

participation in risk pooling; by defining a universal explicit right to a BP of specified insurable events; and by targeting subsidies to public health goods to the poor, the aged, the indigent, and other disadvantaged groups. In addition, the authors stress that the overall efficiency of the health sector needs to be overhauled by what they call “strategic purchasing.” Future lines of research are: the classification of health shocks according to the proposed taxonomy, the policies that should be implemented to increase participation in SI systems, how to delink risk-pool financing from labor status, and the mechanisms that should be implemented to increase the overall efficiency of the health sector. I am less surprised now, after reading this interesting and well executed book, that there has been so little reform in the health sector in LAC in last two decades.

## REFERENCES

- Arrow, Kenneth J. 1985. “Uncertainty and the Welfare Economics of Medical Care.” In *Collected Papers of Kenneth J. Arrow, Volume 6: Applied Economics*, ed. K. J. Arrow. Cambridge, Mass. and London: Harvard University Press, Belknap Press, 15–50.
- Galiani, Sebastian, and Federico Weinschelbaum. 2007. “Modeling Informality Formally: Households and Firms.” Unpublished.
- Laffont, Jean-Jacques. 1990. *The Economics of Uncertainty and Information*. Cambridge, Mass.: MIT Press.
- ▶ Rothschild, Michael, and Joseph E. Stiglitz. 1976. “Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information.” *Quarterly Journal of Economics*, 90(4): 630–49.
- Sheshinski, Eytan, and Luis Felipe López-Calva. 1998. “Privatization and Its Benefits: Theory and Evidence.” Cambridge, Mass.: Harvard University.

SEBASTIAN GALIANI

*Washington University in St. Louis*

*Global Integration and Technology Transfer*. Edited by Bernard Hoekman and Beata Smarzynska Javorcik. Trade and Development series. Washington, D.C.: World Bank, Houndmills, U.K. and New York: Palgrave Macmillan, 2006. Pp. xix, 346. \$35.00, paper. ISBN 0–8213–6371–9, cloth; 0–8213–6125–2, pbk.

JEL 2006–1478

This book collects a series of recent papers—either already published in academic journals, working paper series or other volumes—analyzing the impact of trade openness on technological

change broadly defined. The fact that most of the papers have been published elsewhere makes it very interesting to readers who did not closely follow this field in recent years.

The various chapters are very different in approach and methodologies used to establish a rich set of results. For those who are familiar with the recent developments in the field, it cuts both ways. On the one hand it should make us less nervous about the exact estimation algorithms and functional forms we use in applied work as this book documents strong relationships between technology (measured in various ways) and openness to trade using a series of methodologies. However, given that the papers here want to formulate policy recommendations, and go beyond establishing strong correlations between firm performance and international activities—such as exporting, importing and FDI—the underlying model and what we exactly measure becomes very important. As the editor asked me to referee this entire book, I will not go into an elaborate discussion of each chapter.<sup>1</sup> I will first discuss ( a selection of ) the main results that I found to be important, especially in light of current and future work that needs to be done.

The increasing availability of micro data (plant and firm level data) has boosted empirical work in this area of research in the recent years. It is therefore hard to avoid that some studies that find different results—than those found by this volume—are not mentioned or cited. In addition it is edited by the World Bank and therefore only natural that most of the papers are taken from in-house research of the past years. Regardless of the specific choice of papers, this book introduces an interesting mix of country, industry, and firm-level evidence to put results in perspective.

The book has three parts where the first one is essentially a literature review which is extremely useful for “students” of the field. The remainder of the book deals with various studies using a mix of country-level, industry-level, and firm-level data for various countries trying to link openness to trade with productivity and technology transfer, all broadly defined.

In general, the channels for technology transfers are activities that are directly or indirectly

<sup>1</sup> The fact is that most of the chapters collected in this volume have already been published and went through a referee process.

related to trade. Direct transfers occur through direct trade in knowledge through technology purchases or licensing. The papers collected in this book, however, only consider the indirect transfers of technology either by trading goods and services or through receiving FDI.

One theme that appears in various chapters is a long and still outstanding empirical question: whether firms gain from engaging in export activities. Various studies have established a strong relationship between firm performance and export status. The book presents evidence for two alternative hypotheses: self-selection into export markets and learning by exporting. The evidence for the latter has been confirmed recently in various studies (e.g., Johannes Van Biesebroeck 2005). However, it is clear that the exact channels of these productivity gains upon export entry have not been analyzed. This is clearly an important area of research especially since the World Bank has been an important player in pushing forward export supporting policies. One important aspect seems to be the characteristics of the destination market (Jan De Loecker forthcoming). However, a key problem remains to disentangle the effects of importing intermediate inputs while being an exporter and to determine which activity impacts firm-level productivity most, in order to pin down the productivity gains from only exporting. Related to this, chapter 12 documents that increased import competition only leads to productivity gains for firms not engaged in export activities. This again demonstrates the importance of analyzing the interplay of exporting and importing—ideally—at the plant level and to what extent that trade liberalization impacts productivity through intermediate inputs or through increased export participation on the output market (Mary Amiti and Joep Konings 2006).

