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Citation for published version:

Siedlok, F, Hamilton-Hart, N & Shen, HC 2022, 'Taiwan's COVID-19 Response: The Interdependence of State and Private Sector Institutions', *Development and Change*, vol. 53, no. 1, pp. 190-216.
<https://doi.org/10.1111/dech.12702>

Digital Object Identifier (DOI):

[10.1111/dech.12702](https://doi.org/10.1111/dech.12702)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Development and Change

Publisher Rights Statement:

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Taiwan's COVID-19 Response: The Interdependence of State and Private Sector Institutions

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ABSTRACT

During 2020, Taiwan's facemask policy formed a critical part of its relatively successful response to the COVID-19 pandemic. It also served to showcase capacities for coordinated action by state and business actors. This article demonstrates that Taiwan's ability to rapidly increase facemask production called for the government and key industry players to overcome a series of cooperation challenges. The authors show that the effective industry response required concerted action in three domains: the state sector, business–government cooperation, and cooperation among private firms. This article makes two contributions. First, it differentiates the dynamics attached to coordination, commitment and collective action challenges that actors in public and private sectors needed to overcome in order to deliver on the policy. Second, it contributes to the literature by endorsing the view that business–government cooperation and private sector coordination are complementary and interdependent. The findings presented here further illustrate the evolution of Taiwan's state institutions in their capacity to take on new tasks and modes of interaction with private sector actors.

INTRODUCTION

The COVID-19 pandemic has highlighted the need for coordination and collective action among public and private actors (Hattke and Martin, 2020). Discussions around the challenges of collective action focused initially on the early race to supply ventilators (Elsahn and Siedlok, 2021); this was followed by tensions around the production of vaccines (Beardsley, 2021; Karp, 2021) and, more recently, acute shortages of oxygen supplies (Parker, 2021). One of the earliest challenges, however, was ensuring sufficient supply of medical facemasks. Acute shortages of this unassuming,

The authors would like to thank the anonymous referees for their constructive comments on the earlier versions of the manuscript. We also would like to recognize Taiwan's contribution to fighting the global pandemic, despite the adversities it faces.

Development and Change 53(1): 190–216. DOI: 10.1111/dech.12702

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low-complexity product left healthcare workers and patients exposed, and policy makers scrambling to purchase or develop sufficient manufacturing capacity (Contrera, 2020). In early 2020 medical facemasks became one of the most coveted commodities worldwide (Subramanian, 2020).

The rapid upscaling of facemask production and distribution in Taiwan required effective state and private sector cooperation to overcome a range of coordination challenges and formed an important part of Taiwan's relatively successful response to the COVID-19 pandemic. Overall, cases in Taiwan remained very low throughout 2020 and, despite an outbreak in late April 2021, Taiwan escaped a full lockdown, avoiding major disruption to economic activity, social life and education (*The Economist*, 2020; Kuo, 2021). By September 2021, total deaths attributed to the disease in Taiwan stood at 835 — around 35 deaths per million inhabitants, well below fatalities in the United States (1,914 per million) and much of Europe.¹ The shortfall in Taiwan's pandemic response has been slow procurement of vaccines, which the Taiwanese government blamed on Chinese obstruction (Davidson, 2021). Resolving this problem also called for state and private sector cooperation, as access to the German BioNTech vaccine was eventually arranged by two large technology companies (Taiwan Semiconductor Manufacturing Company and Foxconn) and a Buddhist charity (Chung, 2021; Hille, 2021).

This article focuses on Taiwan's facemask policy of 2020, as a showcase of capacities for coordinated action by state and business actors. As early as January 2020, Taiwan's authorities recognized the potential risk of shortages of medical facemasks and undertook to rapidly increase production and manage distribution. The challenge was greater than might be assumed. The difficulties faced by countries across the world in securing supplies of this critical product demonstrate that soaring demand did not automatically lead to sufficient market supply (Dallas et al., 2021). Although facemasks are seen as a relatively low-technology product, the production machinery and process are complex and demand access to specialist, often tacit, knowledge to achieve production at scale (Elsahn and Siedlok, 2021). Consequently, governments and industry players quickly came to realize that they faced a series of challenges related to rapidly scaling-up production. Chaotic market conditions in the United States showed that uncoordinated attempts to procure increased supplies were doomed to fail (Contrera, 2020). Left to market forces alone, the private sector was unlikely to have invested in increasing mask production capacity in ways that channelled large volumes of masks, at affordable prices, to those that needed them.

The Taiwanese facemask policy therefore required an actively coordinated response. This was in many ways state-led, as suggested by accounts of Taiwan's pandemic response that emphasize the enduring importance of Taiwan's 'developmental' state institutions (Yen, 2020). Just as the United

1. Based on public data from Johns Hopkins University (<https://coronavirus.jhu.edu/>) and Taiwan Centres for Disease Control (www.cdc.gov.tw/En).

Kingdom's response to the pandemic was shaped — for the worse — by the institutions of its 'regulatory' state (Jones and Hameiri, 2021), so Taiwan's developmental state institutions influenced the course of its pandemic response.

The institutions of the developmental state, however, do not reside only in a centralized, authoritative state (Haggard, 2018; Hattke and Martin, 2020). We argue that Taiwan's ability to rapidly increase mask production required government and industry to overcome a series of cooperation challenges in three domains: the state sector, business–government cooperation, and cooperation among private firms. Such concerted action is difficult. The capacity to achieve coordinated action within and across state and private sectors depends on specific attributes of formal and informal institutions that structure action by both state and private sector players. Together, these form an 'institutional ecology' in which institutions are interdependent (Doner et al., 2021). In the case of the Taiwanese state, the relevant attributes include centralized authority, ambition and organizational capacity. Scope for business–government cooperation rests on institutionalized relationships between public and private sector actors (Wade, 2018) while, in the case of private sector cooperation, business associations and other interfirm connections underpin collective action (Chung, 2001; Hamilton, 1997; Noble, 1998).

The argument that specific institutional characteristics enable particular economic outcomes is consonant with major streams of thought in the literature on economic development and industrialization in East Asia, including Taiwan. The first contribution that we make here is to differentiate the cooperation challenges Taiwanese actors in public and private sectors needed to overcome in order to deliver on the policy aim of rapidly scaling-up mask production. We differentiate the dynamics attached to coordination, commitment and collective action challenges, highlighting the different range of institutional capacities involved (Ricks and Doner, 2021).

