likely for an Indian importer of affected inputs to be exposed to these measures.

Empirically we find that Indian firms affected by an import tariff on inputs, reduce their use of protected inputs on average by 25–40%, relative to other inputs. The input reallocation effect becomes larger the longer protection is in force. At least part of the effect remains in place, once the temporary protection has been lifted, pointing to a more permanent effect of trade protection. Indian firms do not so much drop imported inputs ensuing trade protection, but use less of them in production relative to other inputs, consistent with earlier findings on trade shocks and adjustments along the different margins (Das et al., 2007). Input prices of protected inputs rise on average, but only for low intensity users of the protected input.

This input reallocation then feeds into output reallocation with firms reallocating their sales towards outputs made of unprotected inputs, and reducing their sales of outputs made of protected inputs on average by 50–80%, relative to sales of other outputs. Our evidence points in the direction of rising output prices of outputs produced with protected inputs. Despite rising output prices, we find trade protection on inputs to lower firm-level markups, suggesting incomplete pass-through of the cost of input protection into output prices.[2]

These empirical findings confirm the predictions of a theoretical model of heterogeneous firms that produce multiple outputs with multiple raw material inputs in production. Consumer preferences in the model are quasi-linear and allow for varying markups and incomplete pass-through of production costs into output prices (Melitz and Ottaviano, 2008). Inputs can be sourced from abroad or domestically, the former entailing larger fixed costs than the latter, but prices of foreign inputs are lower than domestic ones. In the multi-product firm with varying productivity along the product ladder (Eckel and Neary, 2010), a range of outputs will use at least some inputs from abroad and a range of outputs will only use domestic inputs.

The model predicts a number of within-firm adjustments ensuing tariff protection on foreign inputs. First, it raises the cost of foreign sourcing and results in input substitutability away from the protected input but towards larger use of unprotected inputs. Second, the cost of more expensive inputs will be passed on to output prices and lower the demand for outputs produced with protected inputs, which will negatively impact the use of all inputs that these outputs are made of. And third, input protection will affect the sourcing decision for some outputs in the multi-output firm. There will be a range of outputs with intermediate productivity levels that, after trade protection, can no longer afford to source internationally because of the larger fixed cost. These output varieties will switch supplier from foreign to domestic, despite the higher input price that the domestic supplier is charging. Demand for varieties that alter their sourcing will drop further as higher domestic input prices are passed on to consumers.

Independent of the degree of input substitutability, the model generates three predictions that are confirmed by our empirical findings. First, input reallocation takes place, resulting in a lower quantity share of protected inputs in total inputs. Second, output reallocation occurs, resulting in a reduction in the quantity share of outputs produced with protected inputs, in total firm outputs. Third, output prices rise but firm-level markups decrease with input protection.

An input-using domestic firm that is facing antidumping protection on a raw material input has to decide whether to continue importing the input from the same supplier, to switch supplier or to stop using the input altogether. Regardless of the input-using firm's choice, its marginal cost of production is bound to rise. If the firm continues to import the input, it is forced to pay the tariff, which will raise the cost of the input. Alternatively, the domestic firm may switch away from the protected supplier and start sourcing the input from another foreign or domestic supplier, which will involve an additional fixed cost as building new supplier relationships is time-consuming and costly. The new supplier's inputs can moreover be higher priced or of lower quality, which in case of the latter may cause additional processing costs for the input-using firm. Instead of disentangling each of the firm's potential responses, the model

[1] The tariff level is not only specific to the foreign trading partner but can even vary for different foreign firms. 62% corresponds to the average minimum tariff level per case, while 90% is the average maximum tariff level.

[2] Markups are measured at the firm as opposed to the product level to take into account that markups of other products made by the firm could also be affected by the import tariff through linkages in supply and demand.