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Robison, H. David. 1988. Industrial pollution abatement: The impact on balance of trade. *Canadian Journal of Economics* 21:187–99.
Walter, Ingo. 1973. The pollution content of American trade. *Western Economic Journal,* 11:61–70.
World Bank. 2001. *China: Air, land, and water.* Washington, DC: World Bank.
World Trade Organization (WTO). 2006. *Trade policy review: People's Republic of China.* Geneva, Switzerland: WTO.
Zhang, Shuguang, Yansheng Zhang, and Zhongxin Wan. 1998. *The costs of protection in China.* Washington, DC: IIE.

Comment Arik Levinson

Dean and Lovely's chapter makes an important and interesting contribution to our understanding of the relationship between international trade and pollution. Many observers argue that developed countries, such as the United States, have improved their environments in recent decades largely by outsourcing pollution-intensive production to developing countries, such as China.[1] If that is the case, U.S. imports and Chinese exports should be increasingly composed of pollution-intensive goods. Economists have now refuted that idea, from the U.S. perspective, by showing that the composition of U.S. imports has become less pollution-intensive over time, not more.[2] Dean and Lovely are the first I know of to examine the converse. They show that the composition of exports from China has been shifting toward cleaner goods, not dirtier.

The result nicely complements existing evidence from the U.S. perspective and is, therefore, both important and believable. However, the analysis contains two unavoidable biases that unfortunately work in favor of that result, making the composition of China's exports appear spuriously cleaner. Dean and Lovely acknowledge both biases clearly in their chapter and explain convincingly that they have exhausted all possibilities for ameliorating those biases given the available data. It is, therefore, worth taking a few moments here to demonstrate with the U.S. data just how large those biases can be.

The first bias involves industry aggregation. Dean and Lovely calculate emissions intensities (pollution per thousand yuan of output) for each of thirty-three sectors, listed in their appendix table 11A.1. They then conduct a counterfactual thought experiment, constructing the aggregate pollu-

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1. See, for example, Jane Spencer, "Why China Could Blame Its CO2 on West," *Wall Street Journal,* November 12, 2007, A.2.

2. In addition to work cited by Dean and Lovely, see Kahn (2003), Cole (2004), and Gamper-Rabindran (2006).

tion intensity of Chinese exports, assuming each of the thirty-three sectors remained at its 1995 pollution intensity, but allowing the composition of exports among those thirty-three sectors to change over time. The results are the dashed lines in figure 11.5, which display how pollution caused by production of Chinese manufactured exports would have changed, holding the sector-specific pollution intensities constant, and allowing the composition of exports among the thirty-three sectors to change. The fact that the dashed lines slope down indicates that Chinese exports are increasingly composed of sectors with lower pollution intensities.

The industry aggregation bias arises because the thirty-three sectors are themselves heterogeneous. Sector 22, "papermaking and paper products," includes raw pulp manufacturing, which is extremely pollution-intensive, and envelope manufacturing, which is not. By holding the pollution-intensity of the entire paper sector constant, the dashed lines in figure 11.5 rule out any within-sector composition change. If the composition of industries within each of the thirty-three sectors has shifted toward dirtier goods (more raw pulp and fewer envelopes), Dean and Lovely's calculation will overstate the degree to which Chinese export composition has become cleaner.

To get a feel for the magnitude of this bias, I apply their analysis to data on U.S. imports and sulfur dioxide (SO_2) emissions. The bottom (dashed) line in figure 11C.1 depicts the pollution intensity of U.S. imports from non-Organization for Economic Cooperation and Development (OECD) countries. It is calculated by holding constant the pollution intensities of each of the eighty-six four-digit North American Industry Classification System (NAICS) industry codes at their 1997 levels and calculating the aggregate pollution intensity of imports. The dashed line in my figure 11C.1 is analogous to the dashed line in Dean and Lovely's figure 11.5 (though my line uses eighty-six sectors while theirs uses thirty-three, and mine plots U.S. manufactured imports from all non-OECD countries, while theirs plots all Chinese manufactured exports). I then reconstruct the same line using the 469 six-digit NAICS industry codes. Paper manufacturing, for example, has eighteen different six-digit industry codes. This new line is plotted as the middle (solid) line in figure 11C.1. It lies above the dashed line, indicating that using the more aggregate industry definitions (eighty-six four-digit NAICS codes) exaggerates the composition change of U.S. imports toward cleaner goods. It also suggests that aggregating trade into even fewer sectors, as Dean and Lovely do, may exaggerate that composition change even more if the within-sector composition of Chinese exports has shifted toward pollution-intensive industries.

