# Global Sourcing from Low-Wage Countries: Implications for R&D and Employment*

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**Abstract**

We examine the implications of offshoring to China, Mexico and other low-wage jurisdictions using data on 6,500 Canadian manufactures who imported intermediate inputs between 2002 and 2011. We first present a model which illustrates that offshoring to low-wage countries can both help and hinder R&D and employment. As is standard, it helps by lowering costs which raises sales, employment, profits and the marginal returns to R&D. To see why it hinders we consider two types of goods, an R&D-intensive, high-quality good that uses high-quality domestic inputs and a non-R&D, low-quality good that uses low-quality imported inputs. As imported inputs become cheaper the profitability of no-R&D low-quality goods rises relative to R&D-intensive high-quality goods, which discourages innovation. For a firm that switches to low quality as a result of falling trade costs, R&D falls along with profits, sales and employment. Thus, whether low-wage offshoring helps or hinders R&D is an empirical question.

We regress long-run changes in firm outcomes such as R&D on firm-level imports of intermediate inputs from low-wage countries. We instrument for these imports using HS6 tariff changes and HS6 measures of pre-sample offshoreability, both averaged up to the firm level using firm import weights. We find that increased imports reduced employment by 7%, reduced R&D expenditures by 46%, reduced M&E investments by 29%, reduced sales by 8% and reduced profits by 17%. These are our main results.

In addition, sourcing high-quality intermediates from high-wage countries does not have these negative effects (a placebo test). Finally, there is no evidence of alternative mechanisms such as increased product-market competition, increased imports of goods for resale, or fragmentation of manufacturing.

Keywords: Offshoring, R&D, Employment.

JEL Codes: F1, F6, O3

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# 1 Introduction

Theories of global sourcing predict that firms offshore intermediate inputs in order to lower costs (e.g., Tintelnot, 2017 and Antràs, Fort and Tintelnot, 2017) and this insight is confirmed in CEO surveys which consistently show that cost reductions are the primary motivation for offshoring, e.g., McKinsey Global Institute (2010). Not surprisingly, there is a strong sense in the business community that the increased globalization of supply chains — especially the integration of China, Mexico and other low-wage jurisdictions into these supply chains — is crucial for the competitiveness of firms in high-wage jurisdictions. This sentiment is clearly expressed, for example, in corporate opposition to Trump's tariffs on intermediate inputs such as steel.

Global sourcing can do more than just lower costs. There is also evidence that it can promote process and product innovation. Manufacturers that start importing or increase their imports causally experience an increase in productivity in studies for Indonesia (Amiti and Konings, 2007), Chile (Kasahara and Rodrigue, 2008), India (Topalova and Khandelwal, 2011), and Hungary (Halpern, Koren and Szeidl, 2015). Further, India's cuts in tariffs on intermediate inputs improved Indian manufacturers' access to a greater variety of imported inputs. This reduced their marginal costs (De Loecker, Goldberg, Khandelwal and Pavcnik, 2016) and enabled them to produce a greater variety of goods (Goldberg, Khandelwal, Pavcnik and Topalova, 2010). China's tariff cuts on intermediate inputs raised firm-level productivity and markups (Brandt, Van Biesebroeck, Wang and Zhang, 2017), where we interpret higher markups in part as a reflection of quality improvements (innovation). Thus, in low- and middle-income countries, firm-level importing leads to process and product innovation.

We do not necessarily expect the same for high-wage countries because their firms source from China, Mexico and other low-wage countries primarily to reduce input costs, not to improve input quality or variety. The only study we are aware to address this question head on is Bernard, Fort, Smeets and Warzynski (2018) who find that Danish firms that source from new member states of the European Union (e.g., Poland and Czech Republic) causally increase their R&D. A related paper is Boler, Moxnes and Ullvtveit-Moe (2015) who convincingly show that in response to Norwegian R&D tax breaks, Norwegian firms simultaneously invest more in R&D and expand the number of products they import.[1] Clearly, more work is needed on this topic. Further, we shall see that these papers do not examine our core mechanism.

There are sound economic reasons for why greater integration of low-wage countries into high-wage supply chains can hinder R&D in high-wage countries. We develop a very simple model in which integration has one channel that helps R&D and another which hinders it. In the model there are two goods. The low-quality good is made with low-quality inputs and these are most cheaply sourced from low-wage countries. The high-quality good is designed with R&D and made with a combination of high-quality inputs (that can only be sourced from high-wage countries) and low-quality inputs. A fall in the cost of importing intermediates from low-wage

[1] Other more tangentially related papers include Peters, Lelarge and Blaum (2013), Blaum, Lelarge and Peters (forthcoming) and Kikkawa, Magerman and Dhyne (2017) as well as the empirics in the last section of Antràs et al. (2017).

countries lowers costs for both types of producers and raises the marginal returns to R&D by raising sales.[2] However, the cost share of low-quality inputs is higher for low-quality goods than for high-quality goods so falling import costs differentially benefits producers of low-quality goods. *This encourages some firms to switch from high-quality to low-quality goods, thereby reducing innovation.* For a firm that switches to low quality as a result of falling import costs, the model predicts not just a fall in R&D, but a fall in profits, sales and employment because low-quality goods by definition have low demand. Thus, whether low-wage offshoring helps or hinders R&D is an empirical question. This simple model makes two points. First, better integration of low-wage countries into the supply chains of high-wage countries can have either positive or negative effects on innovation. Second, if there are negative effects, then there will also be negative effects on employment.