Second, we contribute to the literature that sees government intervention, business–government cooperation and private sector coordination as complementary and interdependent (Doner et al., 2021; Haggard, 2018). Although this analysis is limited to the particular requirements of increasing production and managing distribution in a mature industry, the analytic lens of identifying specific cooperation challenges relating to a developmental task (Ricks and Doner, 2021) provides an alternative perspective on debates over whether state or private sector actors drive development. Rather than seeing these as zero-sum spheres of action, we show that what is most critical is whether the overall institutional mix can supply the coordination required for a particular developmental task. Thus, our analysis informs ongoing debates about the evolution and functioning of state and private sector institutions in Taiwan (Chen and Chen, 2016; Hamilton-Hart and Yeung, 2019; Wade, 2014, 2018; Wong, 2004).

Third, the escalation of mask production illustrates the dynamics of successful state-led intervention in a mature industry, identifying capacities for reviving 'old' industries that may have largely moved offshore. Mature industries remain important as providers of employment and supply chain resilience, as suggested by recent calls for reshoring of industrial capacity (Dallas et al., 2021). Thus, understanding the dynamics of industry coordination in this area complements the recent works on state-led development and industry coordination in high-tech or frontier industries (Chu, 2021; Kim, 2021; Wong, 2011).

Our account of cooperation within and across government and industry recognizes the importance of other factors. The 2003 SARS epidemic, for example, can be seen both as an exogenous factor that prompted 'learning' on the part of key officials and as a pivotal juncture that prompted the creation of a legal and administrative infrastructure for centralized, authoritative state action that was brought into play in 2020 (Yen, 2020). The legacy of the earlier SARS experience does not, however, fully explain the successful response to the COVID-19 pandemic in 2020. As we show below, the legacy of SARS was in fact perverse when it came to scaling-up mask production, creating additional challenges to securing private sector investment.

Taiwan's diplomatic isolation and the domestic politics of increasing Chinese pressure against manifestations of Taiwanese nationalism, evident in the lead-up to Taiwan's presidential and legislative elections of January 2020, also formed the backdrop for the pandemic response (Yu, 2021). They appear to have been key factors in Taiwan's very rapid response to the first news of a novel virus in China, which in part was informed by mistrust of early Chinese assurances (Armitage and Stein, 2020). Heightened concerns about the threat represented by China over the course of the pandemic may also have reinforced the long-standing role of security motives underpinning developmental state institutions (Zhu, 2002: 20).

The next section briefly reviews the institutional foundations of Taiwan's accelerated industrialization, and makes explicit the different cooperation problems associated with different economic challenges or tasks (Ricks and Doner, 2021), showing how different institutional capacities are called upon to resolve these challenges. The subsequent section then describes the details of Taiwan's mask policy, showing the varying cooperation challenges facing state and private sector actors. This is followed by a discussion of the empirical findings in relation to the cooperation challenges and institutional capacities involved. The final section offers some conclusions.

INSTITUTIONS AND COLLECTIVE ACTION IN TAIWAN'S DEVELOPMENT

Seminal studies of Taiwan's rapid economic development have focused on the array of policy interventions by state actors (Wade, 1990, 2014). State

institutional capacity — in the form of coherent, disciplined state organizations with prestige, expertise and authority — was a critical prerequisite for successful intervention, which would otherwise have fostered unproductive rent seeking. This capacity was deliberately created in the early decades of Kuomintang (KMT) rule by investments in key bureaucratic organizations. Centralized coordination, strong organizational independence from the legislature and societal interests, and an elite recruitment system were important characteristics (Cheng et al., 1998).

As Taiwan's economy matured and its political system democratized, the state's economic role and underlying institutional attributes shifted. While the success of the developmental state 'sowed the seeds of its own degeneration', it simultaneously 'created the imperatives for its continual adaptation' (Wong, 2004: 348). Some accounts emphasize the retreat of the state, as Taiwanese firms became enmeshed in global production networks (Yeung, 2017). Nonetheless, the state remained active in solving coordination problems, such as the diffusion of technology from public research institutions and reducing the cost of risky research and development (R&D) (Breznitz, 2005). State intervention continues to demonstrate its ambition in several frontier industries and in steering the internationalization of the Taiwanese economy (Chen and Chen, 2016; Chu, 2021; Kim, 2021; Wong, 2006).

Meanwhile, the institutional characteristics of the state sector also evolved. Although democratization put pressure on state autonomy and administrative discretion (Wade, 2018), a close-range study by Bernstein (2020) has shown that civil service organizations retained a strong institutional ethos and understood accountability to include a leading role for proposing legislation and policy formation. Officials 'do not present the relationship as one of unilateral command by the legislature, nor of mechanical implementation by the agency' (ibid.: 37). Bernstein concludes that 'Taiwan's bureaucracy has built on, rather than simply rejected, its role in the country's dictatorial developmental-state period. Retaining its centrality in a modified way, the bureaucracy has presented itself as a key site for public participation in creating the common good' (ibid.: 45).

Early revisions to the developmental state thesis called into question a sole focus on the state sector institutions that underpinned authoritative intervention. Cooperation between business and government was in fact central to East Asian developmentalism (Doner, 1992). The institutional preconditions for productive cooperation are demanding. Relationships need to be close and trusting enough to ensure adequate information flows and willingness to cooperate. Yet close and friendly relationships can easily pave the way for capture, rent seeking and corruption. Treading the fine line between these outcomes calls for an institutionalized relationship that provides for cooperative but disciplined interaction, described as 'embedded autonomy' (Evans, 1995) or 'governed interdependence' (Weiss, 1995). The developmental state gains high 'capacity' from such institutional arrangements (Wade, 2018). Rather than attributing accelerated industrial transformation

to an all-powerful autonomous state, the developmental state model 'rested on coordination and communication with private actors and complex bureaucratic capabilities in policy implementation and monitoring' (Haggard, 2018: 31–32).

A focus on the business–government relationship calls for greater attention to the mediating institutions that prescribe de facto rules for interaction between public and private sectors (Doner, 2009). Characteristics of state institutions (for example, the degree of effective hierarchical discipline) incentivize different types of interaction with private actors (personalized and informal, for example, or collective and formalized), with predictable consequences for the discipline and consistency of policy implementation (Davidson, 2015; Hamilton-Hart and Palmer, 2017). The organization of private sector actors also matters: the readiness of firms to organize through business associations or interfirm group ties varies widely, affecting the firms' ability to provide common-good functions independently and enabling collective interactions with government actors (Doner and Schneider, 2000; Noble, 1998; Wade, 2018).

