NBER WORKING PAPER SERIES

THE ROLE OF TRADE IN ECONOMIC DEVELOPMENT

David Atkin
Dave Donaldson

Working Paper 29314
http://www.nber.org/papers/w29314

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2021

We are grateful to Bhargav Poudel—and especially to Rebekah Dix, Erin Grela, and Todd Lensman—for incomparable research assistance, as well as to David Baqaee, Johannes Boehm, Penny Goldberg, Amit Khandelwal, Jan de Loecker, Nina Pavcnik, and Ezra Oberfield for sharing code and data, to Amit Khandelwal and Nina Pavcnik for their stimulating conference discussions, and to David Baqaee, Arnaud Costinot, Elhanan Helpman and Garima Sharma for helpful comments. We also gratefully and fondly acknowledge many (and yet, sadly, far too few) insightful conversations with Emmanuel Farhi that have taught us about the subject matter surveyed here. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The Role of Trade in Economic Development
David Atkin and Dave Donaldson
NBER Working Paper No. 29314
September 2021
JEL No. F0,O0

ABSTRACT

This chapter (to appear in the forthcoming Handbook of International Economics, Vol. 5) develops a framework with which to interpret and survey answers to the question: how does increased openness affect aggregate welfare in a typical developing country? We decompose answers into four mechanisms:(i) an effect akin to technological progress that is purely mechanical; (ii) an effect on factoral terms of trade; (iii) a distortion revenue effect that exacerbates or mitigates the consequences of domestic distortions; and (iv) an effect of trade on the magnitude of those distortions themselves. Our focus lies in the last two mechanisms as these are especially important for the study of low-income settings where domestic distortions are thought to be rife. Throughout, we provide both a review of existing work on these topics and quantitative calculations that aim to gauge the magnitudes involved in a global model that is calibrated to match firm- and industry-level data on trade flows, production techniques, and a host of distortions (tariffs, other taxes, markups, bribes, theft, credit constraints, contracting failures, labor regulations, and public utility provision) that have featured in the literature.

David Atkin
Department of Economics, E52-550
MIT
77 Massachusetts Avenue
Cambridge, MA 02139
and NBER
atkin@mit.edu

Dave Donaldson
Department of Economics, E52-554
MIT
77 Massachusetts Avenue
Cambridge, MA 02139
and NBER
ddonald@mit.edu

1 Introduction

Does openness to international trade help or hinder the prospects of economic development? From Adam Smith to John Stuart Mill, from Milton Friedman to Raul Prebisch, and from Jagadish Bhagwati to Joseph Stiglitz, centuries of economic debate has argued both sides of this question. Recent decades have seen substantial progress in the ability of researchers to develop answers that channel new theory, new data, and new empirical tools. This chapter develops a framework whose goal is to survey and synthesize many of these contributions.

The core of our approach is the development accounting framework that is routinely used to analyze comparative living standards. This framework aims to decompose cross-country variation in relative real GDP per capita into contributions deriving from countries' greater access to factor inputs (such as physical and human capital) and a residual defined as aggregate total factor productivity (TFP). Aggregate TFP, in turn, can be decomposed into two contributions: (i) technical efficiency, which derives from individual producers' production technologies; and (ii) allocative efficiency, which derives from a country's allocation of factors of production into their various productive uses. As is well known, in an idealized economy with no distortions arising from market failures, allocative efficiency would be maximized as long as firms and consumers are themselves optimizing. However, it is the hallmark of underdeveloped countries that such market failures are thought to be rampant. As a result, such economies are poorer, in part, because the resources they have are not allocated efficiently and this results in low aggregate TFP.

Against this backdrop, how can international trade interact with economic development? To explore this we examine how a hypothetical increase in trade openness affects economic welfare in a typical developing country—that is, one with distortions in many of its domestic markets. As an organizing device we deploy a model of international trade that allows for a wide range of assumptions about firms' technologies, consumers' preferences, and the size and locus of market failures in potentially any economic exchange (factor-to-firm, firm-to-firm, and/or firm-to-consumer).

In such a framework, changes in the costs of trading have first-order effects on aggregate TFP in a country through four potential channels.[1] The first, and simplest, arises when importing becomes

[1] Relative to the aforementioned development accounting approach, we emphasize the impact of trade on aggregate TFP and abstract from potential impacts on factor endowments, as discussed, for example, by Antras and Caballero (2009) for physical capital or by Atkin (2016) for human capital.

easier due to technological advances (such as an improvement in the nation's ports). This results in gains that we could expect from any technological advance. Such gains have a "mechanical" component—through lowering the price consumers and firms pay for imported goods—in the sense that they materialize even if no physical reallocation takes place. Notably, this effect emphasizes mechanisms that have little to do with the level of development of the country in question—it emphasizes exposure to trade volumes, not the characteristics of the goods contained inside those volumes. Nevertheless, this effect serves as a useful benchmark for gauging the magnitudes of responses to various trade shocks, as we discuss further below.

Second, as is standard in international settings, changes in trade volumes lead to changes in the country's factor prices relative to those abroad. As a result, adjustments in the country's factoral terms-of-trade (FTOT)—changes in factor prices weighted by the extent to which the country is a net buyer or seller of the services of every factor in the world—need to be taken into account.

Importantly, these first two effects operate even in purely efficient economies. As a result, they have been studied extensively in the field of international economics. Our interest in trade and development instead requires particular attention to the implications of departures from efficiency due to the types of domestic distortions that are plausibly important features of developing countries. This brings in the third and fourth considerations that are the main focus of this chapter.

The third channel through which trade can affect welfare operates in distorted economies even if those distortions themselves were to remain fixed. As an economy trades more, the resulting tilt towards activities that involve (direct or indirect) importing and exporting may push factors of production into segments of the economy where market failures are relatively severe. This would raise allocative efficiency because such segments are too small from a social perspective—they are producing more social value per factor input on the margin—than the rest of the economy. In such a scenario, a shock that promotes trade has a additional positive impact (beyond the net of mechanical and FTOT channels) because it mitigates the damage done by domestic distortions. Naturally, the opposite could happen instead.

In the rich settings that we discuss below—featuring many factors of production, a full input-output structure, firm heterogeneity, heterogeneous distortions in all activities, and a parallel informal segment of the economy—there can be no simple presumption about the direction of change in allocative efficiency that is likely to arise when a country trades more. We therefore describe a range of examples that have featured in recent work. To fix ideas, however, consider a simple example consistent with many trade models featuring firm-level heterogeneity in which, within any industry, relatively large firms tend to be those involved in importing and exporting, and economy-wide reductions in trade barriers will result in a relative expansion of such firms. In this setting, trade mitigates misallocation if and only if large firms also tend to have the highest value marginal products of the factors they use. This, in turn, happens whenever such firms, on net, charge larger markups, are subject to more regulation, encounter greater difficulty borrowing, face more rapacious demands from bureaucrats for bribes, etc.

Fourth and finally, if the trade shock (or the reallocations that emanate from it) cause the size of the distortions themselves to change, then this is an additional consideration that needs to be accounted for—and that will interact with the aforementioned FTOT and reallocation mechanisms. Such changes may occur indirectly, insofar as some distortions may be inherently size-dependent and trade may alter the firm size distribution. For example, the enforcement of taxes and regulations may increase in firm size, or firms' optimal markups may increase in the quantity they sell. Or trade may change the size of distortions directly—for example, if heightened foreign competition leads domestic firms to reduce markups, or if greater lobbying by trading firms leads the government to improve its institutions such as the efficacy of its courts.

The above four-way decomposition of potential impacts of trade on welfare in distorted settings provides an opportunity to discuss a wide array of prior work. We complement such discussions with a quantitative analysis of our own. To do so, we build a numerical model of the global economy that matches available measures of trade and production information for many developing and developed countries at both the industry and firm level, as well as firm-specific measures that attempt to capture the myriad distortions that characterize economic life in many of the world's least developed countries.