With these possibilities in mind, we examine the impact of a firm's sourcing decisions on its employment, R&D expenditures, machinery and equipment (M&E) investments, sales and profits using data for 6,500 Canadian manufacturers who imported between 2002 and 2011. Since the fall in trade costs was secular and since it takes time for a firm to reinvent itself through innovation, we take a single long difference for each firm (2011 less 2002). We examine the impact of increased firm-level imports of intermediate inputs from low-wage countries. These countries are dominated by China and Mexico.[3] We employ two instruments for imports. The first instrument deals with the variable costs of importing (the intensive margin) as captured by tariffs. For each HS6 good we compute the 2002–2011 tariff change and average it up to the firm level using 2002 firm import weights. This is similar to Lileeva and Trefler (2010) and Hummels, Jorgensen, Munch and Xiang (2014). The second instrument captures the fixed costs of importing (the extensive margin). For each HS6 good we compute the share of Canadian firms that imported intermediate inputs from low-wage countries at the start of our sample (2002). We then average this share up to the firm level using 2002 firm import weights.

Armed with these instruments for imports we regress long changes in a firm's employment, R&D, M&E, sales and profits on long changes in the firm's imports of intermediate inputs from low-wage countries. Our main result is that increased importing of intermediate inputs from low-wage countries reduced employment by 3%–7%, reduced R&D expenditures by 20%–46%, reduced M&E investments by 13%–29%, reduced sales by 3%–8%, and reduced profits by 7%–17%. The larger numbers are average effects, meaning the effects for a firm whose imports increased by the average across all firms. The smaller numbers are 'typical' effects, meaning the effects for a firm whose imports increased from the 25th percentile of the distribution of import changes to the 75th percentile. The fact that all of these outcomes move in the same direction is consistent with the theoretical mechanism above of substituting from high-quality to low-quality.

In order to assess instrument validity we examine a number of features of the instruments. (1) Comparing firms with high and low values of the instruments, all pre-trends in firm performance

[2] This type of 'scale effect' has been documented empirically for Canada (Lileeva and Trefler, 2010), Brazil (Bustos, 2011) and China (Lim, Trefler and Yu, 2019).

[3] All conclusions hold when examining only imports from China.

satisfy the parallel trends assumption. (2) The instruments do no predict past firm outcomes, a falsification test. (3) In light of Goldsmith-Pinkham, Sorkin and Swift (2018), we show that our results do not change when we replace import weights with binary import weights (imported or not). Taken together, the instruments pass more tests than are typically used in the international trade literature. Also, we obtain similar results using a China Shock instrument (Autor, Dorn and Hanson, 2013).

It is possible that our results can be explained away by other mechanisms. We rule these out for the most important and obvious mechanisms. First, we conduct a placebo test. Our mechanism involves substitution from high to low quality. Our results should therefore disappear for intermediate inputs sourced from high-wage countries because they involve high-quality inputs. As expected, we find statistically and economically small effects for high-wage countries, and these are positive not negative. Second, a firm's increase in imports of intermediate inputs may be correlated with increases in product market competition faced by the firm. This competition could come from abroad (e.g., China) or from domestic firms. We include seven different measures of competition in our regressions and find that none of these affect our conclusions. Third, it is possible that the intermediate inputs end up being resold without further processing. Bernard, Blanchard, Beveren and Vandenbussche (2019) document that goods for resale, or what they call 'carry-along trade,' is pervasive. See also Bernard et al. (2018). We do not have their excellent data that matches what is produced with what is imported at the detailed product level. However, the Canadian ASM survey reports the value of goods for resale. We find that importing has a precisely estimated zero impact on goods for resale. Third, offshoring may allow firms to reorganize by, for example, hiving off non-manufacturing activities such as accounting. See Bernard and Fort (2015). While we do not have access to the type of data they use, the ASM distinguishes between a firm's manufacturing and non-manufacturing activities. We can thus compute the share of a firm's value that is associated with non-manufacturing activities. We again precisely estimated a zero impact of importing on firms' non-manufacturing activities.[4]