These lines of enquiry offer different paths to understanding the role of institutions. While *who* is driving action varies, both state-led and private sector-led accounts describe a variety of developmental or industrialization-related 'tasks' of varying difficulty, which call for specific institutional characteristics to resolve them, depending on the nature of the underlying cooperation dilemma (Doner and Schneider, 2016; Doner et al., 2021; Ricks and Doner, 2021). Building on this insight, we make explicit the different types of cooperation problems involved in increasing mask production in Taiwan: *coordination problems*, *commitment problems* and *collective action dilemmas*.

There are situations in which actors gain from implementing a common standard or other coordination measure and, crucially, face no incentives to renege once a line of action or standard is agreed to. This dynamic characterizes governance standards from which all actors in an industry benefit because they reduce market 'friction' (the costs of producing to multiple different standards) across a range of issues, from technical compatibility standards to mutual recognition of pharmaceutical safety and efficacy rules (Bach and Newman, 2010). However, such mutually beneficial coordination can fail to occur, leading to *coordination problems*. The transaction costs involved in reaching agreement among a large number of actors may impede coordination. Distributional conflicts may also prevent agreement, for instance when the choice of a particular standard benefits those actors most able to meet it. Nonetheless, non-hierarchical coordination often occurs when institutions such as industry associations, international organizations or private governance systems lower the transaction costs involved in voluntary negotiation and exchange of information (Büthe, 2010).

Commitment problems describe situations in which all parties would gain from coordination, but incentives for compliance depend on each actor's

assessment of whether the other actors will make good on their promises. Lacking credible assurances of the others' cooperation, each actor will rationally prioritize the smaller, but more certain, reward associated with non-cooperation (Skyrms, 2004). The need to ensure the credibility of commitments affects many initiatives to upgrade production or pursue economic development (Ricks and Doner, 2021). This dynamic is frequently diagnosed as a reason for non-compliance with government industrial policy — that is, firms do not trust the government and thus withhold investment. Asset specificity can also create commitment problems among private firms, if assurances for long-term commitments (in technological development, skills or upgrading) are lacking. Studies of commitment problems have shown that they can be overcome through specific institutional designs or reassurance strategies. Social structures or norms that heighten the 'shadow of the future' (increasing the salience of future events) and make commitments more credible, enhance prospects for cooperation (Skyrms, 2004). Firms can reassure partners who are asked to make specific, long-term commitments through mechanisms such as joint venture structures that provide mutual reassurance (Yamagishi and Yamagishi, 1994). A government which needs to offer private investors sufficient reassurance that it will not expropriate or over-tax private investment returns may introduce 'self-binding' restraints or engage in co-investment strategies (Hamilton-Hart and Palmer, 2017; North and Weingast, 1989).

Collective action dilemmas are characterized by the presence of ongoing incentives to defect even when the cooperation of other parties is guaranteed. Potential gains from free riding mean that these dilemmas cannot be resolved by reassurance alone. Thus, cooperation requires 'contingent commitments' to cooperate *if* the other parties cooperate, but also to punish or exclude those who do not cooperate (Axelrod and Keohane, 1985). While often resolved through hierarchical solutions, non-hierarchical institutions that lower the transaction costs of monitoring and sanctioning non-compliance can also perform these functions and thereby ease collective action dilemmas (Bair, 2008; Williamson, 1996).

Coordination, commitment and collective action dilemmas can be viewed as types of incomplete contracting in the tradition of transaction cost economics: situations in which mutually beneficial action by two parties may fail to occur due to what Williamson (1981, 1996) referred to as 'hazards' arising from bounded rationality and opportunism. In this tradition, the transaction costs of resolving such hazards through developing different types of 'safeguard' vary according to both the macro-institutional environment (features such as the legal and political system) and three conditions relating to the transaction itself: the expected frequency or recurrence of future transactions involving the parties; uncertainty or problems of measurability; and asset specificity. The appropriate 'mechanism of governance' (market, hierarchy or network, in Williamson's schema) for

organizing transactions thus varies, with hierarchical control becoming more efficient as transaction costs rise.

Viewed from this perspective, studies that emphasize the role of both large business groups and close ties among small firms in Taiwan attest to a highly developed set of institutional safeguards supporting cooperation in the private sector. From early in the post-war period, firms were incentivized to form business group structures (Chung, 2001) and pursue cooperative, iterated relationships linking independent firms (Hamilton, 1997; Lee, 1995). Although evolving as market and political conditions have changed (Chung, 2006), those Taiwanese firms that have developed the capacity for collective action through the formation of network-like ties continue to benefit from reduced transaction costs of exchange, access to capital and sharing of information (Hsieh et al., 2010; Lin and Lin, 2016; Liu et al., 2020). While much of the literature refers to these networks as creating 'trust', they can equally be seen as creating credible solutions to problems of uncertainty and asset specificity, by providing institutional mechanisms for monitoring, reputational sanctions and expectations of future interaction (Williamson, 1996: 250–75).

In the next section, we examine Taiwan's facemask policy with a view to showing the different types of cooperation challenges and the variety of institutional safeguards through which they were resolved. In some cases, the hierarchical authority of centralized state organization is visible; in many other areas we see less hierarchical institutional solutions to problems of coordination, commitment and collective action.

TAIWAN'S MASK POLICY: COOPERATION CHALLENGES

Taiwan's facemask policy aimed to rapidly increase mask production and ensure availability at reasonable cost. We break down the tasks involved into roughly sequential steps: increasing production capacity, managing production output, and ensuring smooth distribution of masks. In each of these areas, we see the capacities of an authoritative state sector with the ambition, legal mandate and centralized coordinating capacities typical of the developmental state, as recognized in another account of Taiwan's successful pandemic response (Yen, 2020). But, equally, we show that these state sector capacities worked in tandem with the private sector, both in terms of the cooperation between government and business actors, and the degree of independent private sector coordination.

The Production Capacity Challenge: Taiwan Face Mask Team

Taiwanese officials recognized a potential shortfall in mask supply fairly early in the pandemic. The Ministry of Economic Affairs (MOEA)

estimated the country's stockpile to be 40–45 million masks (Ministry of Economic Affairs, 2020a). With 90 per cent of masks being imported (Taiwantrade, 2020), concerns arose that supplies might be disrupted, leading to a public panic, as had occurred during the SARS outbreak (Yan, 2020). Once the first COVID-19 case was confirmed in Taiwan, demand rapidly started outstripping supplies (Formosa TV, 2020).

