Health Policy as Industrial Policy: Brazil in Comparative Perspective

Kenneth C. Shadlen and Elize Massard da Fonseca

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Kenneth C. Shadlen
London School of Economics and Political Science, London, UK

Elize Massard da Fonseca
Center for Metropolitan Studies , Sao Paulo Research Foundation (FAPESP), Brazil

Abstract
In contrast to analyses that regard health policy and industrial policy as anathema to each other, either because an emphasis on health implies neglect of industry or because gains in industrialization come at the expense of health, we show positive synergies between the two realms. Government intervention into the health sector can catalyze interventions to promote industrial development in the pharmaceutical sector, which in turn can make health policies more effective. We focus on two pathways by which health policies can trigger industrial policies. A demand-driven pathway entails government commitments in health revealing weaknesses and deficiencies in pharmaceutical production, and thus inspiring efforts to build capabilities to stabilize the flow of drugs to the public sector. A regulation-induced pathway consists of sanitary policies revealing mismatches between what is required for firms to continue to participate in the market and pharmaceutical producers' prevailing levels of capabilities, and government measures then being developed and deployed to address the mismatch. We demonstrate both pathways with the case of Brazil.

Keywords
health, industrial policy, pharmaceuticals, generic drugs, Brazil

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Corresponding Author:
Kenneth C. Shadlen, Department of International Development, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, UK.
Email: k.shadlen@lse.ac.uk

When Jim Yong Kim was selected as president of the World Bank in 2012, prominent scholars of economic development lamented the seeming prioritization that this reflected of health policy over larger issues of economic development. Robert Wade, for example, criticized the US nomination of Kim as reflecting the notion "that the development challenge is to mitigate extreme poverty and particularly its health consequences…" in contrast to being focused on projects of "large-scale national transformation."[1] Lant Pritchett, suggesting that the rancorous debate over Kim's selection was reflective of a "philosophical schism in the development community" between those pushing for "humane development" and those pushing for "national development," concluded that the "appointment appears to be an intrusion by the world of humane development into one of the core institutions of national development."[2] Wade and Pritchett were not alone. The common thread in these criticisms is that Kim, a doctor and health professional whose previous experience in international organizations was at the World Health Organization, is likely to steer the World Bank's policy agenda toward health interventions and thus away from a larger mission of promoting national economic development.

The findings in this article suggest that these fears may be overblown. We offer a new approach to studying the interface between health and industrial policies, and in doing so we show how activist policies directed toward the health sector can trigger efforts to stimulate capability development in the pharmaceutical industry. Specifically, because health policies can reveal—and be undermined by—weaknesses in the pharmaceutical sector, health policies may trigger industrial policies that are designed to establish complementarities between the two areas. If health policies can trigger industrialization policies, then the conflict between the two sides of the "philosophical schism" (to quote Pritchett) may be less than depicted.[3]

Our emphasis is on the positive synergies between health and industrial policies. We consider two channels by which such synergies may be achieved, i.e., how health policies can trigger industrial policies, and we use the case of Brazil to illustrate both channels. One pathway from health policy to industrial policy, which we label "demand-driven," consists of government officials developing and deploying measures to improve pharmaceutical production capabilities to ensure stable supplies of affordable, quality medicines to the public sector. A second pathway from health policy to industrial policy is "regulation-induced," where governments deploy promotional instruments to facilitate pharmaceutical firms' abilities to comply with new health regulations. Our argument is not that health policies will lead to industrial policies, but that they can create opportunities for doing so. In this article we put aside the question of under what conditions such opportunities are likely to be exploited. Instead, we focus on exploring how opportunities for industrial promotion can be created by social policies and we show, in the case of health and pharmaceuticals in Brazil, how these opportunities have been exploited.

The remainder of the article consists of four sections. We begin by outlining, broadly, the relationship between health and industrial policies, focusing on how activity in the former area can generate policy linkages to activities in the latter. In doing so we focus on two channels, labeled "demand-driven" and "regulation-induced." In

subsequent sections we illustrate both channels in the case of Brazil, with analyses of how concerns with the supply of affordable drugs in the public sector led to the generation of a pharmaceutical-focused industrial policy, and how concerns with the successful implementation of a generics medicines program encouraged investments and measures to prevent the regulatory environment from serving as barriers to market participation. In the conclusion we summarize the key findings, discuss the political underpinnings of the synergy between health and industrial policies, and we offer brief observations of the effects yielded by Brazil's new, health-inspired industrial policies.

Health Policy, Pharmaceutical Policy, and Policy Linkages

In the post-World War II period many developing countries targeted pharmaceuticals as a priority area for import substitution on account of the positive spillovers throughout the industrial sector that pharmaceutical industries can generate. The outcomes of such strategies varied, but even where such efforts were regarded as successful, industrial development appeared to come at the expense of social policy achievements. Writing about the Argentinean case more than three decades ago, for example, where successive government initiatives helped local pharmaceutical firms secure a significant share of the local market, Chudnovosky concluded that the benefits delivered to producers "are not transferred to the consumer….The challenge by the large domestic enterprises to the TNC domination of the industry has not benefited the consumer of pharmaceutical products."[4] Gereffi concluded that the "high prices of drugs thus may be viewed as an acceptable trade-off for the consolidation of a local industrial bourgeoisie, which is often considered an essential step in achieving some form of nondependent development."[5] The World Health Organization summarized a broad body of research on national pharmaceutical policies with the observation, "most developing countries in recent decades have developed an interest in the local production of drugs, as a way of improving their economy and decreasing their dependence. In many cases, however, there is a conflict between economic policy and health policy."[6] In sum, many observers came to regard pharmaceutical promotion and public health as conflicting, since efforts to promote national industrial capabilities tended to raise prices and limit access to medicines. Depictions of industrial promotion being a threat to health continue in the current era too: developing countries that, in response to the global intellectual property regime that restricts trade in nonpatented drugs, aim to increase local production are regularly warned about the costs to consumers that such a strategy might entail.[7]

The current global environment for economic development invites us to revisit the relationship between industry and health. Liberalization and economic integration have altered the role of industrial policy in national development strategies and likewise altered the instruments of industrial policy that are used.[8] Thus, the sorts of policy instruments that governments may deploy to develop their pharmaceutical industries in the current era may be different than those used before, and thus have distinct effects on health outcomes. Even if the previous generation of scholarship was correct that

industrial policies in the pharmaceutical sector tended to undermine health policies, if countries are using different instruments now the effects of such actions may differ as well. Moreover, policy priorities tend to be different now: whereas most developing countries are discouraged from active industrial policies, active social policies are encouraged and supported by a wide range of international actors. It is the latter that are the higher priority, and as a result it is less likely that countries would accept industrial policies that are damaging to health policies. An important question, then, becomes whether health policies can, in turn, motivate and also discipline industrial policies. We argue that they can, which we illustrate with the case of Brazil.

A useful starting point for considering how social policies may spur industrial policies is Hirschman's concept of linkages. Linkages occur when activities in one sector catalyze activities in another sector.[9] Forward linkages mean the catalytic effect is sent downstream, and backward linkages mean the effect is sent upstream.[10] To distinguish from externalities and spillovers, we focus on *policy* linkages: if activity in realm X creates demands for inputs from realm Y that are insufficiently or inadequately supplied, then policies to promote realm X can, by revealing deficiencies in realm Y, trigger policies to promote realm Y. We apply Hirschman's intuition to health and pharmaceuticals. Concretely, government commitments toward the health sector may create concerns with the state of the pharmaceutical industry, so governments may then start reinventing industrial policy *for the sake of improving health policy.*

We consider two complementary channels by which health policies may generate linkages to industrial policies in the pharmaceutical industry: the first is "demand-driven" and the second is "regulation-induced." The demand-driven channel features industrial policies emerging from the government's role as purchaser of medicines and medical services. Investing in healthcare provision can reveal the weaknesses of pharmaceutical sectors, which might inspire governments to develop policy instruments that encourage industrial development in this latter area. This may be particularly the case when the health system is deemed to be vulnerable on account of unstable sources of supply. Pharmaceuticals become "strategic," again, as in the high-period of industrial policy of the postwar decades, but what's making pharmaceuticals strategic this time are not the goals of industrialization per se but rather the importance of the sector for fulfilling social policy obligations.

