

# Spillover and Scale Up or Stall? Chinese manufacturing and forward linkages in the Malaysian solar industry

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## Solar Manufacturing and Local Installation

**I**n 2009, Chinese industrial policy and overproduction led to a massive increase in the quantity of solar panels available on the global market, deeply undercutting comparatively high-cost producers in the United States.<sup>60</sup> The price of solar precipitously declined, and global solar installation soared. However, these Chinese firms priced out higher-cost U.S. and European Union (EU) competitors. In 2011, the U.S. and EU imposed retaliatory tariffs on solar photovoltaic cells and modules imported from China, rather than competing with China on cost.<sup>61</sup> To avoid these tariffs, China first moved production first to Taiwan, but lawyers caught up in 2014 and added tariffs to Taiwanese imports. When these 2014 tariffs from SolarWorld Americas

doubled the tariff on solar panels to the U.S.A., Chinese firms chose to yet again offshore solar cell and module manufacturing facilities to nearby Southeast Asian countries, and export onwards to the United States as a tariff circumvention strategy.<sup>62</sup> In 2015, China shifted solar module assembly to Malaysia, Thailand, and Vietnam, building out Malaysian factories in under six months. Did this shock of foreign manufacturing investment increase downstream firm and household productivity for local solar installation?

The remainder of this article proceeds as follows. I first lay out political economy expectations regarding the effects of foreign manufacturing on downstream industries. Local firms interested in solar installation that are located near new manufacturers can connect

with upstream suppliers and should be able to build solar projects at a lower cost as a result. After describing the processes by which FDI can lead to these local linkages, I evaluate the case of Chinese solar manufacturing in Malaysia, drawing on government documents, news reports, and policy briefs from local academic experts. I conclude with a summary of my findings, namely that solar manufacturing does not seem to significantly impact local solar installation and provide some policy suggestions regarding how to exploit FDI more effectively for local renewable energy industry development.

### **FDI and Local Linkages?**

Foreign direct investment (FDI) in manufacturing can create positive spillovers in downstream segments of the supply chain by reducing cost of inputs, transaction costs of procurement for domestic firms, and employing local labor. First, if manufactured panels are available for sale on the local market, rather than simply exported abroad for tariff jumping purposes, Chinese production relocation should directly reduce the total cost of solar panels for local firms and households. Second, as highly productive firms, foreign investors can transfer skills and technology gained through expertise abroad to local markets.<sup>63</sup> They can even provide locals with information about global suppliers for additional components like inverters, even if Chinese panels themselves are not being consumed in Malaysia. Finally, foreign companies can employ local labor in the production process, in this case Malaysians in solar manufacturing.<sup>64</sup> Theoretically, this access to capital, expertise, and local employment will increase domestic expertise regarding solar, and lead to more growth in the local market.

On the other hand, middle income countries have historically struggled to grow domestic industries beyond export-oriented and low value-added manufacturing, falling into the middle-income trap.<sup>65</sup> In these cases, foreign investment is directed towards providing goods for the export market, operating in

enclaves that yield little spillover for the local economy. Malaysian solar presents a unique case of investment and spillover that echoes these potential constraints on the positive benefits of FDI. In solar, all foreign manufacturing facilities are located in Special Economic Zones (SEZs). SEZs were originally intended to serve as vehicles for development, to both entice foreign firms and mediate technology transfer to locals.<sup>66</sup> However, in practice, work finds mixed evidence for their efficacy in achieving positive developmental outcomes.<sup>67</sup> While manufacturing investment may facilitate downstream solar installation via lower costs to locals and higher foreign expertise, the fact that facilities are located in SEZs may pose an impediment to spillovers.

The Malaysian solar industry case presents a rich opportunity to investigate the benefits and challenges for spillover from upstream to downstream segments of the supply chain. Chinese manufacturing has two key advantages that may increase the likelihood of local spillover, rather than an “enclave effect.” First, solar panels are a relatively simple product, and Chinese firms produce the cheapest, most basic version of solar technology - polycrystalline silicon photovoltaic panels. This technology has a low “gap” between FDI and host country capabilities, because it is relatively compatible with Malaysian firms’ existing business activities in low-complexity electronic equipment.<sup>68</sup> As the gap is low, Chinese FDI presents a “likely case” to observe forward linkages to the local economy. Second, Chinese firms strategically chose production relocation to exploit regional cultural variation that reduces transaction costs. Chinese Jinko Solar and JA Solar both set up shop in Penang, the Chinese speaking part of Malaysia. Given that local labor is more likely to speak the MNCs’ native language, and share cultural ties, the transaction costs of doing business and sharing knowledge with local firms are lower.<sup>69</sup> For these reasons, solar provides a “best case” scenario of forward linkages.

## Case study: Chinese Solar Manufacturing in Malaysia

Did Chinese manufacturing benefit solar installation areas closer to production facilities, with lower-cost panels, access to expert knowledge, and solar industry employment? In this section, I first provide background on the Malaysian solar industry, and then evaluate the case of Chinese solar manufacturing and local installation in Malaysia with qualitative evidence. Prior to the relocation of Chinese manufacturing, Malaysia already had adopted policies supportive of domestic solar installation. In 2011, Malaysia adopted a Feed in Tariff (FiT) subsidy for small (up to 5 Megawatt) solar, restricted to domestic firms and households.<sup>70</sup> This provided a flat subsidy per unit (Megawatt) of energy sold, which ensures firms make a profit on energy sold back to the grid. In 2016 this policy was substituted with Net Metering, which allows for self-consumption of solar energy, again restricted to small domestic firms and households. In 2019, the government swapped these locals-only policies for an auction system with competitive bidding for larger projects and allowed foreign investment. Theoretically, firms and households closest to Chinese manufacturers should experience the highest reduction in costs – and increase in solar installation – after the 2015 production relocation.