The first information requirement was to ascertain the extent of the shortfall in production capacities. This called on the established bureaucratic monitoring capacities of the Taiwanese state sector. As early as 24 January Vice-Premier Chen Chi-mai coordinated with Shen Jong-chin, Minister of Economic Affairs, regarding the current stock of personal protective equipment (PPE) and the supply that was needed. Hong Hui-song, head of the Industrial Development Bureau of the MOEA, was already compiling a list of manufacturers of epidemic prevention materials, including masks, to ensure that the National Health Command Center (NHCC) of the Department of Disease Control (CDC) had access to the necessary information (Zhuang, 2020). MOEA finally listed 66 mask manufacturers of medical or surgical masks,² with a total production capacity of 1.88 million facemasks a day, well short of the forecast potential demand of 10 million facemasks per day (Ministry of Health and Welfare, 2020). Chen Chi-mai recognized the problem: 'I told Minister Shen [the Minister of Economic Affairs], we need to add more lines. We will need to produce these ourselves' (Executive Yuan, 2020).

Taking action required the strong legal mandate and specific organizational structures of the state sector, created in part as a result of the legacy of the SARS experience of 2003 (Yen, 2020). For example, Hong Hui-song and Huang Po-hsiung — the Director of Products within Taiwan Textile Research Institute (TTRI), a government-funded research institute, and a chief-in-command for PPE textile production during COVID-19 — both noted that the SARS experience taught them the importance of understanding the existing supply capacity (Yan, 2020). Chen Chien-jen, a Health Minister during SARS and a Vice-President during the COVID-19 outbreak, remembered the SARS experience as 'really chaotic', marked by panic buying of masks, mistrust, and 'people jumping out of windows' (Hernández and Horton, 2020). In the following years, he was instrumental in implementing a series of reforms aimed at improving coordination between different

2. Initially, media reported different numbers due to differences in counting methodologies. By counting all mask manufacturers who obtained medical equipment licences, the Ministry of Health and Welfare put the number at 80. After removing duplicate licencees and entities without manufacturing registration, MOEA adjusted the number to 66. Of these, 29 had reasonably big operations and the remaining 37 were small (Ministry of Economic Affairs, 2020b; Yan, 2020). Some estimates put the number of remaining manufacturers at 52, which was based on the number of manufacturers who were later licensed by the Ministry of Health and Welfare to double imprint masks with the letters MD alongside the Made in Taiwan mark, to clearly distinguish them from imported products (Yan, 2020).

organizations (*The Japan Times*, 2020). A raft of new regulations and laws centralized control in order to improve communication and coordination. As Chou Jih-haw, Director General of CDC, explained: 'We knew that during SARS opinions within the government varied widely, creating problems for the chain of command. So after SARS we made a lot of reforms. After we established CECC [Central Epidemic Command Centre] the entire country's chain of command came under direct line and everyone acted as one' (Executive Yuan, 2020).

The Central Epidemic Command Centre (CECC) is a division of the NHCC, to be activated when necessary. The Communicable Disease Control Act (formulated in 1944 and amended in 2019) grants the CECC extra powers to supervise and coordinate responses across government organizations, state enterprises and civic groups. The CECC thus acts as a unified command centre, with the authority to provide recommendations and coordinate works across government departments, to enlist additional personnel and to establish additional taskforces. Its structure includes surveillance, response and logistics divisions. The 1944 act was supplemented in 2004 by the Implementation Regulations Governing Materials for Communicable Disease Control and Establishment of Resources Act, regulating the management of medical resources supplies, including PPE (Ministry of Health and Welfare, 2016). This allows government authorities to requisition production equipment, facilities and materials during emergencies, with appropriate compensation. Finally, CDC's Strategy and Execution Plan for PPE during Pandemic Outbreak specifies responsibilities and procedures across several ministries for monitoring stockpiles and demand, coordinating supply, and overseeing fair trade and pricing of PPE during an outbreak (CDC, 2011). The CECC was activated on 20 January 2020.

While the procedures and regulations outlined above enabled officials to quickly assess existing stockpiles and production capacity, the task of actually increasing production remained unaddressed. The government set the goal of developing 60 production lines in 45 days, with an additional 32 production lines being added later, in recognition of the fact that existing production capacity was insufficient (TVBS News, 2020). The target was ambitious: in normal circumstances setting up one production line takes up to six months (Taiwantrade, 2020). Only two manufacturers of mask-making machines were left in Taiwan, both of which lacked resources to expand capacity. For one of the machine manufacturers, a government delegation deemed that 'at most two mask machines can be made a month', with the second manufacturer having even more limited capacity (Zhuang, 2020). As it became clear that these companies were unable — and, as we elaborate later, unwilling — to deliver the government order, on 4 February MOEA contacted three public research institutes, Industrial Technology Research Institute (ITRI), Metal Industries Research & Development Centre (MIRDC) and Precision Machinery Research & Development Center (PMC), requesting them to help the two remaining facemask machine

manufacturers. Zhuang reports: ‘After understanding the actual needs and conditions of mask machine manufacturers on February 5, they knew that they were not good at the “assembly technology” needed at this stage, so they decided to seek support from others in industry’ (ibid.).

At this stage the team had no clear plan of how to address the issue. On 6 February, Lai Yung-hsiang, General Manager of PMC, received a phone call from Yen Jui-hsiung, Chairman of Taiwan Machine Tool & Accessory Builders’ Association (TMBA) offering help from the tooling and machinery manufacturing industry. Meanwhile, Hsu Wen-hsien, Director of the TMBA Board, sent a message to Minister of Economic Affairs Shen Jong-chin, also offering help. The gravity of the task was confirmed by Yen Jui-hsiung after he visited one of the facemask machine manufacturers, noting that: ‘That’s almost mission impossible for such a small company to take such big orders. I shook my head and knew I would have to send a crew who not only know machines but who are very adaptive to all kinds of emergencies’ (Cheng and Lauly, 2020).

The next day, MOEA, ITRI, MIRDC, PMC and TMBA met and decided to set up an empty warehouse as a manufacturing space in Taipei, as neither of the existing facemask machine manufacturers had sufficient workshop space. The state’s centralized capacities for command were evident: the MOEA ordered state-run power and telecom companies to set up basic infrastructure, while the Industrial Development Bureau arranged for the installation of base stations to provide mobile coverage (Zhuang, 2020). Without any state compulsion, machine tool companies volunteered their top engineers and equipment. This hastily assembled group became known as Taiwan Face Mask Team (TFMT).³ Meanwhile Hsu lobbied more companies to send staff to join the team (Executive Yuan, 2020).