Specifically, we proceed as follows. We merge the industry-level global input-output dataset prepared by EORA (Lenzen et al., 2012) into firm-level data from the World Bank Enterprise Surveys (WBES) from around the world. This allows us to parameterize a global trade model with a rich set of firm-level distortions in place. Crucially, the WBES measures not only standard firm-level output, input, and trade information, but also surveys firms around the world in regards to their experience with corruption, bribes, security payments, theft, regulation, red tape, market power, credit market frictions, labor market regulations, inability to trust local courts to enforce their contracts, and poor quality electricity, as well as delays, theft, and corruption specifically related to import and export transactions. We develop a new procedure for mapping firms' answers to these questions into estimates of the distortions that these firms face, on the margin. As the above discussion makes clear, the impact of trade on allocative efficiency hinges on factor reallocations across all activities. This motivates our attempts—which admittedly lead to a great deal of extrapolation and interpolation to overcome the limits of currently available data—to incorporate a wide range of potential distortions rather than a subset (since omitting distortions would amount to implicitly assuming that any omitted distortions affect all activities equally).

Having calibrated this quantitative model of global production, trade, and market failures, we subject it to a range of numerical experiments that aim to shed light on many of the ways in which the recent literature has conjectured that trade can affect economic development. For example in a simple exercise, we ask how much any given country's economic welfare would change if the technology that it uses to import were to improve by a small amount while all endowments, tastes, distortions and non-trading technologies are held constant. We also evaluate the effects of these same shocks in model economies with lower levels of baseline distortions (in order to explore the extent to which the level of pre-existing domestic distortions affects the welfare impacts of trade shocks) as well as settings in which trade shocks not only induce reallocations among distorted activities but also have a causal impact on the level of certain distortions themselves.

In these calculations we find that, in a typical low-income country, improving trading technologies would result in a substantial mechanical benefit from technological progress, weakened factoral terms of trade, and improved domestic allocative efficiency, with the combination of these welfare effects being positive for almost all countries. However, as expected in second-best settings such as ours, we find that these effects can often be either larger or smaller in the presence of shrunken pre-existing distortions. This highlights the potential importance of studying interactions between trade and distortions in developing countries that encompass a wide range of sources of market failures—such as markups and market power, credit constraints, contracting imperfections, corruption, informality, knowledge spillovers, etc. We survey an extensive literature that has investigated interactions between trade and certain individual distortions but studies that endeavor to understand a more complete set of interactions are rare to date.

Because this chapter builds on a number of recent surveys on similar themes, we have shaped our focus around elements not present in such work. Winters et al. (2004), Harrison and Rodriguez-Clare (2010) and Atkin and Khandelwal (2020) directly focus on the interactions between trade and development, and we augment these reviews by providing and quantifying a formal framework that connects various strands of the literature related to trade and distortions. This builds on, and updates, pioneering surveys in Bhagwati (1971), Krueger (1984), and Dixit (1985) that have emphasized the classical theme of optimal policy design in the presence of domestic distortions. Nunn and Trefler (2014) provides a more focused survey of the literature on trade and institutions, a topic relevant to our discussions of how trade may directly change the size of the distortions themselves. Costinot and Rodríguez-Clare (2014) reviews recent methodological advances in quantifying the gains from trade, a literature that does not accommodate the pervasive and unrestricted distortions we allow for.

Inevitably, there are also important facets of the trade-development nexus that our review leaves out. This includes the distributional impacts of trade surveyed by Goldberg and Pavcnik (2007) and Pavcnik (2017), implications of trade for growth and innovation as surveyed by Alessandria et al. (2021) and covered elsewhere in this *Handbook* volume by Ackigit and Melitz (2021), the role that trade can play in promoting technology adoption in developing countries (Verhoogen, 2020), and interactions between trade and environmental externalities as surveyed by Cherniwchan et al. (2017) and Copeland et al. (2021) in this volume.

The remainder of this chapter proceeds as follows. Section 2 begins by describing the theoretical framework that frames our discussion of how trade and development can interact. This includes (in Sections 2.1–2.3) the four-way decomposition described above as well as our procedure for populating it with available data (in Sections 2.4 and 2.5). Section 3 then surveys the literature on various types of economic distortions in developing countries as well as our own attempts to arrive at estimates of such distortions as is required to numerically simulate the model of Section 2. We then turn to two sections that split the related trade-development literature (and our accompanying simulations) into two questions. Section 4 asks: How can trade affect welfare in distorted settings even when those distortions are themselves unaffected? And Section 5 asks: How can trade affect these distortions themselves, and how does this effect change the answers discussed in Section 4? Finally, Section 6 offers some brief concluding remarks, with an emphasis on possible directions for future work.

2 Trade and Distortions: An Organizing Framework

In this section we outline a general framework for interpreting the role of trade in the process of economic development. Our goal is both to provide a taxonomy with which to categorize the existing literature and to illustrate qualitatively a set of potential impacts that trade could have on economic welfare in a developing country. We then describe how these impacts can be decomposed quantitatively by using data on payment flows and estimates of the extent of distortions due to market failures.

2.1 Model setup

We draw on and follow closely the presentation in Baqaee and Farhi (2019). Consider a world economy with C countries (indexed by c) and F factors (indexed by f). Factors are differentiated by country (so $F \geq C$ always) and endowed in arbitrary amounts denoted by L_f.

A set of N producers are active around the globe. Each producer maximizes profits subject to the constraints imposed by a constant returns-to-scale (CRS) technology that use goods and factors as inputs, but the nature of its products and production functions are otherwise arbitrary.[2] This generality allows coverage of many important features of recent work, such as a producer's potentially multi-product form, position in domestic or global supply chains, transport costs to or from any other country, intensities of factor usage, horizontal and vertical product differentiation, etc. Producers can be heterogenous in all of these features, both within and across countries. We focus on a fixed set of producers since, under CRS production, entry and exit have no first-order welfare consequences (though see Baqaee and Farhi, 2020 for an extended approach that admits increasing returns to scale and entry).

It is worth emphasizing that the notion of "technology" that we think is appropriate for discussions below is quite broad. In particular, the production function we have in mind is a menu of mappings from inputs into outputs via whatever internal-to-the-firm activities a firm finds privately

[2]That is, there is no further restriction on the manner in which a producer converts the services of the factors in its country, and the products of any other producer in the world, into the products that it sells to any producer or consumer around the world.

optimal. It therefore subsumes activities such as innovation or the purchase of (possibly foreign) inputs, as well as the firm's decision about which goods to produce and what "quality" to embody those goods with. Under our assumption of profit-maximization, each firm will produce at a point on the frontier of its feasible production set at all points in time. This has a stark implication: the only way that a trade (or other) shock could affect a firm's technical efficiency would be as a result of an externality (such as knowledge spillovers) that changed the firm's technology. We return to this point and how it connects to the literature below.

Turning to the demand side, each country c is home to a representative household that earns an amount Y_c, comprised as follows

$$Y_c \equiv \sum_{f \in F_c} w_f L_f + D_c + R_c,$$

where w_f denotes the price of factor f, F_c denotes the set of factors that are based in country c, D_c denotes any net transfers into c from abroad, and R_c denotes the sum of any "distortion revenues" collected in country c. As we discuss further below, such revenues account for the payments associated with any potential pure profits, tax revenues, or other payments (such as bribes). All values and prices are expressed in terms of the numeraire, taken to be total global GDP.