A crucial component which is not mentioned in any of the various chapters is to understand the relationship between international activities of firms and *performance* and whether in this context trading—in broad terms includes importing, exporting, and FDI—impacts different firms differently. This heterogeneous response to trade needs to disentangle passive learning effects from active investments (Alla Lileeva and Daniel Trefler 2007). In other words, the black box that generates productivity gains needs to be opened up. It therefore is important to collect more detailed

data on contracting, investment behavior, and marketing efforts—at the firm level—and link them up with international activities. In addition, we will have to go beyond case study evidence in order to understand the more fundamental processes of productivity growth through international activities.

When analyzing the impact of receiving FDI, an important distinction is made between horizontal and vertical *spillovers*. In terms of terminology, spillovers in this context are actually referring to inter and intra industry *linkages* and quantifying how important they are across industries. Using plant-level data on Lithuania, evidence for vertical linkages are found to be important. More specifically, the only strong channel of productivity spillovers occurs through buying inputs from multinationals (backward linkages) rather than selling to multinationals (forward linkages). Given the insights from other chapters by Jim Tybout, the interpretation of these results is that essentially multinationals upstream increase quality of the inputs or decrease costs of production. Empirically it is still an open question which of the two is the most important one.

A rich set of results are presented that establish productivity gains for firms that receive FDI. However, domestic firms not receiving FDI can lose out.<sup>2</sup> An important determinant for FDI to be beneficial to the local economy is the degree of absorptive capacity and the exact type of FDI, i.e., through fully owned foreign subsidiaries or through joint ventures. The modes of FDI are in turn depending on whether the foreign investors are technological and marketing leaders in their sectors. This has serious implications on the informational burden that governments and institutions face that want to attract FDI.

Given the high number of chapters written by a dozen of authors, it is hard to avoid that some of the underlying modeling approaches and implications are different. Initially it comes across as strength of using different methodologies across the various papers to establish the main results.

However, there is one underlying theme that struck me as an important contradiction. It is

<sup>2</sup> The fact that negative productivity effects are established for domestic firms in this context immediately begs the question what the productivity measures used in these studies are meant to capture, i.e., do we want to include say market power? I address this concern below.

stated very clearly in chapter 4 that “. . . *despite the large volume of research on the link between trade and productivity, there are several ways in which the literature might be improved. One would be to stop pretending that firms in manufacturing industries produce homogeneous products and instead deal with pricing, output and productivity measurement in unified frameworks.*” Although that only recently a few papers have addressed this question in detail, the other chapters that link productivity to export status, FDI linkages, openness to trade, etc. are very salient about how their productivity measures are essentially composed of both true efficiency measures and market power (markups and demand shocks). Using these measures is fine for establishing a relationship between firm profitability and trade openness. However, using those measures to infer whether exposed to more trade or receiving FDI is welfare improving is not without any problems. This implies that all results established throughout the various chapters have to be interpreted as *trade openness* increases sales per input (or value added per worker) and not necessarily the true efficiency of firms. However, in chapters 8 and 11, this concern is explicitly addressed and taken into account when verifying the impact of trade on productivity. This distinction is crucial to verify whether the technology transfer through trade and FDI is welfare improving or not. In this sense, all of the results are salient on this matter. In defense of the various authors, the current state of the literature is just trying to unravel the true productivity response from trade openness and distinguish it from market power broadly defined (level of markups, quality, etc.).

The various studies in this book essentially analyze the productivity gains that could emerge from trading, receiving FDI, or direct knowledge transfers. Productivity gains refer to an increase in the residual of the production function but are not able to distinguish—or pick up at all—whether trade induced technology diffusion leads to process innovation or product innovation. Chapter 11 takes this distinction serious and finds—using a novel approach to combine a demand system with the traditional production function—that international activities seem to move costs and product quality in the same direction. Although that the new methodology presented is promising, it has to rely on somewhat strong

assumptions on the production technology; where constant returns to scale seems to be the most important one. However, the authors of that chapter have worked on a more *flexible* approach (Haijime Katayama, Shihua Lu, and Tybout 2006).

When analyzing the impact of openness on productivity, it is important to distinguish between the quality and the quantity of trade. This leads the editors to conclude that trade openness per se, although crucial, is not enough to boost productivity in developing countries. In addition, an important policy recommendation that is mentioned at different places throughout the book is that host-country absorptive capacity is crucial for obtaining significant benefits from FDI and this implies that liberalization of trade and FDI policies should be complemented with measures that target education, and physical and human capital accumulation. This leads to a very long check list of policies that need to be put into place in order for trade liberalization to be effective in increasing performance of domestic firms in developing countries, ultimately leading to higher growth of the economy as a whole. This is related to the series of papers that study whether trade and competition policies are complements or substitutes (Hylke Vandenbussche 2000; Henrik Horn and James Levinsohn 2001). The results published in this volume indicates another important policy that has to be put into place in order obtain gains from trade.