The next challenge was getting access to technical information, which posed both commitment and collective action challenges. Despite sending their top engineers, none of the TMBA member companies had experience in making mask-manufacturing equipment. Xu Haodong, the deputy manager of Takisawa Taiwan (a member of TMBA), recalled that: ‘We have

3. Different names have been used in media and writing in reference to the team. Initially, given the focus on the development of the production lines, the team comprised the ITRI, MIRDC, PMC, TMBA and the two facemask machine manufacturers (NCM and Chang Hong). Some accounts also include TTRI as part of the team. As the production lines were completed and the focus switched to maximizing output, the 29 mask manufacturers who were given the machines were included. In some cases, the term was used to refer to all requisitioned mask manufacturers (66 in total), and later to the 52 mask manufacturers who obtained a licence for double embossing (see previous footnote). Changes to the composition of the team were also reflected, to some extent, in the names that have been given to the team, which include: ‘machine tool national team’, ‘national mask team’, ‘mask national team’, ‘mask team’, ‘national team’ or ‘Taiwan Face Mask Team’. There were also references to other teams that helped during the pandemic (e.g. ‘Hidden Mask National Team’ denoting the team behind the name-based distribution system). We adopted ‘Taiwan Face Mask Team’ as the most precise of the terms.

never touched the mask machine before, all from scratch. It is very difficult and [we feel] helpless to be responsible for this work' (Zhuang, 2020). Codified information was almost non-existent and the two requisitioned mask machine manufacturers were reluctant to share their know-how and actively assist the TFMT and the government (TVBS News, 2020). Their memory of how the industry was left to collapse after the SARS outbreak made them reluctant to engage; at the same time, they were worried that the tooling companies would enter the small domestic market. Initially, two factions formed within the TFMT: one pushed for a reverse-engineering approach, while the other was wary of further diminishing trust within the sector. Some team members noted that reverse engineering might not reveal the crucial 5 per cent of tacit knowledge. Dai Yunjin — manager from Takisawa Taiwan who, after a meeting between TMBA and MOEA, was selected as the site commander — advocated approaching the mask machine manufacturers to involve them in the team. He reassured the company owners that: 'We won't come to grab your business. If there are future orders, we will pass these to you. We can be good strategic partners to cooperate in the future' (Lin, 2020). The commitment was finally achieved, after three days of persuasion, with an additional verbal assurance from Hsu Wen-hsien, who recalled:

We were afraid that Hsiao [owner of one of the remaining mask machinery manufacturers] thought we were going to copy their machines, and he was reluctant to participate. Therefore, I swore in front of him saying 'I promise you — we [TMBA members] will not become face-mask machinery manufacturers because Machines and Tools industry has its own markets, which is very different from manufacturing facemask machines'. (TVBS News, 2020)

Such verbal reassurances were sufficient to overcome the reluctance to cooperate, arguably demonstrating the level of social cohesion and value of social capital among Taiwanese firms, linked together in formal and informal networks (Hsieh et al., 2010; Liu et al., 2020). While similar cohesion enabled collective action in Germany (Hattke and Martin, 2020), unwillingness to share intellectual property (IP) and lack of government reassurance stalled production scale-up in the US (Contrera, 2020).

Internally, TFMT faced tensions related to managing the partnership and motivating those involved. However, transparency about project progress and workloads, combined with publicity, instigated healthy competition while at the same time ensuring commitment: under peer pressure, the companies sent their best employees who were willing to work overtime, and none of the TFMT member companies left before completion of the task (Lin, 2020). The team delivered the initial 60 production lines in 25 days, with a second government order increasing the number to 92 in 45 days. Simultaneously, MOEA coordinated with fabric suppliers to prioritize domestic demand while also allowing them to continue exporting. TTRI collaborated with Formosa Plastic to develop high-performance fabric, which had previously been imported, embedding the whole supply chain in Taiwan (Yan, 2020). As summed up by Chen Chi-mai: 'In one fell swoop we

gathered the raw materials, and integrated machine tool companies into the supply chain, and formed National Mask Team' (Executive Yuan, 2020). This was a remarkable level of success, given that initially government officials were worried that the small enterprises involved might not have the capacity, or the necessary experience of working together, to meet the challenge (Executive Yuan, 2020). Furthermore, TMBA and member companies bore significant cost of salaries, extra overtime fees, meals, transportation and accommodation — in total estimated at over US\$ 700,000 (Taiwantrade, 2020). As noted by Hong Hui-song: 'They did this voluntarily without charging the government a penny. They even paid their own hotels when staying in Taipei, brought their own lunch/dinner boxes, and their own toolboxes' (Zhuang, 2020).

Managing Production Output: Negotiation and Incentives Instead of Enforcement

Requisitioning production facilities required the principals of the requisitioned facilities to maximize their production capacity, whether through increased commitment (such as extra shifts) or investment. The initial measures taken to invest in creating the necessary mask production lines needed to be extended to the mask producers themselves and maintained over time. Indeed, spike in demand for masks did not automatically create sufficient incentives to increase supply, as demonstrated by the severe shortages of medical masks experienced in the US months into the pandemic, where manufacturers were wary of bearing the big investment needed to increase production (Contrera, 2020; see also Dallas et al., 2021). Similar reluctance was evident in Taiwan. When Minister of Economic Affairs, Shen Jong-chin, called facemask companies and textile manufacturers on 26 January, asking them to increase production capacity, he received a cool response: 'I was so keen and politely asking, and tried to communicate with you [the industry], but why were you cold and not responding? It's like hitting ice-cold water' (TVBS News, 2020).