The second bias involves intermediate goods. When China exports a good, part of the pollution comes directly from the industry that manufactured it. But part also comes from the industries that manufacture the inputs to that good, and the inputs to those inputs, and so on. Look, for example, at Dean and Lovely's table 11.1. Chinese exports of basic metals (sector 27) declined

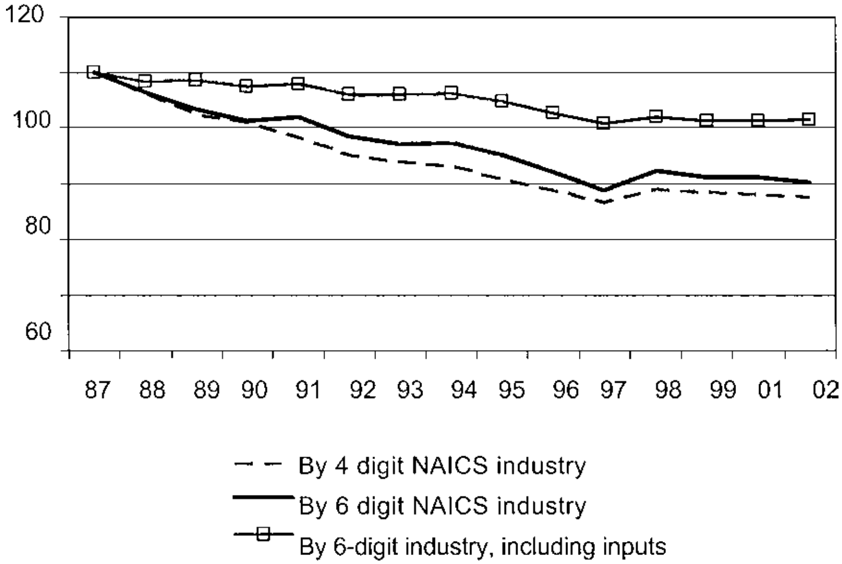

Fig. 11C.1 Pollution (SO_2) intensity of U.S. imports from non-Organization for Economic Cooperation and Development (OECD) countries, 1987–2002

from 5.2 to 4.1 percent of exports, while at the same time motor vehicles (sector 34) rose from 1.4 to 2.1 percent of exports. Because basic metals production is more pollution-intensive than motor vehicle manufacturing, this change represents a composition shift toward exporting cleaner industries. But motor vehicles use fabricated metals as an input, and fabricated metals use basic metals as an input. So exporting more cars does not necessarily reduce China's emissions. The problem here is that the emission intensities ignore pollution from intermediate inputs. What we need is a *total* emissions coefficient that includes pollution from the direct manufacture of each good, the pollution from manufacturing that good's intermediate inputs, the pollution from manufacturing inputs to those inputs, and so on.

In figure 11C.1, I recreate the Dean and Lovely thought experiment, from the perspective of U.S. imports, using total emissions coefficients, including all intermediate manufactured inputs.[3] The top line plots the average emissions intensity of U.S. imports from non-OECD countries, holding constant the emissions intensity of each six-digit NAICS industry code at its 1997 level, but including emissions caused by manufactured inputs to those industries. The top line slopes down much less steeply than the middle line, which ignores intermediate inputs. Importing relatively more cars does not make import composition appear as clean once we account for the steel,

3. Details of this calculation can be found in Levinson (2007).

rubber, and glass that go into those cars. Ignoring those intermediate inputs exaggerates the composition change of U.S. imports toward cleaner goods. And, figure 11C.1 also suggests that ignoring intermediate inputs exaggerates the composition change of Chinese exports documented in Dean and Lovely's figure 11.5.

Figure 11C.1 presents a version of Dean and Lovely's analysis using data on U.S. imports, where it is possible to combat both biases. It demonstrates that, at least for the case of U.S. imports, the two biases exaggerate the composition change. But the biases do not overturn the basic result, that the composition of U.S. imports has become cleaner in recent decades. Because the Dean and Lovely analysis is essentially the converse of this U.S. analysis (Chinese exports rather than U.S. imports), their result also seems likely to survive the two biases. We will never know for sure, however, until somebody constructs emissions coefficients for a finer disaggregation of Chinese industries and input-output tables that can be used to construct emissions coefficients that account for intermediate inputs.

References

Cole, Matthew A. 2004. U.S. environmental load displacement: Examining consumption, regulations and the role of NAFTA. *Ecological Economics* 48 (4): 439–50.

Gamper-Rabindran, S. 2006. NAFTA and the environment: What can the data tell us? *Economic Development and Cultural Change* 54:605–33.

Kahn, Matthew E. 2003. The geography of U.S. pollution intensive trade: Evidence from 1959 to 1994. *Regional Science and Urban Economics* 33 (4): 383–400.

Levinson, Arik. 2007. Technology, international trade, and pollution from U.S. manufacturing. NBER Working Paper no. 13616. Cambridge, MA: National Bureau of Economic Research.