The household in country c makes consumption choices that maximize its welfare, subject to expenditure no greater than Y_c, according to preferences that are homothetic but otherwise unrestricted and free to vary across countries. This focus on a representative household reflects our primary interest in average levels of economic development in country c but of course hinders our ability to discuss intra-national inequality.[3]

We now introduce notation for connecting this model to available data on the value of flows of goods and services. Specifically, let i (or j) denote any one of the $C+N+F$ "entities" (households, producers, and factors) in the world. Then let X_{ij} denote the value that i pays for the exchange of goods and services obtained directly from any j—for example, this could be the purchases made by a final consumer from a domestic producer, the payment of a producer to workers in its own country, or cross-border imports by a producer or consumer in one country from a producer in

[3]Although beyond the scope of this chapter, nothing in our approach precludes the inclusion of heterogeneity across consumers in terms of which producers they buy from, which factors they own, and which distortion revenues they earn (given sufficient data on such heterogeneity).

another. Finally, let $\widetilde{\Omega}_{ij} \equiv X_{ij}/\sum_k X_{ik}$ denote the share of i's total expenditures that it devotes to direct purchases from j.[4] The matrix $\widetilde{\Omega}$ can be thought of as a global input-output shares matrix among all the world's economic entities. We define the Leontief inverse of this matrix as $\widetilde{\Psi} \equiv (I - \widetilde{\Omega})^{-1}$. As usual, whereas $\widetilde{\Omega}_{ij}$ captures only the value of direct exchange from j to i, $\widetilde{\Psi}_{ij}$ includes all of the value of direct plus indirect (e.g where j sells to l, and l sells to i) exchange from j to i.

These objects are essential for all that follows, since they reveal the appropriate combination of structural supply- and demand-side features that prevail in the observed global equilibrium. In Section 2.5 below, we describe our procedure for using publicly available data to estimate the $\widetilde{\Omega}$ matrix (and thus $\widetilde{\Psi}$) for the global economy in a recent year.

The next key element of this model economy is an arbitrary set of distortions that may potentially prevail on any exchange. Such distortions could derive from phenomena such as market power, government actions such as taxation/subsidies and regulation, non-market transfers such as bribes or theft, or an inability to enforce contracts perfectly in product or financial markets.[5] The essence of such market failures is that they create a difference (or "wedge") between the price that the buyer pays in an exchange and the seller's marginal cost of conducting the exchange, and also that this wedge generates distortion revenue for some actor (not necessarily the buyer or seller).[6]

For example, in the case of market power, the seller charges a markup and this (by definition) drives a wedge between the price the buyer pays and the seller's marginal cost, with the corresponding distortion revenue (pure profits) being collected by the seller. As a second example, in the case of a sales tax in a competitive market, the buyer pays a price inclusive of the tax and the seller receives a price exclusive of the tax, with the difference generating distortion (tax) revenue collected by the government. If both features are at work then the overall distortion remains the difference between the buyer price and the seller's marginal cost, and the total distortion revenue created is the sum of profits and taxes. Letting $\mu_{ij} \geq 0$ denote the distortion on j-to-i exchange, the case of $\mu_{ij} > 1$ corresponds to a markup or tax distortion (or combination thereof), that of

[4] When an entity has no expenditures (as happens only in the case that the entity is a factor of production) we set $\widetilde{\Omega}_{ij} = 0$.

[5] This notation can also incorporate traditional externalities such as pollution, external economies of scale, or knowledge spillovers by adding an extended set of fictitious exchanges.

[6] Determining whether wedges truly generate revenue for some agent can be challenging in practice since the revenue from some potential distortions (such as contracting failures or corruption) may not be recorded in conventional datasets.

$\mu_{ij} < 1$ corresponds to a subsidy, and that of $\mu_{ij} = 1$ occurs if there is no distortion at all.

It proves useful below to define $\Omega_{ij} \equiv \widetilde{\Omega}_{ij}/\mu_{ij}$. The crucial distinction between $\widetilde{\Omega}$ and Ω is that $\widetilde{\Omega}$ measures exchange using X_{ij}, where the quantity changing hands is reported in terms of the value paid by the buyer. On the other hand, Ω measures exchange using X_{ij}/μ_{ij}, where the quantity is valued at the seller's marginal cost. A second useful definition is the Domar weight (global sales as a share of global income) of any entity i, given by $\lambda_i \equiv \sum_c Y_c \Psi_{ci}$.

A final matter of accounting in this model concerns the geographical locus of the distortion revenue deriving from $\mu_{ij} \neq 1$—that is, which country c earns a contribution to R_c from the i-j transaction. Our convention is to assign to the country of the seller (that is, the household in the country where the seller is located) any revenue deriving from markups, sales taxes, bribes, etc., and to the country of the buyer any revenue deriving from distortions on inputs or direct consumption (such as tariffs and contracting failures).[7] Transactions between primary factors and firms are always domestic so the revenue from labor and capital distortions accrues to the country in which the factor is based.

Just like the matrix $\widetilde{\Omega}$, the matrix Ω, and hence μ, is essential for what follows. Section 3 describes our procedure for using publicly available to build up an estimate of the μ vector for the global economy.

2.2 How trade shocks affect development

We now turn to the question that motivates much of the work summarized in this chapter: *for a typical developing country, what is the impact on economic welfare of being able to trade more cheaply?* To shed light on this question we deploy the model described above. Specifically, we subject the model economy to a series of international trade-related shocks and calculate the change in the welfare of the representative household in a given "Home" country of interest. For simplicity, we focus on local derivatives—formally, the response of all of the model's endogenous variables to infinitesimally small versions of these shocks—though in principle the effects of larger shocks could be calculated from a sequence of "chained" local derivatives.

The trade shock that is our primary focus is *technological* in nature—a generic advance in

[7] Assigning markup revenue to the selling country rules out cross-border ownership, and the important related phenomena of tax havens, transfer pricing, etc. (see, for example, Tørsløv et al., 2018). But this is necessary in the absence of data on such ownership patterns.

the technology underpinning the act of cross-border trading. Examples that fit here include an improvement in the efficiency with which Home's shipping occurs, with which Home's ports (or those of its trading partners) handle its cargo, or with which international buyers can find suppliers from Home.[8] This is admittedly a highly reduced-form representation of an "openness" or "globalization" shock, but one that provides a useful benchmark. We return to the discussion of an alternative shock—to trade policy—below.

The model above is agnostic about the initial level of trading technologies since all technologies, of cross-border trade and otherwise, are embedded in the observed flows matrix Ω. But when *changes* to these features of international trade occur for any given cross-border pair of entities i and j, we let $-\mathrm{d}\log\tau_{ij}$ denote the proportional (Hicks-neutral) change in the productivity of the technology that conducts the j-to-i trade. That is, $\mathrm{d}\log\tau_{ij} < 0$ refers to the case of technological progress.

When examining the effects of the shock $\mathrm{d}\log\tau_{ij}$ we hold all preferences, endowments, transfers (in terms of the numeraire), and technologies (apart from that used to carry out the j-to-i trade) constant around the globe. We do, however, allow for an arbitrary change in all distortions μ, tax-based and otherwise, in the world economy that may change as a result of the trade shock (or independently). Any single such change is denoted by $\mathrm{d}\log\mu_{ij}$. For example, domestic or foreign firms' markups may respond endogenously to the adjustments caused by cheaper trade, or governments may change their domestic or border taxation policies. Finally, our comparative statics derivation allows all factor allocations and prices, and hence the prices and quantities of the goods and services produced by every global entity, to adjust in general equilibrium.

As discussed above, holding each firm's production technology constant does not rule out endogenous responses of the firm's choices about how much innovation to do, what production techniques to adopt (from Home or abroad), which products to produce, or what quality to embed in the products they sell. But it does mean that any change in the firm's feasible production set must be the result of a change in some externality (i.e. a distortion, μ). In principle, such changes are allowed for in the derivations below. In practice, however, the distortions we emphasize in subsequent analysis are relatively distinct from those emphasized in the literature on trade and growth,

[8]For simplicity, we treat such technological advances as if they are costless to create, but extensions that incorporate innovation or construction costs are straightforward to include.

where greater openness may affect externalities such as technological diffusion, or where innovation itself may involve market failures (for example, due to incomplete appropriability or competitive externalities). Alessandria et al. (2021), Verhoogen (2020), and Ackigit and Melitz (2021) provide recent reviews of the trade and innovation literature, with Verhoogen (2020) particularly focused on developing countries.