An obvious question to ask here is, if stable pharmaceutical supply is essential for fulfilling healthcare obligations, why governments cannot simply rely on imports. The most obvious answer is that imports may not be available on account of intellectual property restrictions: depending on the patent status of particular drugs, countries may not have a range of available suppliers. As we shall see, changes to the global intellectual property regime, in particular the introduction of pharmaceutical product patents in India, threaten to dramatically change the nature of generic drug supply.[11]

But putting aside questions of intellectual property, even for drugs that are not affected by patents, importation still may not be a sufficiently reliable tool for obtaining stable supplies of medicines. The reasons for this have to do with countries having specific demands that may not be reliably supplied via imports: countries have distinct disease profiles and thus demands for particular quantities and presentations of

different drugs; climate conditions can require that drugs are produced with particular characteristics or in distinct formulations; particular strands of viruses require often specific vaccines that need to be produced locally.[12] These factors mean that the supply of drugs may not adjust easily and quickly to changing demands. Of course unmet demand due to unstable supply is hardly unique to drugs, but the consequences of—and the responses motivated by—such conditions may be. That is, the excess of demand relative to supply is typically self-correcting, with adjustment occurring through higher prices, a phenomenon that occurs on a regular basis in all sorts of markets, international and domestic, for goods and services. In the case of drugs, however, where the consequences of higher prices and diminished access may be more severe—and also felt more directly by governments—concerns with supply shortages may be greater.[13] Finally, authors have also noted that in the case of pharmaceuticals local producers may be better at identifying special product markets and more willing to distribute drugs outside of major urban centers.[14] To be sure, the choice between importation and local production is not all-or-nothing: many drugs can be—and will be—imported, but a stable supply of medicines needed for comprehensive healthcare provision can require some degree of local production.

Health and safety regulations can also inspire industrial policies toward the pharmaceutical sector. Health policy may consist of measures to assure that drugs on the market satisfy certain standards; implementing such measures may entail steps to eliminate subpar medicines from the market. Of course, health surveillance of this sort can be directly beneficial for industrial development in that it may resolve problems of international information asymmetries and allow local producers to increase their global presence: by assuring foreign consumers and other countries' regulatory authorities that drugs produced locally are satisfactory and meet high standards, stringent health surveillance can open markets. The risk of more stringent regulations, however, is that professional surveillance will shine a light on subpar firms and could force them to cease production.[15] In that case, health regulations may be detrimental to industrial development—unless the government complements the health regulations with measures to help local firms attain the capabilities to comply. When it does so, we can say that health policies have triggered industrial policies, in the form of measures to upgrade capabilities.

Our discussion of health regulation engages explicitly with the concept of "rewarding regulation." We draw inspiration from Piore and Schrank's and Coslovosky's work on labor and environmental inspection.[16] As these authors show, regulators sanction or close subpar facilities, but they can also enforce regulations so to aid firms' adjustment and help firms acquire the capabilities needed to be able to comply. Schrank and Piore refer to this latter process as governments not simply eliminating the "low road" but helping private actors travel on the "high road."[17] That is, state officials convert potential barriers to market participation into tools to help firms increase competitiveness.

We build on the concept of "rewarding regulation" in two ways. First, we suggest that health can offer a distinct area of study because of the spatial location of the two objects of rewarding regulation. In contrast to labor, for example, where the direct

beneficiaries of the regulations (workers) are located at the regulated factories, in health the direct beneficiaries (consumers of drugs) and the regulatory targets (pharmaceutical firms) are spatially separated.[18] Arguably, these distinct conditions generate distinct political challenges for regulatory design and enforcement. Second, by pairing our analysis of rewarding regulation in the pharmaceutical sector (the third section of the article) with analysis of demand-driven industrial policies (the second section), we embed the analysis of rewarding regulation, in particular the postregulatory efforts of the state to help firms upgrade, in broader discussions of industrial policy. That is, we explicitly treat the implementation of regulations as part and parcel of industrial policy.

We regard regulation-induced industrial policy as constituting an important approach to promoting industry, one where the means are subjected explicitly to social welfare objectives. Analysts of industrial policy teach us of the need for state support to be complemented by constraints.[19] Ordinarily, the promotional instruments precede the constraint. Governments extend benefits, and once extended these become difficult to remove; often the threat of withdrawal lacks credibility. Indeed, one of the longstanding critiques of industrial policy is that promoting key sectors creates powerful political actors that are then difficult to constrain.[20] In this instance, the joint effect of regulation and promotion via bureaucratic agencies reverses the traditional order, in that the control mechanism comes prior to the supportive instruments.[21]

Demand-driven Industrial Policy: From National Health System to the Health Industry Complex

Since the late 1990s, the Brazilian government has faced challenges that emerged from its extensive obligations to provide drugs. Both the burden that the high cost of drugs was placing on public finances and concerns over the stability of supply inspired the government to act. Beginning with alterations of the patent system and investments in public laboratories, by the late-2000s the government had a full-fledged industrial policy focused on pharmaceuticals. This section examines the process by which health policies, specifically the government's demand for a stable supply of a wide range of affordable drugs, triggered industrial policies.

The Brazilian government's concerns with the supply of drugs are rooted in its extensive commitments in the health sector. Brazil's 1988 constitution stipulates health as a constitutional right; the national health system (*Sistema Único de Saúde*, SUS), established in 1990, offers access to healthcare—including treatments—to all Brazilians.[22] Roughly 75 percent of Brazilians use the SUS, and even the quarter of the population with private healthcare coverage relies on the state system for many interventions, particularly costly treatments for cancer, hypertension, and diabetes.[23] Supplementing the SUS, the government also offers free medicines for treating rare diseases and conditions affecting small groups.[24] Importantly, a 1996 law requires the federal government to provide free and universal access to medicines for treating HIV/AIDS. Guaranteed coverage of drugs led to concerns with supply, and obviously price,

but also stability. Stability of supply is a common problem, and it was one that has been particularly accentuated in Brazil, where many drugs that are formally guaranteed by the public sector have simply not been available.[25] In short, deficiencies in the supply of drugs made the health system vulnerable, which in turn made pharmaceuticals a strategic sector.

Both the problems created by supply deficiencies and the government's responses to these problems are most vivid with regard to HIV/AIDS medications. Brazil stands out for its early (since the late 1980s) and comprehensive approach toward prevention and treatment.[26] As indicated, a 1996 law guarantees free HIV/AIDS treatment, and intense social mobilization has reinforced the government's obligations. Brazil's approach to HIV/AIDS affected the government's concerns with price, stability of supply, and local production capabilities. Because antiretroviral drugs (ARVs) treat but do not cure HIV/AIDS, they need to be taken indefinitely; and patients need to change treatment regimens as immunities develop. By the late 1990s, ARVs already consumed one-third of the Ministry of Health's (MH) drug budget, and this was at a time when treatment still depended almost exclusively on unpatented first-line drugs. When Brazil introduced pharmaceutical patents in 1997, products that were already on the market in Brazil remained nonpatented, but new products—including those patented elsewhere prior to 1997 but not yet marketed—would become patented.[27] As more people began treatment, and as patients migrated to expensive second-line regimens based on drugs that were patented under Brazil's new patent law, the program risked becoming unsustainable.[28]

One response to these concerns was to reform the country's patent system, particularly those aspects regarding compulsory licenses. Compulsory licenses are provisions by which the government permits an actor (public or private) to use proprietary, patented knowledge without the owner's authorization (i.e., the government compels the owner to license the protected knowledge, hence the name). Such measures are compatible with international agreements and feature, in one form or another, in virtually all countries' patent laws, yet compulsory license provisions will differ in terms of the grounds according to which they can be invoked and the degree of ease or complexity in putting them to use. In Brazil, presidential directives in 1999 and 2003 made issuing—and threatening to issue—compulsory licenses simpler, thus increasing the government's capacity to leverage price reductions from patent-holding pharmaceutical firms.[29]