### Relationship to the Literature

Our work is related to the debate about the impact of product-market competition from Chinese producers exporting to the United States and the European Union. Two notable papers are Bloom, Draca and Van Reenen (2015) and Autor, Dorn, Hanson, Pisano and Shu (forthcoming) who examine the impact of Chinese import competition on the innovation activities of European Union and U.S. firms, respectively. Bloom et al. (2015) find that there is considerable heterogeneity in responses. Firms that were R&D-oriented before the China Shock escaped the competition by doing more R&D and patenting. Less R&D-oriented firms reduced their innovation activities. They argue that this can be explained by 'trapped factors,' that is, by firm assets that have no value

[4]The ASM variables on goods for resale and non-manufacturing activities are 'principal statistics,' that is, variables whose reliability is carefully checked because they feed into the system of national accounts. Also, in 2000-2002 there was overlap in how products and imports were classified. In unreported results we find that firms rarely imported the same goods they produced or produced in the past. This is consistent with Atalay, Hortaçsu and Syverson (2014).

outside of the firm but do have value if the firm continues to engage in innovative activities. See also Bloom, Romer, Terry and Reenen (2014). In contrast, Autor et al. (forthcoming) find that Chinese import competition reduced the patenting activity of U.S. firms and this is true even for R&D-oriented firms. In private conversation, Bloom explains the discrepancy by appeal to environmental differences, pointing specifically to the relative lack of competition in the European Union. Kueng, Li and Yang (2016) use Canadian data to estimate the effects of Chinese import competition on employment and innovation. They find that increases in imports from low-wage countries reduce both employment and innovation. Gutiérrez and Philippon (2017) and Pierce and Schott (2017) find that the China Shock led U.S. firms to reduce capital investment, investments which often embody new technologies. Finally, Lim et al. (2019) use a calibrated model to show that increased import competition from China has reduced R&D in the OECD. The fall in R&D is the net of two effects, reductions in R&D as firms doing R&D exit and increases in R&D as surviving firms escape the competition by doing more R&D.

We noted above that Boler et al. (2015) and Bernard et al. (2018) arrive at different conclusions than ours, so this requires a reconciliation. Recall that Boler et al. (2015) showed that in response to Norwegian R&D tax breaks, Norwegian firms simultaneously invested more in R&D and expanded their global sourcing. Their study does not distinguish between low- and high-wage sourcing so their results are not necessarily incompatible with ours. That said, even if all Norwegian imports were from low-wage countries their results would still be completely consistent with our model and empirics. An R&D tax break encourages firms to switch from low quality to high quality. This raises R&D and allows firms to grow, thereby increasing all of their activities, including offshoring to low-wage countries. That is, an R&D tax break leads to substitution *towards* high quality. In contrast, falling trade costs leads to substitution *away* from high quality. Thus, any apparent differences in results can be explained by differences in the choice of instrument.

Another excellent study is Bernard et al. (2018) who find that Danish firms who offshore causally increase their R&D. Their study has several advantages over our own. They match what a firm produces with what it imports. This allows them to define offshoring as the change in the import share of produced goods. That is, they match goods produced by the firm with goods imported. It also allows them to examine movements in the prices of produced goods relative to offshored goods, which gets at quality as well as cost savings. They also know the educational attainment of workers in their firms and are able to show that their slightly negative effect of offshoring on employment reflects significant increases in highly educated workers that are offset by significant decreases in less-educated workers. We do not have educational status in our data. There are too many differences between their study and our own to be sure why some of the conclusions differ. One source of differences is that their main IV specification is restricted to new member states of the European Union such as Poland and the Czech Republic. These countries are considerably richer than Mexico and China. Another source of differences is that Danish offshoring is primarily offshoring of produced goods rather than intermediate inputs. See their

figures A.4 and A.5. Our mechanism is about intermediate inputs, not produced goods.[5]

Finally, we turn from firm outcomes to welfare. Our standard theories strongly predict that if all trade costs falls from prohibitive to zero, all countries must experience a welfare gain. So why should we be concerned about the negative impact of China, Mexico and other low-wage countries? Among other reasons, there is a large literature about local, knowledge-based externalities and how important these have been over long periods of history as a major source of economic growth. See Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992) for theoretical discussions on innovation-driven growth. See Helpman (2004) for a review of the evidence. Such externalities have long figured in international trade models, e.g., Helpman (1984), Krugman and Venables (1995), and Grossman and Helpman (1991, ch. 8)).[6] If falling trade costs reduce innovation in high-wage countries then this has a negative welfare impact that does not appear in our standard models.

[5]Their study uses Danish data, a small country with a somewhat narrow industrial base for offshorers (see their figure 1), so that their IV subsample has only 139 firms that offshore. (There are many more in the full sample.) In contrast, we have about 5,000 firms that offshore to low-wage countries.

[6]This does not detract from the important point made by Atkeson and Burstein (2010) and Burstein and Atkeson (forthcoming) that absent externalities, the impacts of trade on R&D overstate the impacts of trade on welfare. Essentially, if there are no externalities then the fixed costs of entry must exactly offset the benefits from R&D.

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