The particular shock that we focus on changes trading technologies on all j-to-i trades that are imported into Home (a set of transactions that we denote B_H) by a uniform amount $\mathrm{d}\log\tau_H^{imp}$. This will change the welfare of Home's representative household (denoted by W_H) by

$$\frac{\mathrm{d}\log W_H}{\mathrm{d}\log\tau_H^{imp}} = -\sum_{ij\in B_H}\widetilde{\Psi}_{H,ij} + \frac{\mathrm{d}\log FTOT_H}{\mathrm{d}\log\tau_H^{imp}} + \frac{1}{Y_H}\frac{\mathrm{d}R_H}{\mathrm{d}\log\tau_H^{imp}} - \sum_{ij}\widetilde{\Psi}_{H,ij}\frac{\mathrm{d}\log\mu_{ij}}{\mathrm{d}\log\tau_H^{imp}}, \tag{1}$$

where we define $\mathrm{d}FTOT_H$ as the change in Home's *factoral terms of trade*, given by

$$\mathrm{d}\log FTOT_H \equiv \sum_{f\in F_H}(\beta_f^H - \widetilde{\Psi}_{H,f})\mathrm{d}\log w_f - \sum_{f\notin F_H}\widetilde{\Psi}_{H,f}\mathrm{d}\log w_f, \tag{2}$$

and $\mathrm{d}R_H$ is the change in Home's distortion revenue. These expressions draw on the auxiliary notation that: $\widetilde{\Psi}_{H,ij} \equiv \tilde{\Psi}_{Hi}\tilde{\Omega}_{ij}$, which denotes the exposure of the Home household to the j-to-i trade;[9] $\beta_f^H \equiv \mathbf{1}_{f\in F_H}\cdot(w_f L_f/Y_H)$, which denotes the share of Home's income that it derives from factor f; and $\widetilde{\Psi}_{Hf}$ refers to the element of $\widetilde{\Psi}_{cf}$ corresponding to $c = H$.

This expression provides the bedrock for much of our discussion, literature survey, and quantitative analysis below. Section 2.3 unpacks and interprets the four terms. We refer the reader to Baqaee and Farhi (2019) for a formal derivation, but offer the following brief intuition here. With homothetic preferences the log change in Home welfare is simply the log change in nominal income Y_H minus the log change in Home's cost-of-living. The former effect comprises changes in the prices of factors owned by Home (i.e. for which $\beta_f^H = 1$) and any change in Home's distortion revenue $\mathrm{d}R_H$; these channels are captured in the component $\sum_{f\in F_H}\beta_f^H\mathrm{d}\log w_f$ in $\mathrm{d}\log FTOT_H$ and the third term in (1), respectively. The cost-of-living effect is given, applying the envelope theorem to the household's consumption problem, by a consumption expenditure share-weighted sum of price

[9] That is, $\tilde{\Psi}_{Hi}$ captures this household's exposure to the buyer of this trade (that is, to the entity i), $\tilde{\Omega}_{ij}$ captures the exposure of this buyer to the seller of the trade (that is, to j), and hence the composite exposure of the household to the trade is given by the product of these two exposures, or $\widetilde{\Psi}_{H,ij}$.

changes on all goods that Home consumes. After again applying the envelope theorem to all producers, these price changes are themselves determined by input expenditure share-weighted sums of factor price changes (the component $\sum_f \widetilde{\Psi}_{H,f} \mathrm{d}\log w_f$ in $\mathrm{d}\log FTOT_H$), as well as the effects of any changes in a producer's technology ($\mathrm{d}\log \tau_H^{imp}$ here, captured by the first term in 1) and/or distortions ($\mathrm{d}\log \mu_{ij}$, captured by the last term) that prevail holding factor prices fixed. The exposure measures $\widetilde{\Psi}_{H,ij}$ and $\widetilde{\Psi}_{Hf}$ appropriately combine Home's consumption expenditure shares, and all producers' input expenditure shares, to changes in factor prices, technology, and distortions.

We see three potential uses of expression (1). First, it offers a chance to organize discussions of mechanisms through which trade shocks can affect economic development, especially in settings where distortions are thought to be rampant. We return to such a discussion in Section 2.3, next. Second, it can be used to decompose calculations about *ex-ante* predicted responses to a primitive shock such as $\mathrm{d}\log \tau_H^{imp}$. This involves more assumptions about the nature of technologies and preferences than we have invoked so far—unsurprisingly, since these assumptions have involved no more than constant returns, homotheticity and individually-rational behavior—in order to predict the equilibrium changes in R_H and w_f that enter (1). Section 2.4 describes a procedure to do so in general, Section 2.5 describes our particular implementation of such a procedure, and Sections 4 and 5 report the results of such calculations. Finally, expression (1) can be used to guide *ex-post* development and growth accounting to the extent that all of the terms on the right-hand side are observable. Such an analysis would seek to decompose variation in observed aggregate TFP changes (and hence welfare changes, given that factor endowments are held fixed) into its constituent parts. We are not aware of exercises that apply (1) in this manner but see this as an important direction for future work.

2.3 Decomposing the role of trade in the development process

Equation (1) offers a high-level view of the way that trade shocks can affect aggregate welfare under a weak set of primitive assumptions. It contains four terms, which provides a four-way decomposition that we now describe in detail.[10]

[10] Our discussion below provides interpretation for each of these terms separately but, as expected for any non-linear model, in general there will be interactions among all terms (apart from the first). We return to this point below.

Term 1: The mechanical effects of technological change

To see the value of term 1, begin by supposing, hypothetically, that all allocations in the Home economy are fixed and unable to change when the trade shock occurs. In such a scenario the only effect of the trade shock $\mathrm{d}\log\tau_H^{imp}$ on Home's welfare would be given by term 1. This is because domestic prices are pinned down by domestic allocations (and fixed trade balances), so no reallocation implies no factor price changes, and hence $\mathrm{d}\log FTOT_H = 0$. In addition, with fixed allocations the sum of the last two terms will be zero since even if distortions themselves are changing (i.e. $\mathrm{d}\log\mu_{ij} \neq 0$), those effects will have equal and opposite contributions via dR_H and $\widetilde{\Psi}_{H,ij}\mathrm{d}\log\mu_{ij}$. We therefore refer to term 1 as a "mechanical" effect of a reduction in trade costs that are technological in nature. In this thought experiment, new technologies have arrived like "manna from heaven" and the Home country will benefit by the amount given by term 1 even without a single economic adjustment taking place.

Why single out this mechanical effect? We see this as an essential component to isolate from any study of the effect of trade shocks on economic development for a number of reasons. First, in principle, quantifying the mechanical effect amounts to measuring $\sum_{ij\in B_H}\widetilde{\Psi}_{H,ij}$, an object that can be directly observed from the Ω matrix and μ vector described above. Such measurement is challenging since these quantities themselves require measurement of domestic and cross-border flows of goods, and distortions, respectively. But this only serves to highlight the importance of endeavors to advance the measurement of these ingredients, as well as the fact that, in the absence of such measurement, theory must play a central role in filling the gaps.

Second, conditional on $\sum_{ij\in B_H}\widetilde{\Psi}_{H,ij}$, this effect does *not* depend on the Home country's level of development *per se*. Two countries that have the same value of $\sum_{ij\in B_H}\widetilde{\Psi}_{H,ij}$ will have the same mechanical effect of technological trade shocks on development regardless of whether they are rich or poor, distorted or undistorted, open or closed, or exporters and importers of quinoa, quinalones, or quantum computers.

Third, isolating this term serves to highlight a sense in which technological trade shocks can be benchmarked against the effects of other technological changes in the Home economy. Would this economy be better served by an improvement in its trading technologies or its retailing technologies? The answer lies, to first order, in all four terms of (1) but we see value in starting with comparisons between such technologies that first normalize by the extent of relevant exposure of Home's consumption to these two shocks.

Finally, while beyond the scope of our uniform-shock derivation above, a similar point would apply to comparisons of technological trade shocks to subsets of the Home economy. For example, exercises that aim to compare the impacts of shocks to different sectors, different types of firms, and different regions can provide sharper contrasts if they first remove the mechanical differences that may exist across these units.