At the same time, the government sought to strengthen the network of public sector laboratories that languished since the early 1990s.[30] Government demand—and direct investment in production—resurrected the public sector labs: Farmanguinhos, the leading laboratory (linked to the National School of Public Health, in Rio de Janeiro), experienced a seven-fold increase in production (and a twenty-fold increase in revenues) from 1995-2002, allowing it to invest heavily in personnel and facilities, and engage in research.[31] The revitalization of public labs—aiding them to expand their abilities to produce imitation versions of existing drugs—constitutes the seedling of industrial policy in the pharmaceutical sector. Because imitators do not usually have complete information about specific drug manufacturing and synthesis processes, it is

necessary to rediscover the knowledge used to formulate drugs, i.e., to reverse-engineer the manufacturing processes. Compared to the research and development investments involved in designing and discovering new molecules and treatments, reverse-engineering is a simpler and less costly activity, but it nevertheless depends on acquisition of significant technological capabilities. Concerns with the supply of ARVs stimulated the government to try to rebuild such capabilities.[32]

Notwithstanding the patent reforms and the renewed public-sector investment of the late 1990s and early 2000s, the challenges facing the health system became accentuated. The structure of health care provision and pharmaceutical demand was changing in such a way that drugs were becoming increasingly expensive in a nonlinear fashion: more people were being covered for more sorts of conditions, and coverage was extending to more expensive drugs (some beyond the capabilities of local producers). These effects meant that increased costs imposed on the system overwhelmed the benefits yielded by the initial reforms.

With regard to ARVs, of the roughly fifteen drugs used in the National AIDS program, only the older ones could be produced locally. Brazil continued to depend on foreign suppliers for newer ARVs, and since the treatment regimen depended increasingly on new drugs, local supply came to constitute an ever-smaller share. Brazil thus went from being largely self-sufficient in ARVs in the 1990s to becoming heavily import-dependent in the 2000s, and the trajectory continued: from 2001 to 2005 local (public and private) laboratories' share of government ARV purchases decreased from roughly 40 percent to less than 20 percent.[33] Meanwhile, the share of government expenditures on imported drugs increased, as both the number of HIV/AIDS patients receiving treatment increased and more patients moved to treatment regimens, including patented drugs such as efavirenz, lopinavir/ritonair, and tenofavir; more Brazilians were being treated with more expensive, imported, patented drugs.[34] Furthermore, because threats of compulsory licenses are only credible to the extent that the government has alternative sources of supply, uncertainty over local production and the availability of drugs from foreign suppliers (e.g., Indian producers, where these drugs remained unpatented) threatened to make negotiations with patent holders less effective, too. To summarize, then, the sustainability of the AIDS treatment program was coming into question, on account of increased demand for expensive drugs, limited capabilities of local suppliers, and reduced effectiveness of negotiating price reductions with patent-holding, transnational pharmaceutical firms.[35]

The challenges confronted by the Brazilian government make more sense when we consider both the full pharmaceutical supply chain and the broader changes in the international pharmaceutical industry that were transpiring. Although local production of drugs increased in the late 1990s and early 2000s, manufacturing often consisted of formulating on the basis of imported raw materials and active pharmaceutical ingredients (APIs). Capabilities in this sector were significantly more advanced in preparing formulations and compositions of final products than in manufacturing pharmo-chemical ingredients, and as a result local laboratories still depended heavily on imported inputs.[36] For example, national suppliers' share of Brazilian public laboratories' API purchases decreased from 27.4 percent in 2003 to 8.0 percent in 2005.[37] Here it is

worth noting the particular implications of Brazilian health policy, specifically ARV treatment: because Brazil has been ahead of the curve in terms of HIV/AIDS treatment, with more people receiving ARVs earlier than in many other countries, there is often limited supply, globally, of the newer APIs that become needed in Brazil as patients migrate to second-line regimens.[38]

Even where newer APIs were available, that would change too. Brazil had been able to rely on India as a source for nonpatented pharmaceutical products (APIs and final formulations), as India delayed the introduction of pharmaceutical product patents until 2005. Yet as of 2005, India also began granting pharmaceutical patents, and while the effects of this were not retroactive (drugs that were available from Indian suppliers as of 2005 have continued to be), it meant that, going forward the supply of inexpensive nonpatented products from Indian suppliers would become much less reliable.[39] The changing nature of global supply, in turn, could undermine the changes to Brazil's patent policy discussed above. To repeat, the ability of the Brazilian government to use the threat of a compulsory license to elicit price reductions from patent-holding firms depends on the threats being credible, and threats to issue compulsory licenses are credible only if the government can obtain the patented products from alternative suppliers, either foreign or domestic. Thus the Brazilian government's ability to use its reformed patent system to lower prices comes to depend, increasingly, on local (public and private) producers' having adequate supply capabilities. The post-2005 closing of the "India window" casts a large shadow: to make health policy sustainable, the Brazilian government finds itself compelled to create capabilities for local production because it cannot rely, indefinitely, on the supply of nonpatented drugs from India.[40]

The crystallizing moments in the process by which the government's health policy commitments triggered the expansion of industrial policies were conflicts with Abbott and Merck over the supply of key ARVs that were patented in Brazil. By the early 2000s the demand for Abbott's "Kaletra," a combination of two protease inhibitors (lopinavir and ritonavir, LOP/r) that plays an essential role in second-line treatment, was increasing (for the reasons indicated above: the increased number of HIV/AIDS patients on advanced treatment regimens). So, too, was the demand for Merck's "Sustiva" (efavirenz, EFZ), which was used by nearly half of all HIV/AIDS patients in Brazil. Both drugs were placing a significant drain on the budget of the National AIDS Program,[41] and in both instances the government attempted to negotiate lower prices to keep up with the escalating demand. In the case of LOP/r, after protracted negotiations with Abbott failed to yield a price reduction at the level the government sought, the Brazilian government took all of the steps necessary to issue a compulsory license. Yet, ultimately, the MH agreed to terms with Abbott in 2005, with the latter guaranteeing supplies of LOP/r at a reduced price through 2011. In the case of EFZ, negotiations with Merck since 2001 yielded a price decrease of more than 50 percent, but the savings from lower prices were nullified by the costs of higher demand as more people entered the treatment program, and ultimately the government issued a compulsory license in 2007.

Of the two drugs LOP/r involves more complex production processes. Although many factors are likely to have influenced the decision to agree with Abbott rather than issue a compulsory license, we draw attention to concerns that Brazil lacked sufficient production capability to satisfy the government's demands and that alternative sources of supply (e.g., importing from India, where LOP/r is not patented) were not regarded as sufficiently reliable. Furthermore, in the course of negotiating with Abbott, the MH received (or claims to have received) commitments from Abbott that it would transfer technology for LOP/r production to Farmanguinhos. The upshot is that the lack of domestic capabilities to supply newer and more complex ARVs was regarded as a source of vulnerability for the AIDS treatment program, and the government's strategy with regard to this drug was to secure lower prices in a way that could, potentially, enhance local production capabilities.[42] In the case of EFZ, when Brazil ultimately did issue a compulsory license for efavirenz in 2007, deficiencies in the country's pharmaceutical production capabilities were also evident. For the first two years upon issuing the compulsory license the Brazilian government imported EFV from India, where it was unpatented. Not until 2009, after a partnership with three private local firms, did Farmanguinhos deliver its first batch of EFV.