This episode underscored the perverse legacy of the SARS experience: private sector suppliers who helped increase the production of PPE had been left with over-capacity, sunk costs and diminishing demand (Li, 2020; Yan, 2020). Their losses were compounded by a government shift to a 'lowest price' purchase policy, favouring Chinese suppliers (Fang, 2020). Thus, SARS had damaged the legitimacy of the government in the eyes of the industry players and created an additional reassurance problem that the government needed to resolve. During the early COVID consultations, Shen Jong-chin acknowledged these issues and apologized to the suppliers:

After SARS, their machines were left in the warehouse and subsequently their workers were facing layoff at the time. That is our bad management in the past, very bad.... So I immediately knew the point and apologized to them: 'Sorry, I know that you are not happy because

in the past, the government used up and then threw you away after SARS'. ... Once I mentioned this, they immediately felt better. To have compassion together with the industry is so important. (TVBS News, 2020)

Shen Jong-chin subsequently provided a verbal assurance that in the future, government purchases of medical masks will prioritize 'Made in Taiwan'. This verbal reassurance was backed up by government support: to alleviate the cost of investment, the additional production lines were paid for by the government and given free of charge to 29 facemask manufacturers⁴ who were assessed by MOEA as having sufficient capacity (human resources, space, etc.) to scale up their production (Ministry of Economic Affairs, 2020c), under the condition that the companies committed to producing 5 million facemasks per machine, 1.2 million being free of charge. The government then paid TW\$ 2.5 (US\$ 0.1) per mask, slightly over the market price of TW\$ 2.4, to further incentivize the manufacturers (Li, 2020).

To reach these production outputs, the government assessed and set a quota for each requisitioned company, with bonus payments for meeting targets. Some companies complained that the targets were unreasonable. After the MOEA had failed to obtain a firm assessment of production capacity in each company, TTRI sent some 30 people to count every factory building, production line, shifts per day, and proportion of experienced and novice workers, to calculate the maximum production capacity for each factory. This was overseen by Huang Po-hsiung from TTRI. An additional bonus of TW\$ 0.5 was offered for each mask over the target.

Despite these efforts, initial output remained significantly lower than the 4 million masks a day target: by mid-February only five or six companies were reaching their targets. Companies were still fulfilling prior foreign orders or simply did not have sufficient staff to maximize output. This led the authorities to amend the bonus payment system to reward the fulfilment of domestic commitments first, to increase payment for overtime or working over holidays, and to mobilize the army to assist companies (Yan, 2020).

However, the challenges did not end there. Increased supply at the height of the pandemic raised the prospect of over-supply post-pandemic. As one of the owners of a mask factory asked: 'If the epidemic suddenly ends like SARS, what should we do with the excess capacity in our factory?' (Yan, 2020). After apologizing for its past mistakes, the government developed a coordinated strategy for the mask sector consisting of three key measures (ibid.): (1) to prioritize the purchase of 'Made-in-Taiwan' facemasks to meet public, medical, official and military demand; (2) to promote local development of all parts of the industry, including raw materials, technology and services; (3) to export mask technology rather than just machinery.

The first measure was focused on creating an internal market and avoiding the same collapse in demand that followed the SARS outbreak. The

4. These are the larger of the 66 mask manufacturers as explained in footnote 2.

remaining two measures focus on the future, with the government providing assistance in areas of technological upgrading to meet the standards required in foreign markets and assistance in obtaining necessary certifications, as well as facilitating collaboration among companies and promoting export of technology and services (Wu and Chen, 2020; Zheng, 2020a). There are reports that individual organizations are already making further investments to increase production and investment in R&D (Pan et al., 2020; Zheng, 2020b).

Distribution and Sales Monitoring: The Common Good

In the context of a crisis, and without a coordinated distribution system, users may hoard supplies and compete to outbid each other, creating sharp price spikes and bottlenecks in distribution, as seen in the US where hospitals and local governments engaged in competitive bidding for PPE (Contrera, 2020). The Taiwanese government, utilizing its centralized regulatory authority, took full control of production, distribution and price regulation of medical masks, both for medical and public use. To prevent price gouging, the government requisitioned masks and production facilities and introduced a name-based rationing system to ensure the public had access to sufficient masks at a set price (Wong, 2020), while the MOEA introduced daily targets and monitoring of outputs for manufacturers (Executive Yuan, 2020), releasing daily updates to the public. Distribution of masks was achieved through collaboration with the Taiwan Pharmacy Association, Chunghwa Post (the official postal service) (Huang, 2020), and civil society (Molteni, 2020).

Although this centralized capacity rested on a legal mandate, the government also needed to elicit consensual compliance. Hence, a policy adjustment meant that, once they had met their output commitments, manufacturers were free to sell excess production on the free market, initially in Taiwan and later through export. Similarly, non-woven fabric producers were allowed to export, and charge significantly higher prices, after they committed to supplying the local market first (Yan, 2020). While the government assisted in technology development and transfer, there was no investment in production facilities in this sector as there was in mask making. This suggests that the Taiwan government took a flexible approach to address potential commitment and collective action issues, mixing assurance strategies, centralized distribution and price setting, and monitoring of activities.

Monitoring was necessary as a safeguard against opportunism. In Taiwan, some firms and individuals have been caught attempting to illegally export masks during the export ban while others were found illegally importing industrial masks from China that were labelled as medical masks,

claiming to be 'Made in Taiwan' (Oung, 2020).⁵ These attempts were initially reported by one of the pharmacies, with the local government later tasking pharmacies to watch out for counterfeits. The government introduced additional measures to control and monitor all imports and exports of masks, medical and industrial, and introduced a requirement that all masks made by the TFMT needed to be appropriately embossed. As well as paying fines and facing negative media coverage, offenders run the risk of losing their licence to import medical masks. Such increased visibility and exposure of offensive behaviours creates social pressure which serves to limit the risk of cheating — another institutionalized mechanism that sustains collective action by threatening to punish opportunistic behaviour.

DISCUSSION

Building on the finding that different developmental tasks call upon specific institutional capacities (Ricks and Doner, 2021), we have identified three tasks that were involved in Taiwan's facemask policy: increasing production capacity; managing production output; and distribution and sales monitoring. Implementing these tasks required state and private sector actors to overcome coordination, commitment and collective action problems. Resolving these challenges called on specific institutional capacities across state and private sectors. We briefly summarize these in Table 1.

Faced with coordination problems at the start of the pandemic, the state was able to use pre-existing associations between state and private sectors to lower the transaction costs involved in (a) identifying the relevant actors, (b) supplying information on their production capacities and shortfalls, and (c) bringing together key actors. These prior links were established in part through the creation of organizational mechanisms described above in the wake of SARS, but they were supported by a continuity of personnel in the form of a cadre of bureaucrats with strong links to industry. In particular, public research institutes have constantly adapted their strategies and structures to retain their relevance to and influence over industry (Chen and Chen, 2016). Furthermore, non-systematic sampling shows regular contacts between government agencies and business associations in meetings, and through cases of interlocking directorships and committee roles, in which directors of business associations also serve on advisory committees or boards of research institutes, and vice versa.