Starting with Deaton (1989), who analyzes the welfare effects of a proposed reduction in a rice export tax across households in Thailand, a number of papers in the trade and development literature aim to directly measure this mechanical effect using household survey data. For example, Porto (2006) estimates Argentinian households' direct consumer exposure to the tariff changes that resulted from the MERCOSUR trade agreement and also captures the trade-policy induced wage changes that appear in the factoral terms of trade above.[11] Atkin et al. (2018) assess the welfare effects of foreign retail entry into Mexico that also includes variety gains in the cost-of-living expression. Turning to more aggregate measurement approaches, Burstein and Cravino (2015) show that under assumptions commonly used in the trade literature, consumption deflators produced by national statistical agencies capture the mechanical effect even when trade cost reductions change product quality and variety.

Term 2: Changes in the factoral terms of trade

The second term in equation (1) highlights an effect that is familiar to the study of technological (and other) shocks in open economies: changes in the (factoral) terms of trade. This term is active when domestic allocations do adjust in response to the trade shock, as they surely would. For example, in a Ricardian economy with one factor per country, typical modeling scenarios would predict that a trade shock such as $d \log \tau_H^{imp} < 0$ will result in greater imports by Home and hence a deterioration in its factoral terms of trade (due to the upward pressure that such importing places on the relative demand for foreign factors relative to the home factor). Counterexamples—such as in Bhagwati (1958) or Bhagwati and Ramaswami 1963—famously exist as well.

[11] Since both Deaton (1989) and Porto (2006) consider changes in export taxes and tariffs, their mechanical effects should, strictly speaking, appear in the $d \log \mu_{ij}$ term in (1). However, both papers ignore the tax revenue term and so treat the policy shock as if it were a technology shock.

Our discussion below places relatively little focus on this second term because it has seen relatively limited explicit attention in recent work.[12] One notable exception is the work of Ventura (1997) and Acemoglu and Ventura (2002) that explores the growth ramifications of changes in the returns to capital resulting from FTOT effects. In addition, the study of terms of trade has tended to focus on phenomena—such as country size or specialization in low-elasticity goods—that cut across the development spectrum. By contrast, recent work has focused on domestic distortions as a hallmark of developing countries. While interactions between domestic misallocation and FTOT are surely important, we are unaware of work on such a topic.

Term 3: Changes in distortion revenue

The third term in equation (1) captures the change in distortion revenue caused by the trade shock. This term is central to our survey and analysis below because we see it as the term in (1) that is most clearly connected to the modern literature (reviewed in Section 3) on developing countries that emphasizes the presence of distortions. To see the relevance of this term for understanding interactions between trade and development, begin with the special case in which distortions are not changing as a result of the trade shock (i.e. $\mathrm{d}\log\mu_{ij} = 0$). Crucially, if the initial level of such distortions were zero then $dR_H = 0$. This follows trivially from the fact that if there were no distortions then there is no distortion revenue (and hence no change in such revenue). Equivalently, we know from the first welfare theorem that, holding FTOT constant, in the absence of distortions at Home, the factor allocation at Home would already be maximizing Home's welfare so the welfare consequences of any reallocations would be zero to first-order. Indeed, the study of welfare effects of trade shocks in undistorted environments, in which terms 1 and 2 capture all first-order effects, has seen widespread recent attention (as surveyed by Costinot and Rodríguez-Clare, 2014 in this *Handbook*).[13]

On the other hand, if Home's domestic economy features substantial market failures we could

[12] This stands in contrast to a long tradition of studying (factoral and traditional) terms of trade and their determinants in the field of international trade. See, for example, Chipman (1965). There is a voluminous literature exploring wage effects of trade, although this work focuses on the impacts of trade reforms on wage inequality across different types of worker or household—e.g., see the surveys by Winters et al. (2004) and Goldberg and Pavcnik (2007)—rather than estimating the impacts of trade reforms on relative wages across countries.

[13] Specifically, Costinot and Rodríguez-Clare (2014) focus on a wide class of single- and multi-sector gravity models. The single-sector versions of these models are undistorted, whereas those that allow for multiple sectors and feature monopolistic competition and entry/exit feature a domestic distortion due to differing markups across sectors.

expect the contribution of the distortion revenue term $\mathrm{d}R_H$ to be important in magnitude—even when these distortions themselves are fixed (so that term 4 is neutralized). However the sign of this effect is ambiguous in general. At a high level, under fixed distortions a change in distortion revenue raises welfare if and only if the trade shock causes factors of production at Home to move into the activities that are, relative to other activities, the most distorted. That this would raise welfare can be seen superficially from the fact that $\mathrm{d}R_H$ enters positively in (1), and R_H is nothing more than a sum over the size of each activity multiplied by its distortion and so it must increase (holding distortions themselves fixed) if distorted sectors expand. But more fundamentally, this feature follows from noting that distorted activities are ones in which the seller is not being paid as much as the buyer's willingness to pay, implying that the seller is being allocated too little factor usage from a social perspective.

Ultimately, even with distortions that are themselves fixed, the reallocations set in motion by a cost-reducing trade shock could move factors towards relatively distorted activities, thereby magnifying the benefits of the shock on welfare. But, equally, if the trade shock exacerbates the extent to which factors are misallocated then the welfare effects of such a shock could be dampened or even turn negative.

Section 3 reviews what we know about the extent of different distortions in the developing world while Section 4 discusses a range of concrete examples from the literature of trade reallocating factors across activities facing different levels of distortion (e.g., between formal and informal firms, or between high and low markup firms). One lesson that is already apparent, however, is that studies of this effect must be careful to incorporate a relatively comprehensive picture of distortions in the economy. For example, omitting a sector is innocuous only if that sector is no more or no less distorted than the included sectors. Analogously, omitting a source of distortion is innocuous only if that distortion affects all activities equally.

Our discussion of term 3 has so far emphasized the fixed-distortion case. The case with $\mathrm{d}\log\mu_{ij} = 0$, however, is not qualitatively distinct—term 3 is still governed by the equilibrium change in distortion revenue, $\mathrm{d}R_H$. The amount of such changes will differ, however, since changes in distortions have direct implications for distortion revenue. We turn to this next.

Term 4: Direct exposure effects of changes in distortions

The final term in (1) captures the effects that any changes in distortions induced by the trade shock (i.e. $\mathrm{d}\log\mu_{ij} \neq 0$ for any given j-to-i transaction) will have on the cost of living of the Home consumer (holding factor prices constant, since those are in term 3). These effects depend, like term 1, on the consumer's cost-of-living exposure to any resulting price changes, which is measured by $\widetilde{\Psi}_{H,ij}$.

One important caveat concerning terms 3 and 4 is that there are many settings in which they will interact via strong and offsetting effects. For example, consider an economy free of distortions apart from a tax on a transaction involving the sales of a Home firm that does no direct or indirect exporting—all of its sales end up in the hands of the Home consumer. In this case, the cost-of-living effect in term 4, given by $\widetilde{\Psi}_{H,ij}\mathrm{d}\log\mu_{ij}$, has an exactly offsetting counterpart inside dR_H.[14] That is, the cost-of-living effect in term 4 could not (generically) operate while term 3 remains constant. However, some scenarios do result in a decoupling between terms 3 and 4. One example concerns cases where the distortion change $\mathrm{d}\log\mu_{ij}$ involves a foreign firm adjusting its markup in the face of the trade shock. This has no direct implication for Home's distortion revenues (since the firm's profits accrue abroad) but it does have a clear implication for the cost-of-living of Home consumers who buy (directly or indirectly) from this foreign firm as captured in $\widetilde{\Psi}_{H,ij}$. In the opposite direction, for a Home firm j that is a pure exporter (i.e. $\widetilde{\Psi}_{H,ij} = 0$) changes in the firm's markup will affect distortion revenues at Home but term 4 would be zero.