The conflicts with Abbott and Merck over these two ARVs constituted important moments in the development of an industrial policy aimed at improving domestic supplier capabilities in order to reduce the vulnerabilities of the health sector. Although these episodes certainly do not constitute the sole cause of industrial policy in the health sector—indeed, it actually began prior to this incident—these events vividly highlighted the vulnerability of a health sector that depended, increasingly, on the stable supply of affordable versions of complex drugs. Both experiences raised concerns regarding the ability of public and private laboratories to produce more complex medicines, and the experience of creating public-private partnerships with local labs to produce EFV would, ultimately, serve as a template for an ambitious project to produce other key medicines, some prioritized because of high cost (e.g., cancer drugs) and others prioritized because of lack of appropriate treatments available in Brazil (e.g., for malaria and other neglected diseases). Indeed, according to Carlos Lessa, ex-president of the Brazilian National Development Bank (BNDES), it was the vulnerability of the entire health sector that these events brought to light that prompted the government to treat pharmaceuticals as a strategic sector for industrial development.[43]

If the HIV/AIDS epidemic provided a crucial trigger for broader industrial policies in the pharmaceutical sector, the instruments deployed were not developed from scratch. To the contrary, aligning health and industrial policies had been an earmark of the Lula government since taking power in 2003. While the government of Lula's predecessor Fernando Henrique Cardoso pursued an active health policy, as will be discussed more in the following section, it was Lula's government that turned health policy into industrial policy.[44] Pharmaceuticals were identified as a "strategic" sector in the 2003 Industrial, Technological, and Foreign Trade Policy (PITCE), with the government offering financial support (e.g., tax incentives) for API production. Soon thereafter the government launched a BNDES financing program to support the

pharmaceutical sector (*Profarma)*, and eventually an array of programs toward the "Health Industry Complex" (*Complexo Industrial da Saúde*, CIS), all part of an integrated, transsectoral program to develop and strengthen the healthcare sector called "Greater Health" (*Mais Saúde)*.[45]

Throughout this period, as the new programs replaced existing programs and new instruments were created, pharmaceuticals remained a targeted sector, with the objectives being to build capabilities throughout pharmaceutical production chains to thereby reduce vulnerability of the public health system. A core aim of *Mais Saude*, for example, is to stimulate the local production of strategic medicines and medical devices, via the strategic use of government purchasing power and encouragement of public and private partnerships (so-called partnerships for productive development, PDPs).[46] Other instruments included continuous investment in public labs, encouraging and subsidizing local biomedical innovation,[47]and entering into licensing arrangements with foreign firms in more technologically complex activities.[48] All of these measures are designed to create more stable sources of supply for a wider range of drugs and health technologies to meet the specific demands derived from the government's extensive obligations.

We are not providing a full exposition of the various industrial policy instruments developed and deployed toward the pharmaceutical sector in this period, but two key initiatives worth underscoring have been *Profarma*, the BNDES credit line for development of the sector, and the promotion of PDPs. With regard to *Profarma*, both the level and nature of direct financing has been unprecedented. *Profarma* has lines of funding for production, innovation, and export. In the first years of the program most of the lending was to improve existing production facilities, as discussed in the following section, while more recently lending has been focused more on innovation. In 2011, for the first time, funding for innovation projects exceeded funding for production (50 percent to 39 percent).[49] Although both public and private production of medicines dates from the early 1930s, the Brazilian government has never before invested in the development of this sector so actively.

With regard to PDPs, the objective here has been "to reduce the vulnerability of Brazilian social policy through the strengthening of the [CIS], joining the objectives of the SUS with the necessary transformation of the country's productive and innovative structures."[50] To that end, the MH identifies key inputs (e.g., drugs and medical devices) for the SUS and then draws up plans to increase the local supply of these products. Where production capabilities are absent or inadequate, measures are taken to build capabilities by encouraging collaboration among public laboratories and private firms. In some instances, where collaboration among domestic actors alone is not sufficient, as in the case of some vaccines and other advanced biotech products, licenses are negotiated with foreign firms and joint ventures launched for local production. The objectives of all these measures are, unabashedly and explicitly, to substitute for imports and to transfer technology to public laboratories through public- private partnerships.[51]

In this section we have provided brief overviews of some of the many industrial policy instruments that the Brazilian government has developed and deployed toward

the pharmaceutical sector since the early 2000s. The objective has not been to assess the instruments per se, but rather to consider the sources of policy innovation in this domain. Throughout this process, government officials have been explicit as regards the drivers of industrial policy in the pharmaceutical sector: the sense that Brazil cannot have a strong and stable national health system without stronger and more dynamic local pharmaceutical and pharmo-chemical sectors. In sum, the Brazilian government, concerned about the sustainability of its health policies, started developing and deploying a range of support instruments to promote the national pharmaceutical sector.

Before concluding this section, it is worth returning quickly to the relationship between industrial policy and the price of drugs. Many drugs produced in Brazil (especially ARVs from public laboratories) are more expensive than those available from India.[52] This fact may suggest that, notwithstanding the new motivations for industrial policy, fundamentally deleterious consequences for health policy of attempting to generate local production capabilities remain evident. Yet we would caution against such an interpretation. Capabilities in the pharmaceutical sector can also serve as instruments for negotiation and thus price reduction. That is, while local production of some drugs may be expensive, the ability to produce locally can also make negotiations with foreign suppliers more effective. It is because of local production capabilities that Brazil was able to negotiate significant price reductions with transnational firms on a wide array of ARVs, and these reductions compensated for the higher prices of Brazilian production of some drugs.[53] Thus, despite the fact that Brazilian-produced ARVs have tended to be more expensive than imported generics (from India), the overall effect of the Brazilian strategy has been to lower prices.[54] Furthermore, even the higher prices of locally produced ARVs may be a temporal phenomenon. When Farmanguinhos began producing efavirenz (EFZ) in 2009, for example, the Brazilian-produced version was more than 25 percent more expensive than what was available from Indian suppliers. Yet within a few years the price in Brazil has come down toward the international level. A recent survey of ARV prices in African and non-African middle-income countries (MICs) showed that the price of EFZ is lower in Brazil than in any other non-African MICs and below the median for African MICs.[55] In sum, through both indirect and direct channels, the MH is able to obtain lower prices than it otherwise would because of local production capabilities. The building of capabilities (industrial policy) thus served to support—not undermine—health policy.

Regulation-induced Industrial Policy: Creating and Supporting a Generic Drugs Sector

The Brazilian government's strategy to establish and extend a formal "generic" drug sector also generated backward policy linkages from health to industry, but of a more indirect type. Specifically, a new set of regulations created a mismatch between the requirements for participating in the generic drug market and local firms' capabilities. In response, the government applied a set of industrial policy measures, both

extending existing instruments and creating new instruments, to build capabilities and redress the mismatch.

In 1999 the Brazilian government introduced the "Generics Law," which conditions marketing approval for "generic" drugs on demonstration of bioequivalence.[56] To demonstrate bioequivalence means to show that a new drug is equivalent to an already-approved drug (i.e., "reference drug") in terms of the rates of absorption and dissolution in the human body ("bioavailability"). The Generics Law is part of a broader strategy of pharmaceutical assistance, part of the National Medicines Policy that was launched in 1998, whereby the government has aimed to lower the price of drugs and thus extend affordability and use.[57] The strategy to promote generic drugs in Brazil emerged in response to a conjuncture of events, including the demands on the health system because of the government's comprehensive treatment commitments and, critically, a series of crises regarding drug safety.[58]

The Generics Law and the MH's subsequent implementing of regulations created a new category of drugs in Brazil: a "generic" drug is bioequivalent to a reference drug and produced under conditions that satisfy "good manufacturing practices" (GMP). Interchangeable generics are sold by the name of the active ingredient, rather than a brand.[59] Prior to the 1999 law, this category did not exist. Instead, the market featured originator drugs and "similars," the latter having the same APIs as originator drugs but without being required to demonstrate bioequivalence, and with their own brands. The new framework stipulates which categories of drugs need to demonstrate bioequivalence by which dates.[60] Though the bioequivalence requirement applied initially to therapeutic categories regarded as higher-risk (e.g., ARVs, antibiotics), by 2014 all follow-on drugs will need to show bioequivalence to obtain market authorization.[61]

A successful generics policy rests on multiple pillars. Governments need instruments to facilitate market entry—what is typically referred to as creating a generic "pathway." These instruments include intellectual property policy measures to address patents as they reach the end of their terms, as well as health surveillance measures to assure the quality and substitutability of generic products (and thus provide consumers and healthcare professionals with confidence that generics are adequate substitutes for brand-name drugs). In this section we focus on this latter issue, namely the challenges of ensuring that local producers comply with the new regulations.[62]