Finally, a very interesting set of open research questions are listed on pages 19–22. It is clear that reading the series of papers collected here are a very important component of understanding how to answer these. I must say that, after reading the book, the reader should be clear about what the outstanding questions are and even more so how to go about and address them. Given the importance the World Bank has in guiding economic policy—especially in developing countries—the policy conclusions are based on sound empirical work covering various datasets and institutional designs.

#### REFERENCES

- Amiti, Mary, and Joep Konings. Forthcoming. “Trade Liberalization, Intermediate Inputs, and Productivity.” *American Economic Review*.
- De Loecker, Jan. Forthcoming. “Do Exports Generate Higher Productivity? Evidence from Slovenia.” *Journal of International Economics*.

- ▶ Horn, Henrik, and James Levinsohn. 2001. "Merger Policies and Trade Liberalisation." *Economic Journal*, 111(470): 244–76.
- Katayama, Haijime, Shihua Lu, and James Tybout. 2006. "Firm-Level Productivity Studies: Illusions and a Solution." NBER Working Papers, no. 9617.
- Lileeva, Alla, and Daniel Trefler. 2007. "Does Improved Market Access Raise Plant-Level Productivity?" Unpublished.
- ▶ Van Biesebroeck, Johannes. 2005. "Exporting Raises Productivity in Sub-Saharan African Manufacturing Firms." *Journal of International Economics*, 67(2): 373–91.
- ▶ Vandenbussche, Hylke. 2000. "Trade Policy versus Competition Policy: Substitutes or Complements?" *De Economist*, 148(5): 625–42.

JAN DE LOECKER  
New York University

## Q Agricultural and Natural Resource Economics · Environmental and Ecological Economics

*Solar Revolution: The Economic Transformation of the Global Energy Industry.* By Travis Bradford. Cambridge and London: MIT Press, 2006. Pp. xvi, 238. \$24.95. ISBN 978–0–262–02604–8. *JEL* 2007–0342

At a time when political turmoil in the Middle East is forcing the rest of the world to think hard about alternative energy sources, the arrival of Travis Bradford's new book, *Solar Revolution: The Economic Transformation of the Global Energy Industry*, is opportune. It joins a growing number of books dedicated to examining how we can meet the world's energy demand when its dependence upon fossil fuels (as it eventually must) ends. Do not be mistaken in thinking that it is about the "greening" of America, about how we should embrace solar power as a clean source of energy for its own sake; you will be sorely disappointed if you do. Instead, Bradford's take on solar power is that, for economic and technological reasons (with a few nice benefits for the environment on the side), solar power is one of the few viable energy sources to which we can turn given our current delivery of energy through the grid system. *Solar Revolution* makes measured arguments that are not overly technical as to why solar powered energy makes sense in financial and technological terms. It is important to keep in mind that this is not a book written by an economist for economists—it is meant to appeal to the reader with little to no background

in economics but with some financial common sense.

*Solar Revolution* starts by taking the reader on a whirlwind history of world energy use, starting when mankind first learned to harness fire, through to the first recorded energy shortage (somewhere around the 3rd or 4th millennia BCE<sup>1</sup>) on to the importance of coal during the Industrial Revolution, and then the rise of electricity and our current dependence upon fossil fuels. Where we end the journey is where we are today: a place that Bradford describes as an unsustainable status quo. With world population projected to grow by 3 to 4 billion people over the next fifty years (p. 45), the corresponding growth in energy demand cannot be met with dwindling supplies of fossil fuels.

So, what can we do? Bradford briefly discusses a number of alternative energy sources, from wind to biomass, but very quickly focuses on solar as the adoption choice that makes the most sense. In particular, he focuses on the potential for photovoltaic (PV) technology. PV relies on sophisticated solar panels to collect the sun's light and heat and convert it directly into electric current. A common concern that is voiced about solar energy is what happens when there is no sunlight? Where will the power come from then? Battery storage is always a possibility, but not a very popular one. A major advantage of PV that may overcome this problem is that it can be grid-tied with other PV systems as well as being integrated into the existing electric grid. What that means is that for those with PV grid-tied technology, when they produce excess electricity, the excess can be transferred to the electric grid, and when there is excess demand by the PV users (during the night or winter), electricity from the grid may be transferred to the users. This can be done using a "net-metering" system so that during parts of the day, PV suppliers might be selling their electricity to the grid, while during other parts of the day, the PV suppliers might be buying electricity from the grid.

Although this all sounds appealing, to make solar energy viable will require a substantial commitment from consumers, producers, and the government. A large fraction of *Solar Revolution* is dedicated to describing in some detail the programs developed by the Japanese and German governments to support and promote solar energy. These programs have included substantial