The sign and magnitude of the implications (via terms 3 and 4 combined) of changing distortions is difficult to gauge a priori—a reflection of the principle of the second-best (Lipsey and Lancaster, 1956). But the high-level view is the same as before: if and only if factors tend to reallocate towards relatively distorted activities, then allocative efficiency (and hence welfare, holding $FTOT_H$ fixed) will rise. A simple corollary is that a reduction in distortions, $\mathrm{d}\log\mu_{ij} < 0$, on those activities that are already relatively less distorted can actually reduce welfare. But, ultimately, the size and direction of this mechanism—and hence whether the effect of trade on distortions magnifies, dampens, or even overturns the fixed-distortions impact of trade on welfare—is an empirical question, and we discuss existing answers in Section 5. Notably, in this case there are separate empirical questions

[14] That is, in this case, $dR_H = \lambda_j\widetilde{\Omega}_{ij}\mathrm{d}\log\mu_{ij} + (\mu_{ij} - 1)\mathrm{d}(\lambda_j\Omega_{ij})$, such that the sum of terms 3 and 4 is just $(\mu_{ij} - 1)\mathrm{d}(\lambda_j\Omega_{ij})$.

to be answered: (i) whether trade shocks are likely to reduce or raise domestic distortions, and (ii) whether those changes are good or bad for the overall extent of misallocation.

We have so far remained agnostic about the nature and extent of distortion changes $\mathrm{d}\log\mu_{ij}$ induced by the trade shock. The literature features both size-dependent distortions (e.g., distortions on capital inputs that are larger for small firms), such that any change in firms' sizes will lead to changes in the vector of μs, as well as distortions that are directly affected by trade (e.g. trade changing markups or contracting institutions). Section 5 reviews this literature in detail.

2.4 Solving for reallocation effects

Summarizing the discussion so far, equation (1) provides a decomposition of the welfare effects of a technological trade shock into four contributions. The first is mechanical, in the sense that its value is unaffected by the extent or nature of any endogenous adjustments that take place in the global economy as a result of the trade shock. Term 4, similarly, can be computed without knowing the extent of endogenous adjustments. However, the remaining two terms hinge precisely on such adjustments: term 2, which captures the change in Home's factoral terms of trade, depends on equilibrium changes in factor prices at Home and abroad; and term 3, which captures the change in Home's distortion revenue, depends on the even richer set of micro-level adjustments across transactions that may feature distinct amounts of distortions. *Ex-ante* counterfactual exercises must therefore make further assumptions about the nature of agents' technologies and preferences in order to solve for these effects. We now briefly describe a version of such a procedure.

We begin by differentiating every producer's optimal pricing condition, which implies that the change in the price charged by producer j when selling to any entity i will satisfy

$$\mathrm{d}\log p_{ij} = \mathrm{d}\log\tau_{ij} + \mathrm{d}\log\mu_{ij} + \sum_{k\in N,F}\widetilde{\Omega}_{jk}\mathrm{d}\log p_{jk}, \tag{3}$$

where we follow the shorthand that p_{jk} can refer to a factor price if the seller k is a factor.[15] This

[15] This expression can be used to solve for changes in goods prices for a given vector of changes in factor prices, but solving for factor prices themselves requires factor market clearing conditions. The implications of such conditions can be stated parsimoniously by noting that $\mathrm{d}\lambda' = \mathrm{d}Y'\Psi + Y'\Psi\mathrm{d}\Omega\Psi$, with each element of $\mathrm{d}\Omega$ given by $\mathrm{d}\Omega_{ij} = (\Omega_{ij}/\widetilde{\Omega}_{ij})\mathrm{d}\widetilde{\Omega}_{ij}$ (and the convention that $\mathrm{d}\Omega_{ij} = 0$ if $\widetilde{\Omega}_{ij} = 0$) and $\mathrm{d}\widetilde{\Omega}_{ij}$ discussed further below. When entity i is a factor, the change in its Domar weight $\mathrm{d}\lambda_i$ will correspond to the change in the factor's price because factor endowments are held fixed.

expression, which again follows from the envelope theorem, mandates that any producer j's price change will reflect the changes in prices of intermediates and factors that it uses, with weights based on pre-shock shares, $\widetilde{\Omega}_{jk}$.

Next, quantities of all goods produced will adjust as consumers and producers substitute away from purchased goods whose prices have increased. Letting $\theta_i(j,k)$ denote the Allen-Uzawa elasticity of substitution, for entity i, between entities j and k, such substitution implies

$$\mathrm{d}\widetilde{\Omega}_{ij} = \widetilde{\Omega}_{ij} \left(\mathrm{d}\log p_{ij} + \sum_k \widetilde{\Omega}_{ij} \left[\theta_i(j,k) - 1 \right] \mathrm{d}\log p_{ik} \right). \tag{4}$$

Finally, closing this system requires the change in distortion revenue, which is given by

$$\mathrm{d}R_c = \sum_{ij \in O_c} (\mu_{ij} - 1)(\Omega_{ij}\mathrm{d}\lambda_j + \lambda_j \mathrm{d}\Omega_{ij}) + \sum_{ij \in O_c} \Omega_{ij}\lambda_j \mathrm{d}\mu_{ij}, \tag{5}$$

where we use the notation O_c to denote the set of transactions whose distortion revenue accrues to country c. The first term in this expression calculates the change in revenue resulting from changing allocations at fixed distortions, while the second term does the opposite.

Together, the equations (3), (4) and (5) comprise a system of linear equations that implicitly defines the changes in factor prices and distortion revenue that matter for determining $\mathrm{d}\log W_H$ in equation (1). The results presented below solve this system of equations many times in order to explore the effects of different types of shocks.

2.5 Mapping the theory to the data

Applying the theoretical results above requires three inputs: (i) data on flows X_{ij} of payments from any entity (consumer, firm, or factor of production) j in the world to any other entity i; (ii) the Allen-Uzawa elasticity for every choice being made by each consumer and producer; and (iii) measures of distortions μ_{ij} prevailing on each payment from j to i. We discuss our choices surrounding the first two of these in this section and return to our construction of the μ vector in Section 3. Naturally our choices involve compromises and require substantial scrutiny that is beyond the scope of this chapter. We hope that the discussion below nevertheless highlights the value of efforts to improve the measurement of each of these three data inputs.

2.5.1 Data on flows

Our construction of X_{ij} begins with data on firms in 142 countries around the world that has been collected as part of the WBES initiative (World Bank, 2021a). By design, developing countries are heavily represented in this initiative, but a broad geographic and per-capita income coverage is still available. For each country we extract the survey year that is closest to 2013, which results in a sample based on one survey per country, concerning 84,779 firms in total, and 361 firms in the median country.[16] This survey aims to be representative (when using the sampling weights provided) of private-sector, formal, non-agricultural activity in each country in question.[17] But with the relatively small number of surveyed firms in many countries, we recognize the scope for sampling error and take steps to reduce it, as described below.

The WBES data provide measures of each firm's annual revenues, labor payments, intermediates, electricity use, exports and imports. This homogenized firm-level data, available for countries across the income spectrum, makes the WBES an irreplaceable source for our exercise. Furthermore, as detailed in Section 3, the surveys include questions designed to probe the responding firm's experience with various potential distortions to their economic decisions. This affords an unrivaled opportunity to learn about how trade and distortions interact in a calibrated version of the model above.

To complement the firm-level WBES survey we also rely on industry-level data. Specifically, we use the EORA MRIO database (Lenzen et al., 2012) which provides an estimated world input-output table at the level of 26 industry groupings and 199 countries in many recent years (including 2013, which suffices for our purposes). Using data on all EORA countries, we therefore have $C = 199$. For every country-industry pair, EORA reports bilateral flow values both within and across country borders. Payments to labor, as well as shipments to the final consumer in each country, are also available for each producing country-industry. Because EORA aims to represent the entire economy, formal and informal, we use information from the formality share of labor

[16] We choose to work with the 2013 cross-section in order to strike a balance between maximal coverage and recency.