The new Brazilian regulatory regime set a high bar for market participation. With bioequivalence testing new in Brazil, and lacking its own technical expertise, the government hired an external consultant, from the United States, to design the new guidelines. The result was a regulatory framework that mirrored the U.S. system, which the then-director of Brazil's health surveillance agency (*Agência Nacional de Vigilância Sanitária*, ANVISA) later acknowledged as being too stringent.[63] Not surprisingly the initial supply response to the requirements was minimal: as of December 2002 only 5.3 percent of the pharmaceutical firms in Brazil were producing generics.[64]

Although ANVISA subsequently modified the guidelines, even the revised Brazilian generic guidelines remained among the most stringent in Latin America. In a 2003 survey of pharmaceutical regulations, the Pan American Health Organization

(PAHO) examined bioequivalence requirements in six countries (Argentina, Brazil, Chile, Colombia, Cuba, and Venezuela). Of the eighty-six drugs in the PAHO study, fifty-one required demonstration of bioequivalence in Brazil, the most of any of the countries analyzed.[65] Of course, depending on disease profiles, not all drugs are marketed in all countries, so variation in requirements is to be expected; yet these data suggest that Brazil introduced comparatively stringent requirements. In fact, PAHO lists forty-four drugs where bioequivalence was required in just one of the six countries surveyed: of the forty-four instances, twenty were from Brazil.[66]

Many firms were unable to comply with the new regulations. As indicated, prior to the late 1990s "similars" constituted the predominant form of nonpatented drugs in Brazil. The new regulations meant that local firms aiming to stay in the market needed to stop producing similars and instead begin producing generics. To do so they must, in addition to satisfying GMP requirements, produce bioequivalent versions of originator drugs and demonstrate, with in-vivo testing, that their versions are bioequivalent. GMP is not easy to satisfy,[67] however, establishing bioequivalence is not simple, and demonstrating bioequivalence is costly. Consider, for example, the small pharmaceutical industry Sebadel, founded in 1953, with annual turnover of roughly US$1 million. Half of this firm's roughly 200 products were required to provide bioequivalence tests, which at the time cost roughly US$100,000 per drug. Meeting the new obligations would have consumed virtually all of the firm's sales.

The mismatch created between the stringent regulations and local capabilities is a common regulatory challenge. If the regulations are too strict they can be counterproductive. After all, if firms are unable to satisfy the requirements and, as a result, the number of suppliers decreases, then the new regulations could have the perverse effect of *reducing* access to medicines by driving up prices.[68] This is why some observers (and actors) regard stringent bioequivalence requirements across a wide array of therapeutic segments as a barrier to market entry.[69] Although relaxing regulatory requirements could alleviate these concerns, doing so may lead to lower-quality and less-safe drugs being on the market, i.e., if the regulations are relaxed it may defeat the purpose of having them. In fact, the government's initial response to the mismatch was to simplify drug registration regulations to increase supply. For example, ANVISA created a special registry for granting authorization, via a streamlined and rapid process, of generic drugs already registered in Canada, the United States, or the European Union.[70] This measure generated strong criticism from the national sector, which then worked closely with ANVISA to eliminate the *de facto* discrimination in favor of imported products.

The alternative to either forcing firms out of the market with strict enforcement of regulations or allowing substandard firms to stay in the market with lax enforcement is to complement regulatory enforcement with measures to facilitate compliance.[71] In the case of generic drugs in Brazil, the government helped facilitate compliance via investment in bioequivalence testing facilities, renegotiating and clarifying regulatory guidelines, and helping local firms acquire capabilities.[72] In doing so the government regularly consulted with industry. In March 2003, to provide one early example, ANVISA hosted a workshop on regulatory aspects of generic medicines and similar

medicines. The aim was to promote collaboration between the regulated sector (firms and bioequivalence centers) and the regulating agency. This event was crucial as industry and bioequivalence centers could express their concerns with the ANVISA requirements (including the necessity of revising some resolutions) and propose further consultations to facilitate compliance.[73]

Most importantly, an array of promotional policies directed toward the sector, including instruments discussed in the previous section, were applied to help Brazilian firms gain the necessary capabilities to meet the new regulatory requirements. Indeed, when *Profarma* was launched its mission was to help firms improve their production facilities. According to the first director of *Profarma*, it was evident that the new regulations introduced by ANVISA would require significant investments in upgrading, to satisfy both GMP and bioequivalence standards, and addressing these needs was the initial challenge confronted by BNDES as it turned toward the pharmaceutical sector.[74]

In *Profarma*'s first phase, from 2004–2007, 49 percent of the loans made were for "production," a category that BNDES officials state as being directed to helping firms upgrade their facilities to comply with ANVISA's new requirements. When BNDES was lending for production and investment in this first period, it was largely about helping firms comply with ANVISA regulations.[75] Although many local firms had long acquired the capabilities to reverse-engineer existing drugs, doing so according to GMP and achieving and demonstrating bioequivalence were new challenges. These challenges, and in particular recognition that firms would need to make expensive investments to be able to put generic drugs on the market, motivated BNDES' early lending strategy toward the pharmaceutical sector.[76]

More recently, *Profarma* has begun to focus more directly on funding "innovation" to meet specific Brazilian health needs, as discussed in the previous section, which has meant that the share of lending directed toward "production" decreased slightly during the second phase, from 2008–2012. Yet the absolute levels of production-oriented lending continued to increase, and over the course of the program (through 2012), 41 percent of *Profarma's* lending has been directed toward helping firms upgrade their production facilities in this way (BNDES data). And while BNDES supported private firms, the government also supported public firms. During the first years of Lula's administration, between 2003 and 2005, the MH invested USD 100 million to enable the public laboratories to comply with the requirements for good manufacturing practices.[77]

In addition to providing financial support, the government took a number of other steps to address the mismatch created by the new regulatory requirements. ANVISA attributed the weak and disappointing initial supply response to a number of factors, including low capabilities of the sector, minimal abilities to conduct bioequivalence studies, and information gaps yielding low demand for such drugs. To address these gaps, and thus facilitate adaption to the new regulatory environment, the agency introduced a range of measures, including specific steps to improve the country's scientific and technical infrastructure in the area of drug safety.[78]

More generally, the country's health and scientific infrastructure was ill equipped for the new regime. Immediately following the introduction of the new regulations, nearly all of the bioequivalence tests submitted to ANVISA for approval were conducted outside of Brazil.[79] One reason for this is that few local firms were prepared to meet the new requirements, as discussed above, and the foreign firms that used the system were accustomed to undertaking such measures abroad. Another reason for the reliance on external testing centers is simply that local alternatives were not available. Of course, these two factors are related, in that the scarcity of local opportunities raised the costs and complexity of complying with the regulatory requirement, making it less likely that Brazilian firms would participate in the new regime. To address this shortcoming ANVISA created a specialized unit to monitor and certify local bioequivalence centers (*Coordenação de Inspeção em Centros de Bioequivalencia*), and, importantly, to help bioequivalence testing centers gain the capabilities to obtain certification. The government invested significantly in developing capabilities for local certification, and within a decade most bioequivalence testing for the Brazilian market occurred within Brazil. In 2002, 27.3 percent of bioequivalence studies submitted to ANVISA were conducted in Brazil, while by end of 2009 87.6 percent were performed locally.[80] This expansion was the result of a conscious and explicit response to the problem that Brazilian firms were not participating; ANVISA wanted to know why so few Brazilian firms were applying and why so many applications were being rejected, and sought to correct the problems.[81]

The new generic regulations were thus implemented with a combination of carrots and sticks. On the one hand, firms that could not satisfy the bioequivalence requirements were not allowed to participate in the generics market. Many firms had GMP certification withdrawn or cancelled.[82] Firms were forced out of the market for noncompliance, and, importantly, our informants report that firms *fear* being forced out of the market for noncompliance. On the other hand, the government supplemented enforcement with extensive supportive measures to help local firms acquire the capabilities to adjust to the new and more stringent regulatory environment. Thus, the threats of punishment attached to noncompliance are real, and so too are the supportive measures to help firms comply.