In trying to elicit private sector investment in building capacity, the government faced a serious commitment problem: it needed to assure private actors that it would not withdraw market support and that it would protect

5. At least one case of stealing of masks by employees was reported. The factory management alerted police after realizing lower than expected output and the offenders were prosecuted (Yang, 2020).

Table 1. Tasks, Actions and Cooperation Challenges

Task	Action	Cooperation Challenge (Numbers in brackets correspond to the task numbering in column 1)
(1) Production capacity	● Assess production capacity and future demand	<p>Coordination: Need for information on actors (1, 2, 3), capacities (1, 2), and stocks (2, 3); appropriately set required output levels (2). Largely achieved through previous regulations, capacity to provide timely information and rapid commitment of resources by the authorities and industry</p> <p>Commitment: Need for assurances about the future of the industry (1, 2, 3) and individual players (1, 2). Achieved through official apologies and assurances, undertaking the burden of investment and addressing potential IP tensions. Assurances provided by industry associations were crucial</p> <p>Collective action: Need to avoid opportunistic exploitation of shared resources by other players (1), syphoning of outputs for black market (2) or illicit importation and distribution (3). Achieved through verbal assurances by industry players, monitoring by the state and/or the industry, reinforced by social norms and high visibility of offences</p>
	● Increase manufacturing capacity	
	● Ensure access to IP and expertise	
	● Maintain commitment of the TFMT companies over time	
	● Organize rapid collation of information by centralized state agency	
	● Approach and engage the industry	
	● Ensure transparency and peer pressure to gain commitment of TMBA members	
	● Maintain personal involvement by senior government officials	
	● Acknowledge and apologize for abandoning the industry post-SARS	
	● Issue assurances from industry association to respect IP	
(2) Production output	● Address unwillingness of industry to invest	<p>Assurances provided by industry associations were crucial</p> <p>Joining the TFMT potentially offers selective benefit of future contracts, exposure and reputation</p>
	● Maximize and ensure steady outputs from each producer	
	● Prevent post-crisis collapse of the industry	
	● Government to subsidize cost of new production lines (with conditions)	
	● In-depth assessment of potential production capacity	
	● Introduction of a flexible bonus payments systems	
(3) Distribution and monitoring	● Prevent public panic buying and hoarding	<p>Assurances provided by industry associations were crucial</p> <p>Joining the TFMT potentially offers selective benefit of future contracts, exposure and reputation</p>
	● Prevent price gouging	
	● Prevent illicit export and import	
	● Prevent mis-selling of masks as 'Made-in-Taiwan'	
	● Support for future technological upgrading and technology export	
	● Introduction of name-based distribution and control of price of allocated masks	

Source: Compiled by the authors; analysis based on framework of Ricks and Doner (2021).

the future interests of the industry players who were expected to bear the cost. In Taiwan, the industry had learnt from the SARS outbreak the risks and cost of responding to calls for increased capacity and the vacuum that is often left once the crisis is over (Pan et al., 2020). For the government facing this dilemma, the SARS experience was thus a hindrance, as it undermined the government's credibility and necessitated additional assurances, formal acknowledgement of the mistake and an apology. Nevertheless, government credibility was aided by the established links between the government and the industry — a manifestation of the 'embeddedness' of the developmental state (Evans, 1995). The unexpected phone call from TMBA suggests the existence of an informal communication channel between the industry and MOEA. Prior research shows that such relationships have evolved over years, resulting in a build-up of trust, which can help to ensure commitment and develop a more collaborative approach to solving research-related issues (Chen and Chen, 2016). Indeed, not only did TMBA offer to help, it proactively encouraged member companies to join in and coordinated the work of the TFMT. We see in this case that while sufficient government centralization to deliver on its promises was necessary, the ongoing ability of state sector players to coordinate developmental outcomes also rested on a foundation of prior associative ties and norms, allowing state actors to leverage long-standing industrial networks (Breznitz, 2007; Noble, 1998).

Collective action problems also arose, in that private actors needed to share technical information and resources but were aware that doing so exposed them to the risk of opportunistic behaviour by others. In the case of development of PCR tests in Germany, 'strong professional ethos persuaded actors to deviate from the individually rational strategy' (Hattke and Martin, 2020: 626). In Taiwan, we can see a similar functional safeguard provided by high levels of social capital and pre-existing interfirm cooperation among at least parts of the private sector (Lin and Lin, 2016; Liu et al., 2020). Such ties have been described as providing institutional frameworks 'within which firms find it to be in their interests to collaborate on specific projects, while remaining fierce competitors' (Mathews, 2002: 649). So far, TMBA member companies have kept to the promise of not entering the face-mask machinery market, duly forwarding incoming inquiries (30 a week on average) to the two mask machinery manufacturers.⁶ Although we lack direct evidence, it seems likely that this restraint can be attributed to an effective monitoring and informal sanctioning system created both by institutions and the business sector, which enabled collective action and appears to have deterred free riding. Such systems work through a combination of inducement (gains from cooperation) and the selective withdrawal of such benefits for those that fail to cooperate (Doner and Schneider, 2000; Ville, 2007). Selective benefits in this case include additional payments for meeting

6. Email communication with TMBA, November 2020.

production quotas; assistance in achieving certification for export of technology or masks; and gains in reputation and exposure for participating companies due to high visibility of the project. The price for non-cooperation, besides the loss of such benefits, also included the potential withdrawal of import quotas for those that did not comply. Despite its temporary nature, members of TFMT felt compelled to put their best people on the team to demonstrate that they were contributing their share to the collective effort.

The difficulty of these challenges can be further assessed in terms of four moderating factors delineated by Ricks and Doner (2021): number of actors involved, duration of implementation, visibility, and information required. Table 2 provides an analysis of the four factors as they apply to the three challenges identified in this article. Additionally, we include an analysis of institutional capacities and arrangements in Table 2. In this particular case, the fifth factor in Ricks and Doner's framework — distributional consequences — is less important and is thus omitted.