Chinese firms specifically offshored manufacturing capacity to Malaysia following European quota impositions in December 2013 and a sharp increase in U.S. tariffs in 2014 from 26.71 to 78.42 percent on solar cells and 27.64 percent to 49.79 for modules.<sup>71</sup> JA Solar, JinkoSolar, and LONGi all shifted production facilities to Malaysia in 2015, with JA and JinkoSolar located in Penang, and LONGi in Sarawak. These three facilities accounted for over a third of total Malaysian solar exports in facility capacity (i.e. number of production lines) at the time of construction - though in output, they likely even accounted for a greater share of production. The two facilities located in Penang are the focus of this study, as Sarawak operates on a unique grid system with different

governance over renewable energy subsidies and solar installation.

Despite the opportunity afforded by solar manufacturing in its relative technological simplicity, and the advantageous location of Chinese production facilities in terms of local language compatibility, there is little evidence to suggest that Chinese manufacturers created significant positive benefits for local solar installation. First, Chinese solar manufacturers did not visibly contribute to local supply chains for solar installation, except in the largest of projects. Systematic searches of local newspapers identified few instances of Chinese solar modules used in a local solar project. JA Solar publicized the fact that it supplied modules to Malaysia's "largest single-axis tracking PV project," a massive 116 MW solar farm in eastern Malaysia in 2022, as well as the first floating solar project and the first installation with bifacial modules and sun-tracking technology in 2020.<sup>72</sup> However, JA Solar's collaboration appears limited to only the largest projects in Malaysia, and there is no evidence to confirm that Jinko Solar supplied modules for *any local Malaysian solar projects*. Beyond the "first" innovative large-scale projects, all of which were constructed many years after 2015 solar manufacturing relocation, Chinese manufacturers have not supplied the domestic market.

However, even with limitations in supplying solar panels to locals, solar manufacturers do appear committed to utilizing local labor. CEO of Jinko Solar, Kanping Chen, remarked that "Malaysia offers us talent pool of highly educated workers and engineers, relatively advanced industry infrastructure, a receptive business investment climate, cost competitive environment. In return, we bring our latest technology and manufacturing excellence know-how and expertise, our experienced management team helping to cultivate local talents, and our capital as well."<sup>73</sup> Indeed, Jinko Solar promised to create 4000 jobs at the manufacturing facility.<sup>74</sup> That said, these employment benefits appear insufficient to generate significant public awareness about the benefits of solar



installation. Other authors find that Malaysian public awareness of solar energy and its benefits is overall very low, despite hosting manufacturing facilities.<sup>75</sup> This is compounded by the fact that households enjoy subsidized electricity from fossil fuel generation. While there are some targeted employment benefits to high-skilled workers, it is unclear if manufacturing relocation truly increased widespread awareness of solar energy among the local population.

Indeed, the primary proponents of solar energy in Malaysia seem to be local firms themselves, adopting solar to power energy intensive industrial operations rather than an FDI-driven pattern of solar energy adoption.<sup>76</sup> For example, local leading solar developer SOLAR+ lists that its primary clients are local firms with a high level of energy consumption, including IOI Acidchem and Ma Sing Plastics manufacturing facilities, and an IKEA shopping mall.<sup>77</sup> Solar helps power these industrial and commercial businesses at a low cost. These large, industrial, electricity consumers have driven Malaysia's solar energy installation – but this domestic demand does not appear to have benefitted from Chinese production destined for U.S. and European markets.

Spatial analysis of solar investment among Malaysian firms and households, which exploits available government data on the Feed-in-Tariff subsidy and auction contract recipients, confirms that areas closest to Chinese manufacturers did not, in fact, experience a significant increase in solar installation after manufacturing relocation. Evidence echoes the enclave hypothesis at best, where some Malaysian workers may be employed at solar assembly facilities, but panels are produced for export and Chinese firms only do business with the local market on the largest of projects.

## Conclusion

Did areas most proximate to Chinese manufacturing in Malaysia install more solar relative to areas far away? On balance, I find scant evidence for meaningful local linkages, beyond a small number of manufacturing-

workers and a handful of large local projects where Chinese manufacturers have supplied modules. This engages with IPE debates about the relative benefits of foreign investment, particularly how manufacturing does, or in this case does not, lead to local industry scale up. On balance, solar panel manufacturing follows more an enclave-style model of investment and export, where foreign firms exploit local labor and expertise but do not contribute significantly to local infrastructure and development.

While the case of Malaysia may be unique in that China specifically relocated production to evade tariffs on exports to the United States, these insights travel to other green technologies that are often destined for North American and European Markets, like electric vehicles. Particularly in green technologies where the technology gap between FDI and host countries is higher, these enclave-style effects are likely to persist even in the absence of tariff jumping incentives. Broadly, where FDI invests to produce for export markets, production alone may be insufficient to reap benefits for local firms. In Malaysia, the real determinant of local solar installation seems to be demand from the business community rather than some FDI-led pattern of spillovers. Centering the role of local firms, rather than foreign investors, may be most effective to sustain energy transition.



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