Regulation-induced industrial policy appears to have been successful. Brazilian firms did not merely remain competitive, but rather they grew in size and stature as generics producers. Brazilian firms account for 88 percent of this market; the top five firms are (or were, until recent foreign acquisitions) national. In 1999, the local firm EMS ranked twenty-ninth in terms of sales, and in less than a decade it became the market leader in the generic drug sector. Similarly, Eurofarma, Biosintetica, and Medley—all family-owned Brazilian firms[83]—all grew spectacularly in the wake of the new generic drug regulations, and these firms dominate the market. Importantly, the acquisition of these capabilities did not occur spontaneously, but were the effects of government promotion.

Government-industry collaboration to facilitate adjustment to the new regulations constitutes a form of industrial policy. There is a virtual consensus among

representatives of the pharmaceutical sector that the generic drug regulations, at first seen as a threat to survival, ultimately became crucial for improving manufacturing plants. Producing generic drugs, while not as research-intensive as discovering new molecules, relies on significant research and development capabilities. In the absence of industrial policies that followed the introduction of the generic regulations, it is unlikely that Brazilian pharmaceutical firms would have attained the degree of technological capabilities that many have since exhibited.

The key issue for our analysis is the extent to which adjustment to the new generic regulations occurred on account of—or independently of—the Brazilian government's efforts to extend support and facilitate compliance. We envisage four scenarios: (1) firms that already possessed the capabilities to meet the new regulations did so; (2) firms that lacked the necessary capabilities to meet the new requirements acquired them autonomously and thus were able to adjust to the new regulations; (3) firms that lacked the necessary capabilities and acquired them with government support thus were able to adjust and participate in the generics market; (4) firms that lacked capabilities did not acquire them, and exited the market.[84] Although all four scenarios exist, it is the third that is most relevant to this article. We acknowledge that disentangling the second and third scenarios is difficult, and that in the absence of more data it is hard to know whether firms that developed capabilities to adjust did so on their own or because of the government's efforts. However, we know that BNDES attempted to increase capabilities and thereby facilitate compliance (i.e., to generate the third scenario) and we know that these measures were motivated by a concern that the regulations would have perverse effects without such promotion. In other words, health policies triggered industrial policies.

Conclusion: Health, Industry, and Virtuous Circles

Development economists have long justified populations using subpar or more expensive locally manufactured radios, for example, on the ground that this is a short-term side effect of a developmental process that includes creating capabilities for radio production and electronics. Rightly or wrongly, the logic informing this policy prescription is that the developmental benefits of increased industrial capabilities outweigh the short-term costs of using lower-quality or more expensive consumer goods. Yet we do not justify populations using subpar medicines this way; it is difficult to say people should die or experience additional suffering in order to build capabilities for pharmaceutical production. In this realm the trade-offs seem much starker: governments can promote health or industry, but not both (at least not simultaneously).

This article suggests that this logic may be only partially right, at best; the emphasis on trade-offs, rather than synergies, may be misleading. If a focus on healthcare provision reveals weaknesses in the pharmaceutical sector, and if these weaknesses make healthcare provision unsustainable (i.e., if the absence of sufficient industrial capabilities undermines social policy), then focusing first on health policy can lead

policymakers back to promoting pharmaceuticals as well. And when policymaking occurs in this order, with industrial policies toward the pharmaceutical sector focused to meet the specific needs and demands of the health sector, we can observe better industrial policies.

To that end we have focused on cases from Brazil. Weaknesses in the local pharmaceutical sector created vulnerabilities for the government's flagship health policies. These weaknesses prompted the government to introduce new industrial policies for the pharmaceutical sector. As different as these two cases are, both illustrate processes of backwards linkages from health policy to industrial policy. The first case, of health policies leading to the emergence of the Health Industry Complex, is self-evidently a story of linkages from health to industry. The second case, of generic regulations inspiring the application of ancillary policies to upgrade local production, is also about linkages in that the government introduced industrial policy measures to help local firms adjust to the new regulations and thus assure that the health policies succeed. Thus, in both instances the government found its health policies vulnerable in the absence of a more vibrant national pharmaceutical sector; and in both instances concerns with making the health policies successful triggered industrial policies.

The effects of the government's supportive policies can be observed not just in the market, but in politics too. The local pharmaceutical sector in Brazil expressed strong opposition to the Generics Law.[85] As explained, the regulations threatened established procurement and production practices, and implied new costs and investment requirements. Yet the Brazilian government was able to overcome this opposition and build a coalition in support of the new strategy. In addition to the measures that we have discussed here, the Minister of Health, José Serra, inspired the creation of a private-sector organization to collaborate with on implementation. The organization that emerged from this initiative, *Pro-Genericos*, works closely with the government and, ultimately, constituted the cornerstone of the coalition to support the generics policies.[86] Thus, the generic regulations, while initially introduced over the opposition of the local pharmaceutical sector, came to obtain and benefit from this actor's support as firms adjusted to the new environment and essentially redefined their interests. The supportive instruments applied by the government to address the mismatch appear to have not just helped overcome opposition but also converted opponents of the generics policy into advocates.

The path by which regulations on the generic pharmaceutical industry became consolidated in Brazil appears to be consistent with Streeck's observation that regulatory regimes imposed by governments, by inspiring innovation and improved performance, may come to be supported by the very actors that opposed their original implementation. Streeck refers to these as "beneficial constraints," and later refers to the process of the state requiring firms to adjust (and thus encouraging them to redefine their interests) as "educating capitalists."[87]

What might governments do to educate capitalists, to convert onerous regulations into beneficial constraints? Here, we want to focus on how governmental actions can, in what Piore and Schrank refer to as a "tutelary" process, help private actors acquire the capabilities to survive under the new regulations.[88] To the extent that we witness

such a tutelage process, the observations have important implications for how we think about the politics of regulation. Where we witness tutoring of this sort, it means that firms do not acquire new capabilities and industries' preferences do not change spontaneously in response to the compulsions of the new regulatory regime, but rather firms are being aided in the acquisition of new capabilities which then yield altered preferences. That is, the government does not simply alter policy and then let the new market conditions operate, but rather the government actively seeks to help actors adjust and in doing so generates constituencies for the new status quo created by the revised regulatory regime.

Although the article has focused on linkages between health policy and industrial policy, it is worth concluding with a brief assessment of the effects. We suspect the reality is less rosy than depicted here. Brazil's pharmaceutical sector still runs significant trade deficits; the pharmaceutical sector has grown, but it remains highly dependent on imported inputs (particularly APIs). The transnational sector has an overwhelming share of the market (~80 percent, by volume of sales). These firms tend to import most of their APIs, even off-patent APIs; their local production still amounts mostly to final formulation and packaging. The failure to reduce import dependence is probably not due to inadequacies in the industrial policies per se, but rather the overvalued exchange rate that favors imports.[89] Likewise, the generics sector has grown, but has become intensely concentrated, with a handful of firms accounting for overwhelming shares of sales. Moreover, recent years have witnessed increasing denationalization of the generics sector, as foreign firms seeking a foothold in the growing Brazilian market have purchased successful local producers. An important takeaway from these observations is that as important as the alignment between health policy and industrial policy has been, more alignment (between health-industrial policy and macroeconomic policy, in the first instance, and competition and investment policy, in the second) may be essential too.