[17] Of the 26 EORA industries (discussed below) that eventually enter our analysis, WBES does not survey: agriculture; fishing; mining and quarrying; electricity, gas and water; public administration; education, health and other services; private household services; or re-export and re-import. We note that the sampling weights for the industries covered are likely to be imperfect given the difficulties in constructing representative firm samples in many developing countries (a possibility confirmed by Cirera et al. (2019) for four Sub-Saharan African countries where firm censuses are available).

reported in ILOSTAT (International Labor Organization, 2021) database as well as 17 sets of WBES surveys that focus only on informal firms to apportion the total value of EORA sales, employment, etc. in each country-industry into a formal and informal segment.[18] This procedure results in 52 industries per country, 26 formal and 26 informal. The presence of large informal sector outputs and input usage is an important feature of developing countries. Since many distortions may differ between the informal and formal sectors of the same country-industry, this division will influence the calculations we report below.

The industry-level information in EORA complements the firm-level data in WBES in several important respects. First, as mentioned, sampling variation may imply that (even sampling weight-adjusted) aggregate flows in WBES will not agree with those in EORA. Because EORA is more likely to be grounded in censuses and large surveys, we therefore scale up or down firm-level variables in WBES so that their country-industry aggregates match those in the formal EORA equivalent. Second, WBES firms report only the total amounts of flows such as exports, domestic sales, imports, and domestically-sourced intermediate purchases. We use EORA's (formal) industry-level flows to convert each firm's (sampling-weight adjusted) total flow into a proportionately-assigned bilateral version of the same.[19] Finally, EORA covers industries (including the informal segment of every industry in all countries) and countries for which WBES is not available, in which case we treat the EORA country-industry observation as a representative producer.

Our resulting merged WBES-EORA dataset is a hybrid of firm-level and industry-level information. To summarize, the set of available producers consists of the 84,779 firms surveyed in the 142 WBES countries (that we treat as representative of the firm-size distribution for the country and industry they are in), plus the 26 informal segments of each industry in each of the 199 EORA

[18]Specifically, ILOSTAT reports non-agricultural informal employment rates, agricultural informal employment rates, and public employment rates at the national level. We use the ILOSTAT data to calculate the country-level informality rate across workers in all industries bar agriculture and public services. We then use the combination of informal and formal WBES surveys to obtain country-industry-specific deviations from this country-level informality rate using the relative size of informal and formal sales and employment represented by firms in these surveys (after first scaling up all informal survey weights to match the ILOTSTAT country averages). For countries where no informal survey was fielded we utilize the average ratios from countries in the same World Bank income group and region (followed by same income group and then same region if there are no countries satisfying these criteria).

[19]While all of these imputation procedures will introduce measurement error, they are necessary given data limitations. The impact of such error is not obvious, however. As seen above, to the extent that firms receive similar shocks, or face similar proportional incentives to substitute, many of the data requirements stated in Section 2.2 are linear in the underlying flow data. This feature reduces the risk that firm-level imputation errors will affect our conclusions, conditional on matching aggregates as we always do.

countries, plus the 26 formal sectors in each of the 57 EORA countries not included in WBES, plus the 8 formal segments of industries not covered in WBES in each EORA country. This results in $N = 93,027$ producers in total.

In terms of factors of production, both WBES and EORA report payments to one labor group only. We therefore treat this as one factor of production which we label "labor" (in efficiency-adjusted units). We then create one more composite factor group based on the payments made by each producer that are required to rationalize the producer's use of a CRS technology. While we will refer to this factor group as "capital" it should be thought of as a composite of all non-labor factors. As a result we have two types of factor per country and hence $F = 2 \times C = 398$. In total this amounts to $C + N + F = 93,624$ entities in the global economy.

2.5.2 Elasticity values

We build up the Allen-Uzawa elasticities for every choice being made (by each consumer and producer in the world economy) from nested CES functional forms and elasticity values. Naturally these modeling decisions are not straightforward, given the plethora of supply and demand elasticities involved and the challenges that the literature has faced in estimating each of them well. Our goal is therefore to provide a parameterization that is broadly representative of recent literature.

Beginning with the demand side, we let the representative household in each country have nested CES preferences. The first nest is across industries, with elasticity ψ.[20] And the second nest is across producers (both domestic and foreign) within the industry, with elasticity σ. We set $\psi = 1$, which follows the conventions of simple multi-sector gravity models (e.g. the central case studied in the Costinot and Rodríguez-Clare, 2014 chapter of this *Handbook*) as well as the (closed-economy) analysis of Hsieh and Klenow (2009). And we set $\sigma = 5$, which corresponds to a trade elasticity of 4 as is consistent with commonly used values of such a parameter (see, e.g., the Head and Mayer, 2014 chapter of this *Handbook*) as well as close to the value ($\sigma = 3$) used in Hsieh and Klenow (2009).

On the production side, we assume that each producer has a nested CES technology. The first nest is between a bundle of intermediates and a bundle of primary factors, with elasticity θ.

[20] In this and all other cases discussed here, we highlight the elasticities inside each relevant CES nest. But in the background each decision-making agent always has sufficiently arbitrary demand-shifters as are needed to match perfectly the observed flow data X_{ij} between any decision-maker i and its purchases from any other entity j.

Across primary factors the elasticity is γ. And across intermediates we first allow an elasticity of κ across intermediates from different industries and an elasticity of η across different producers (both domestic and foreign) within a given industry. We set $\theta = \gamma = 1$—the Cobb-Douglas case that is focal in the literature on production function estimation. We also set $\kappa = 1$ and $\eta = 5$ so that (since $\sigma = \eta$) producers substitute across suppliers of intermediates (across and within industries) in the same way that consumers substitute across the final goods produced by those same types of suppliers. Again this is a central case in multi-sectoral gravity modeling (Costinot and Rodríguez-Clare, 2014).

2.5.3 Computational procedure

In principle, our calculations below would solve the systems of equations presented above for a given set of trade cost and distortion shocks, using values of Ω_{ij} and $\widetilde{\Omega}_{ij}$ built up from the full dataset on flows X_{ij} between any global entity j and any other global entity i. In practice, however, with 93,624 entities in the global economy, it is not practical to solve this linear system due to its size (even though the matrices involved may be sparse). We therefore conduct numerical simulations in a simplified setup, as follows.

First, our interest centers on the question of how a given "Home" country's welfare is affected by trade cost and tariff shocks on its own border, and by changes in its own domestic distortions. Little is lost, therefore, by repeating our simulations for one "Home" country at a time. This rules out the ability to study interactions between one country's shocks and another country's shocks, but retains our main focus.

Second, in order to reduce the dimensionality of the system to be solved when studying shocks hitting any one Home country at a time, we collapse *foreign* entities into representative aggregate units in the following manner. We first aggregate over all foreign firms to construct aggregate producers in each industry. Thus, we allow for rich firm-level heterogeneity at Home, which will be crucial for much of our analysis. But we suppress firm heterogeneity abroad because such heterogeneity likely matters little for how Home's welfare responds to a shock to its own trade costs. We then further aggregate over foreign countries to achieve greater dimensionality reductions. In particular, we leave untouched Home's five largest trading partners, but for all other partners we aggregate these into four composite units based on the World Bank's official four-way classification of countries according to per-capita GDP. This reflects the fact that all cross-country interactions in equations (3)-(5) scale with the size of bilateral trade flows from Home to the foreign country, as well as the possibility that rich and poor countries may differ in the structural features of their economies. But again the presence of cross-country heterogeneity for the study of shocks to Home is unlikely to be quantitatively important, especially beyond Home's main trading partners, so we suppress it.

The end result is $C = 10$ "country" units in any simulation, but with the identity of those ten units varying depending on which country is treated as "Home." The final set of entities involved—9×52 foreign producers, 10×2 factors globally, 10 consumers globally, and $361 + 26 + 8$ producers in the median Home country—is small enough for computation to be feasible, yet large enough to allow for rich heterogeneity in the composition and structure of trading partners.