A few additional points are worth noting. First, the short time for implementation in the context of a very public crisis made the first task (increasing production capacity) highly visible. This relates to the third dimension listed in Table 2. This visibility increased public pressure on actors to engage and deliver, as did daily reporting on the TFMT's progress and official visits. Enveloping the contribution of the TFMT in high-profile 'mask diplomacy' added further pressure.⁷ Subsequent breaches of trust were widely publicized. By making commitments very public and bringing considerable media attention to the initiative, opportunities for free riding or defection were reduced, particularly in the case of the initial production capacity challenge. Ongoing commitments to mask production and distribution were inherently more difficult to monitor, but the efforts of a wide array of actors ensured that defectors did face scrutiny and punishment. The information requirements for each task (the fourth dimension in Table 2) were moderately challenging, particularly for the production capacity task, where proprietary information, tacit knowledge as well as more codified information were all needed. The institutions and institutional capacities required thus included a range of private and governmental bodies linked through prior associative ties. Together they were able to reduce the transaction costs of forming initial agreements, generating commitments, and adding credibility

7. Both mask and vaccine donations became a diplomatic tool during the pandemic. On 1 April 2020 Taiwan donated '10 million masks to countries most affected by the pandemic, including America and Europe and to nations with full diplomatic relations with Taiwan'. This was followed by subsequent donations on 9 April and 5 May (over 13 million masks in total) to EU member states, severely affected states in the US, partner countries under Taiwan's New Southbound Policy, medics working with Syrian refugees, and 'other friendly nations' (Alton, 2020). In 2021 some of the recipients (e.g. Japan, Lithuania, Slovakia) donated vaccines to Taiwan in return.

Table 2. Tasks and the Institutional Capacities Required

	Production capacity	Production output	Distribution
Number of policy actors	Low and diverse: range of sectors, associations and public bodies	Medium and homogeneous: mask manufacturers	High and diverse: importers, exporters, resellers, public
Implementation duration	Very short term: 45 days	Short-medium term (months)	Long term (ongoing)
Visibility	High: daily media reporting on progress; visits from officials; emergence of 'mask diplomacy' and 'Taiwan Can Help' initiative	Medium: scope for opportunistic action	Medium: scope for opportunistic action
Information requirements	Tacit Codified (not readily available) Site specific	Codified (not readily available) Site specific	Codified Non-site specific
Required institutional capacity	Coordination: established mechanisms providing access to information on stocks etc. Credibility: demonstrated ability for disciplined implementation; salience of reputation; iterated interactions; centralized authority due to post-SARS reforms Monitoring: information gathering through associative ties and hierarchical control	Coordination: explicit commitments Credibility: salience of reputational costs increased through close associative ties Monitoring: access and assess production data; industry experience needed to accurately assess potential outputs	Coordination: established mechanisms (National Insurance database) to enable name-based rationing system Credibility: salience of reputation Monitoring: pharmacies undertake monitoring duties; monitoring and punishment for breaches strongly embedded in social norms
Institutional arrangements	<i>Business associations:</i> TMBA <i>State sector organizations:</i> MOEA, NHCC, Industrial Development Bureau <i>Business-state linkages:</i> TTRI, ITRI, MIRDC and PMC	Ministerial direct communication Central government spending commitments <i>State sector organizations:</i> TTRI, Army	<i>Business associations:</i> Taiwan Pharmacy Association <i>State sector organizations:</i> MOEA, MOST, MOHW and National Health Insurance Administration, local government, Chunghwa Post, police, civil society

Notes: MOST = Ministry of Science and Technology; MOHW = Ministry of Health and Welfare
Source: Compiled by the authors; analysis based on framework of Ricks and Doner (2021).

to assurances through both internal hierarchical control mechanisms (in the state sector) and dispersed monitoring capacities.

Our findings reinforce the overall conclusion of other recent studies that Taiwan's state institutions have not retreated (Wade, 2018), but have evolved and reconfigured themselves to take on new tasks and modes of interaction with private sector actors (Chen and Chen, 2016; Chu, 2021; Kim, 2021). As in other scenarios, the division of labour between the private and public sector (Park and Chung, 2021) is central to this case. While the government stimulated investment by assuming part of the cost and credibly guaranteeing local demand for the future, it fell largely to industry actors to resolve technological challenges. Thus, our study supports the perspective that business–government cooperation and private sector coordination are complementary and interdependent (Wade, 2014), forming efficient institutional ecologies (Doner et al., 2021).

CONCLUSION

This article has examined Taiwan's facemask policy as a critical part of its COVID-19 pandemic response, with a focus on the actions and capacities that led to an increase in the production of facemasks from below 2 million to over 10 million a day. Our enquiry addresses the call to understand how and why government institutions respond to a challenge and how well a state's response is matched to the threat (Weiss and Thurbon, 2021: 473). Our case illustrates the role of the state, but also the changing dynamics of that role and of the state's relationship with the private sector. We challenge the view that Taiwan's successful COVID-19 response was a direct outcome of its earlier SARS experience (Summers et al., 2020; Yen, 2020). The SARS experience did prompt both learning and consequential state sector institutional reform, but it also generated a negative legacy for mask production, creating additional obstacles to scaling up production and managing distribution.

Our approach confirms the importance of capacities for coordination and collective action if particular developmental challenges are to be met, and builds on work that attempts to specify the cooperation challenges involved in such developmental tasks (Doner et al., 2021; Ricks and Doner, 2021). Institutions underpinning collective action were critical in both state and private spheres of action and in enabling cooperation between government and business. Although we have focused on institutions directly related to the tasks necessary for increasing production and managing distribution, the broader social context also matters. Proactive state intervention was combined with high levels of social mobilization and public participation, which relies on — and simultaneously promotes — trust in government institutions. This is more effective in eliciting cooperation than confrontational attempts at imposing government policy (Park and Chung, 2021; Yang and

Tsai, 2020). While the previous incorporation of citizens into the structure and ethos of state power and national development projects helped to generate 'social capital' (Wade, 2018: 530), our analysis highlights the dynamic nature of the relationship, at a time when social capital needed to be rapidly deployed.

Although increasing production and ensuring smooth distribution of face-masks do not involve advanced technology, the cooperation challenges involved called upon institutional capacities that have been noticeably lacking in several countries (Dallas et al., 2021; Elsañ and Siedlok, 2021). As shown in a hard-hitting study of the United Kingdom's pandemic response, the mistakes, delays, cost overruns and overall ineffectiveness of policy can be traced to specific attributes of the country's neoliberal 'regulatory' state institutions (Jones and Hameiri, 2021). Taiwan's developmental state institutions are the obverse of those of a regulatory state. Its policy effectiveness, however, does not lie in state sector organizations alone, nor rest solely on capacities for authoritative state interventions. Taiwan's pandemic response equally called upon pre-existing capacities for cooperation within the private sector and institutions that facilitated cooperation between business and government.

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