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Notes

1. Robert Wade, "US Keeps Control of the World Bank," *Le Monde Diplomatique—English Edition, LMD*, October 2012 (http://mondediplo.com/blogs/us-keeps-control-of-the-world-bank).
2. Lant Pritchett, "Why Obama's World Bank Pick Is Proving So Controversial," *The New Republic*, April 11, 2012 (http://www.newrepublic.com/article/politics/102624/why-obama%E2%80%99s-world-bank-pick-proving-so-controversial). Out of fairness to Pritchett, it is not clear if he is asserting that Kim's appointment is "an intrusion" or simply reporting that others regard it as such.
3. That is not to say that Kim's appointment is free from criticism. To the contrary, the fact that the U.S. nominee was essentially imposed over qualified candidates from the developing world is also a point that many observers (e.g., Wade, "US Keeps Control") have criticized. The objective here is not to debate the merits of this particular appointment, but simply to point out that the conflict that Kim's appointment is said to represent may be overblown.
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11. Kenneth C. Shadlen, "The Political Economy of AIDS Treatment: Intellectual Property and the Transformation of Generic Supply," *International Studies Quarterly* 51, no. 3 (2007): 559–581.
12. These conditions may be particularly acute in a continental-sized country with tropical and temperate zones and significant degrees of social stratification, but while Brazil may represent an extreme case, it is not unique.
13. Indeed, we witness such concerns in developed countries too: supply shortages in medicines inspire government action in a way that supply shortages in other areas do not. We would not, for example, expect to see the White House acting as such about a shortage of color televisions (http://www.whitehouse.gov/the-press-office/2011/10/31/fact-sheet-obama-administration-takes-action-reduce-prescription-drug-sh)

14. Robert Ballance, Janos Pogany, and Helmut Forstner, *The World's Pharmaceutical Industries: An International Perspective on Innovation, Competition and Policy* (Vienna: United Nations Industrial Development Organization, 1992).
15. Indeed, that would appear to be a goal of the regulations, to drive out the low-quality producers.
16. Michael J. Piore and Andrew Schrank, "Toward Managed Flexibility: The Revival of Labour Inspection in the Latin World," *International Labour Review* 147, no. 1 (2008): 1–23; Salo Coslovsky, *Compliance and Competitiveness: How Prosecutors Enforce Labor and Environmental Laws and Promote Economic Development in Brazil* (PhD Dissertation, MIT; 2009).
17. Andrew Schrank and Michael J. Piore, "Norms, Regulations, and Labour Standards in Central America," CEPAL (Mexico), 2007.
18. We refer to "direct" beneficiaries to acknowledge the public goods nature of these sorts of regulations.
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23. The list of drugs covered by SUS increased from 342 (2008) to 810 (2012), including extension to more expensive treatments for hypertension and diabetes.
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27. As a member of the World Trade Organization (WTO), Brazil was required to begin granting pharmaceutical patents in accordance with the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). However, this additional, retroactive patent protection to drugs in the "pipeline" was not required by TRIPS. Brazil, along with Mexico, is exceptional in granting pipeline patents.
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29. Specifically, the revisions gave clearer definitions of national emergency and public interest and simplified the mechanism for issuing CLs by giving the MH greater authority to act. Kenneth C. Shadlen, "The Politics of Patents and Drugs in Brazil and Mexico: The Industrial Bases of Health Policies," *Comparative Politics* 42, no. 1 (2009): 41–58. Denis Barbosa, "Licenças Compulsórias: Abuso, Emergência Nacional e Interesse Público," *Revista Da ABPI* 45 (2000): 3–22; Jorge Antonio Zepeda Bermudez Maria Auxiliadora Oliveira, *Intellectual Property in the Context of the WHO TRIPS Agreement: Challenges for Public Health* (Rio de Janeiro: ENSP, 2004).
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32. Here it is worth noting that the international market for nonpatented ARVs hardly existed prior to the early 2000s. As a result, in the early years of the government's HIV/AIDS treatment program, Brazilian public laboratories served as the principal source of supply.
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37. Cassiolato et al., "Avaliacao Economica," 172–73.
38. Nunn et al., "Evolution of Antiretroviral Drug Costs," 8–9.
39. Shadlen, "The Political Economy of AIDS Treatment."
40. Though early, because of the country's advanced HIV/AIDS treatment program, Brazil is not unique in reacting to these effects. Imminent reduction in Indian supply has led to a wide array of initiatives to increase local pharmaceutical production in the developing world. See, for example, *African Union-UNIDO, Pharmaceutical Manufacturing Plan for Africa: Business Plan* (Vienna: UNIDO, 2012).
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43. Personal Communication (EF) with Carlos Lessa, April 13, 2009.
44. To put it simply, under Cardoso's government the emphasis was on securing lower prices, while the focus of subsequent governments has been to integrate the search for lower prices with the generation of industrial capabilities in the sector. This is not to say that the alignment of concerns has been without conflict. Our informants suggest recurrent disagreements, within the MH, between the Department of Pharmaceutical Assistance and the Department of Health Economics. While the former has been primarily concerned with purchasing medicines at the lowest price (including imports from India), the latter is more committed to developing local capabilities, on the grounds that doing so best serves health policy in the longer term. The Department of Health Economics largely prevailed during the Lula governments.
45. *Mais Saúde* is the government's overarching framework for healthcare strengthening. One of its principle axes is the Health industry Complex (CIS). Much of *Profarma*'s funding is directed to support the CIS.
46. In 2012 the MH issued guidelines to formalize the strategy for creating PDPs to meet specific needs of the Brazilian health sector: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2012/prt0837_18_04_2012.html
47. This entailed legislative changes that alter the relationship between private firms and public research institutions and that allow direct public subsidies in private firms,

along with a series of tax incentives for local R&D. See Kenneth C. Shadlen, "The Political Contradictions of Incremental Innovation: Lessons from Pharmaceutical Patent Examination in Brazil," *Politics & Society* 39, no. 2 (2011), 143–74.

48. Delgado, Ignacio José Godinho. "A Politica Industrial Brasileira Para Setores Selecionados e a Experiencia Internacional," ABDI (2008), 42-43; Carlos Cezar Flores Vidotti, Lia Lusitana Cardozo de Castro, and Simone Saad Calil, "New Drugs in Brazil: Do They Meet Brazilian Public Health Needs?" *Revista Panamericana De Salud Pública* 24, no. 1 (2008): 36–45.
49. Valor, "Farmas Terão R$ 5 Bilhões do BNDES." http://www.valor.com.br/empresas/2652830/farmas-terao-r-5-bilhoes-do-bndes). For more discussion of BNDES lending in this period, see Kathryn Hochstetler and Alfred P. Montero, "The Renewed Developmental State: The National Development Bank and the Brazil Model," *Journal of Development Studies* 49, no. 11 (Nov 2013)(forthcoming).
50. Ministerio da Saude, *Mais Saude: Direito De Todos, 2008-2011* (Brasilia: Ministerio da Saude, 2010).
51. Here it is important to note that the creation of PDPs has an important goal of changing the role of public laboratories in Brazil, from being suppliers of essential medicines with low value-added to being producers of more sophisticated medicines. More recently, the MH announced an investment of USD 4 billion (roughly 10 percent of the Ministry's budget) toward the promotion of PDPs to increase the national production of technologically complex, high value-added drugs that are currently imported ("Governo Lança Pacote de R$ 8 bi para Setor Saúde," *Valor Economico*, April 12, 2013).
52. Nunn et al., "Evolution of Antiretroviral Drug Costs."
53. Ibid.
54. As we show above, however, the experience with Abbott in 2005 also revealed the limits of such a strategy, and thus further motivated the government to build capabilities.
55. A. Hill et al., "Is the Pricing of Antiretrovirals Equitable? Analysis of Antiretroviral Drug Prices in 20 Low and Middle Income Countries," 7th International AIDS Society Conference on HIV Pathogenesis, Treatment and Prevention, Kuala Lumpur, abstract WELBD05, 2013
56. Note that equivalent and identical are not the same. Bioequivalence is established within a range of variation; variation in bioavailability rates are evident among differently produced batches of all drugs. The discussion in this section is limited to analysis of generic versions of chemical ("small molecule") drugs. The issues involved in demonstrating bioequivalence and regulating generic substitution in the case of biological (protein-based) drugs are considerably different.
57. Jillian Clare Cohen and Kristina M. Lybecker, "AIDS Policy and Pharmaceutical Patents: Brazil's Strategy to Safeguard Public Health," *World Economy* 28, no. 2 (2005): 211–30; Cláudia Regina Cilento Dias and Nicolina Silvana Romano-Lieber, "Processo da implantação da política de medicamentos genéricos no Brasil," *Cadernos de Saúde Pública* 22, no. 8 (2006): 1661–69; Elize Massard da Fonseca, *Reforming Pharmaceutical Regulation: a Case Study of Generic Drugs in Brazil*, Ph.D. Thesis, University of Edinburgh (2011).
58. Fonseca, *Reforming Pharmaceutical Regulation*. Brazil is not unique in this regard. Public health crises generated by unsafe drugs inspired the introduction of more stringent pharmaceutical regulations in the United States and other countries as well. David Vogel, *The Politics of Precaution: Regulating Health, Safety, and Environmental Risks in Europe and the United States* (Princeton: Princeton University Press, 2012).

59. In Brazil, packages containing generics have a yellow stripe and the letter "G" (http://www.portaldosfarmacos.ccs.ufrj.br/imagens/genericos/cx_remedio.jpg)
60. ANVISA Resolutions 133 and 134, from 2003.
61. In addition to creating a new category of interchangeable generic drugs, the regulations, when fully implemented, will convert the category of "similars" into "branded generics" (i.e., bioequivalent versions of nonpatented drugs that are sold under proprietary marks).
62. While we are not focusing on the patent-related issues in this article, they play an important role in the generics strategy. The Brazilian patent office has tended to refuse to adjust patent terms of drugs protected by "pipeline patents." The pipeline refers to international patents predating 1997, when pharmaceuticals became patentable in Brazil, which were then granted in Brazil, retroactively, for the length of patent in the first international country were the patent was granted. When pipeline patents are then extended in foreign jurisdictions, firms request that the extensions be applied to Brazil too. The patent office typically denies these requests, and has been supported by the courts. The nonextension of pipeline patents, in combination with a U.S.-style "early working" provision that allows generic firms to produce patented drugs in order to apply for marketing authorization can promote rapid entry of generic competition at the time of patent expiration. Given that most drugs patented in Brazil with patents expiring prior to 2014 would have received protection under the pipeline, this position vis-à-vis extensions has tantamount significance for generic drug entry. For more discussion, see Shadlen, "The Politics of Patents and Health," 49.
63. Fonseca, *Reforming Pharmaceutical Regulation*, 151–52.
64. Dias and Romano-Lieber, "Processo da Implantação," 1662.
65. After Brazil, Cuba had the second greatest coverage with 43 APIs requiring bioequivalence, followed by Venezuela (30), Chile (26), Argentina (18), and Colombia (5). PAHO, "4th Meeting of the Working Group on Bioequivalence" (Pan American Health Organization, 2003), 27–28.
66. PAHO, "4th Meeting," 29–30.
67. Carlos César Fiocchi and Paulo Augusto Cauchick Miguel, "Um Estudo de Caso de Implementação das Boas Práticas de Fabricação em uma Empresa de Médio Porte do Setor Farmacêutico – Dificuldades e Recomendações," *GEPROS: Gestão Da Produção, Operações e Sistemas* 1 (2006).
68. Indeed, this is a standard economic critique of regulations.
69. Brazil's regulations can also be regarded as constituting a form of market-preserving, industrial policy, in that producers from other markets with less stringent bioequivalent requirements face high barriers to entry to the Brazilian market. Indeed, Argentinean producers expressed precisely this concern: Marta Bekerman and Pablo Sirlin, "Static and Dynamic Impacts of MERCOSUR: The Case of the Pharmaceutical Sector," *CEPAL Review* 75 (2001): 228.
70. Dias and Romano-Lieber, "Processo da implantação," 1663–65.
71. Salo Coslovsky, Roberto Pires, and Susan Silbey, "The Pragmatic Politics of Regulatory Enforcement," in *Handbook on the Politics of Regulation* (2010); Piore and Schrank, "Toward Managed Flexibility."
72. An additional way to enforce regulations in a pro-developmental fashion is to phase them in gradually, which we also witness in Brazil.
73. See the report of this event at http://www.anvisa.gov.br/medicamentos/bioequivalencia/eventos/workshop/index.htm (accessed on December 28, 2012). As discussed below, a consequence of these efforts was that the local pharmaceutical sector's preferences

changed after the regulations are imposed—they came to support a policy that they initially opposed.

74. Personal communication (EF) with Luciana Capanema, March 20, 2009.
75. Ibid.
76. Personal communication (EF) with Carlos Lessa, April 13, 2009. Similarly, Pedro Palmeiras, discussing the evolution of *Profarma* lending, notes that, "at the start of the program, credits were most geared toward improving existing factories" ("Farmas terão" *Valor*).
77. E.A. Oliveira, M. Labra, and J. Bermudez, "A Producao Publica De Medicamentos No Brasil: Uma Visao Geral," *Cad Saude Publica* 22, no. 11 (2006): 2379-89.
78. A.C. Gomes Barra, and I. de Albuquerque, "A Decade of Generic Pharmaceutical Policies in Brazil," *Journal of Generic Medicines: The Business Journal for the Generic Medicines Sector* 8, no. 2 (2011), 72–75. As another example of extension, the Ministry of Health imposed specific packaging requirements to supply generic drugs to the SUS, and ANVISA in turn provided support to firms to help meet the new requirements.http://portal.anvisa.gov.br/wps/content/anvisa+portal/anvisa/sala+de+imprensa/menu+-+noticias+anos/2012+noticias/novo+manual+para+rotulagem+dos+medicamentos+do+ministerio+da+saude
79. Presentation of Silvia Storpirtis, "Workshop sobre Aspectos Regulatórios Relacionados aos Medicamentos Genéricos e Similares, ANVISA (Brasilia), March 18–19, 2003, slide 4; Fonseca, *Reforming Pharmaceutical Regulation*.
80. Fonseca, *Reforming Pharmaceutical Regulation*, 168; Barra and Albuquerque, "A Decade of Generic Pharmaceutical Policies," 74.
81. Storpirtis, "Workshop sobre Aspectos Regulatórios"; Barra and Albuquerque, "A Decade of Generica Pharmaceutical Policies in Brazil." Before proceeding, it is worth making a quick note about the role of pharmaceutical inspectors. Some regulation scholars (Piore and Schrank, "Toward Managed Flexibility"; Coslovsky, Pires, and Silbey, "The Pragmatic Politics") emphasize the importance of inspectors having the discretion to apply and enforce regulations such a way that they can help firms adjust. Their depiction of a tutelary process depicts inspectors as "street-level bureaucrats," agents who apply sets of tacit rules in making day-to-day regulatory decisions. These insights can also apply to health surveillance agents inspecting pharmaceutical firms to help establish GMP practices. Inspection, directly by ANVISA or in collaboration with associations, can entail helping firms upgrade production processes to attain GMP certification (and to be able to satisfy bioequivalence requirements). It is clear that ANVISA recognized that full compliance with GMP would be difficult (Fiocchi and Miguel, "Um Estudo de Caso"). How such recognition affected the practices of inspectors on the ground is an area for future research.
82. ANVISA, "Empresas de Medicamentos com Certificado Cancelado de Boas Práticas de Fabricação (BPF)." http://s.anvisa.gov.br/wps/s/r/clgF
83. Until recently—Medley was purchased by Sanofi-Aventis in 2009.
84. To be sure, there can be no doubt that some firms lacked capabilities to comply with the government's requirements, failed to comply, and nevertheless continue to operate, in non-regulated "black market" zones. Our analysis is restricted to the formal, regulated pharmaceutical sector.
85. Fonseca, *Reforming Pharmaceutical Regulation.*
86. Ibid.
87. Wolfgang Streeck, "Beneficial Constraints: On the Economic Limits of Rational

Voluntarism," in *Contemporary Capitalism* (Cambridge: Cambridge University Press, 1997). Wolfgang Streeck, "Educating Capitalists: a Rejoinder to Wright and Tsakalotos," *Socio-Economic Review* 2, no. 3 (2004): 425–38.

88. Piore and Schrank, "Toward Managed Flexibility."
89. Of course, that industrial policy is difficult to run effectively in the context of an overvalued exchange rate is no secret, a problem with a long history in Latin America. The counterfactuals are what the situation would look like without the industrial policy or with a more competitive exchange rate.

Author Biographies

Kenneth C. Shadlen (k.shadlen@lse.ac.uk) is a political scientist in the Department of International Development at the London School of Economics. He works on the comparative and international political economy of development.

Elize Massard da Fonseca (emassard@gmail.com) is a research fellow at the Center for Metropolitan Studies, Brazil and, affiliated with the University of Sao Paulo. Her research focuses on pharmaceutical regulation and health politics.