3 The Nature and Extent of Distortions in Developing Countries

The model developed in Section 2 allowed for a wide range of potential market failures in any country under study. This approach is inspired by a prominent view that the presence of extensive domestic distortions is a key constraint preventing the developing world from attaining high standards of living; see, for example, Banerjee and Duflo (2005), Restuccia and Rogerson (2008) and Hsieh and Klenow (2009). The size and nature of these distortions—denoted by the vector μ in the exposition above—underpin this hypothesis that misallocation drives underdevelopment. Our focus is on the complementary question of how trade affects development, both because trade may alter the (mis)allocative consequences of domestic distortions, and because trade may alter those distortions themselves.

In this section, we identify a number of well-documented distortions that are thought to arise from government policies, institutions, and market failures, and are particularly prominent in low-income countries.[21] For each type of distortion, we first review the relevant literature concerning its nature and importance. We then turn to populating our μ vector, which amounts to measuring the size of this distortion across firms, industries and countries. The goal here is to provide an

[21] Following the model exposition above, we define a distortion on the exchange of any good or service as the difference in the price paid by the buyer to the marginal cost of the seller, as long as the revenue generated by this price difference accrues to some agent. Whether or not that revenue is actually recovered, in its entirety, is not always clear, but for simplicity we assume throughout that it is.

estimate of the observed level of μ, which feeds into our calculations about the consequences of trade in the face of fixed distortions, in Section 4. Section 5 then goes on to discuss cases in which μ is likely to respond endogenously to trade shocks.

As in Section 2.5, we rely heavily on the unique information reported in the World Bank Enterprise Surveys (WBES). These surveys ask a number of questions designed to measure the severity of distortions firms face that provide insight not just into the average level of distortions in a country but also their distribution across firm-size bins and industries. We briefly describe how we map these questions to estimates of the μ vector in the various subsections below, and relegate more complete descriptions to Appendix A.

3.1 Sales distortions

In the notation above, μ_{ij} represents, generically, the distortion on exchange from any entity (consumer, factor, or producer) j to any other entity i. We now zoom in on different categories of such exchange and use more specialized notation for each case. The first such case corresponds to standard notions of "sales distortions", which potentially occur whenever j is a producer, and we denote these as μ^Y. Examples that we consider here include business regulations, corruption, crime, markups, output taxes and subsidies, and production externalities. We follow the convention, also shaped by data limitations, that (with a few exceptions) these sales distortions do not vary across buyers for any given seller—however, certain buyers will also potentially encounter additional "input distortions" as discussed in Section 3.2 below.

3.1.1 Regulations, corruption and crime

Background: Excessive regulation, often coupled with corrupt and uneven enforcement of these regulations, is one of the most visible types of distortions that characterize the developing world. The view that excessive regulation can distort the allocation of factors and reduce growth is perhaps most closely associated with Hernando de Soto who calculated (and bemoaned) that it took 289 days to obtain the required permits to open a small garment business in Lima, Peru (see de Soto, 1989). This exercise inspired the World Bank to try to measure regulatory burdens across many countries with Djankov et al. (2002) concluding that these regulations benefit politicians and bureaucrats rather than the public interest.

Onerous regulation is often intertwined with corruption, providing dishonest bureaucrats the opportunity to extract bribes in exchange for help with navigating regulatory barriers (see Djankov et al., 2002, Svensson, 2003, and Svensson, 2005). Hallward-Driemeier and Pritchett (2015) compare the Doing Business surveys with the WBES to show that strict *de jure* regulations mask enormous heterogeneity across firms in the same country, with "deals" to decrease the amount of time required to obtain various permits often appearing to be the norm. In fact, bureaucrats may erect regulatory barriers for the sole purpose of extracting rents, as discussed in Banerjee et al. (2012). Shleifer and Vishny (1993) posit that the covert nature of bribery can make it more distortionary than taxation, a conjecture for which Fisman and Svensson (2007) find empirical support in Uganda. Olken and Pande (2012) review the broader literature on corruption in developing countries and note that, while there are few reliable estimates of the magnitude of corruption, the available estimates suggest substantial heterogeneity both within and across countries.

Given limited legal enforcement, crime and theft is another major issue facing firms in developing countries (Gaviria, 2002), particularly in more isolated areas (Fafchamps and Moser, 2003). Besley and Mueller (2018) discuss the misallocative consequences of such activity, and of resources spent to avoid it, using the same WBES data as we deploy below.

Finally, we note that regulations, corruption and crime in the formal sector may lead firms to remain informal. We discuss this relationship further in Section 3.1.4 below because it applies to both sales and input distortions.

Measurement: Six WBES questions contain attempts to quantify the responding firm's experience with such activities directly, so we use these to measure μ^Y. Two of these questions relate to regulation and associated corruption, asking firms about both the share of managers' time spent dealing with requirements imposed by government regulations and payments to public officials to "get things done".[22] Three questions document losses from theft (occurring on the premises, during domestic transit, and during foreign transit) and the final question captures payments for security—i.e. costs incurred to avoid losses due to theft. Appendix A.1 provides further measurement details.

[22] We transform the share of management time into a share of sales by multiplying the share by the management wage bill as a share of total sales obtained from the World Bank Investment Climate surveys. The bribery question is already reported as a share of sales (deliberately asked about peer firms in order to encourage honest answers).

We report all estimated sales distortions as shares of total sales. The first three rows of Table 1 display for low-, middle- and high-income countries the average value of the combined regulation and bribery distortion as well as its distribution by firm size, firm-level trading behavior, and the tradability of the firm's sector of production—three key characteristics for thinking about interactions between trade and domestic distortions.[23] The last column presents averages for informal firms that we discuss in Section 3.1.4 below. Rows 4–6 present the same breakdown for the combined theft and security distortion.

Both of these sets of distortions appear to be more severe for poorer countries. Distortions related to theft and security are particularly sizable, accounting for 13.5% of sales for low-income countries and only 5% of sales for high-income countries. Smaller firms (fewer than 20 employees) face distortions that are approximately 50% bigger than those faced by larger firms (over 100 employees).

These average distortions mask substantial heterogeneity across countries and industries, heterogeneity that we incorporate in our later quantifications. Appendix Table B.1 presents one view of this heterogeneity by reporting the average value of each type of distortion considered in this Section separately for each country in our sample.

3.1.2 Markups

Background: In the absence of perfect competition, firms are likely to charge distortionary markups. The literature has taken three approaches to measuring these markups: (i) inferring markups from the inverse of a firm's estimated residual demand elasticity; (ii) assuming cost-minimization and backing out markups from production function-based estimates of the firm's first-order conditions for an adjustable and undistorted input, under the assumption that the firm faces no other sales distortion; or (iii) asking firms directly.

De Loecker et al. (2016) (dLGKP) pursue the cost-minimization approach for medium and large firms in India, paying careful attention to the attendant challenges of production function estimation arising with multi-product firms and the typical difficulties of obtaining data on quantities of firm outputs and inputs. They find a median markup of 34% over costs, although there is a great deal

[23] Here and throughout this Section, all statistics incorporate survey sampling weights and are sales-weighted averages across firms within countries that are then averaged across countries in an unweighted manner.

Table 1: Distortions by country income-group and firm type

	Formal									Informal
	All	Firm Size		Exporter		Importer		Tradable		All
		Small	Large	Yes	No	Yes	No	Yes	No	
Regulation distortion										
Low-income	0.018	0.022	0.015	0.015	0.019	0.018	0.018	0.019	0.015	0.001
Middle-income	0.010	0.011	0.011	0.010	0.011	0.009	0.011	0.010	0.011	0.000
High-income	0.005	0.006	0.003	0.004	0.006	0.004	0.006	0.005	0.004	0.000
Crime distortion										
Low-income	0.135	0.162	0.110	0.152	0.129	0.135	0.134	0.138	0.123	0.015
Middle-income	0.076	0.104	0.064	0.065	0.081	0.063	0.080	0.082	0.066	0.007
High-income	0.048	0.062	0.042	0.041	0.052	0.037	0.051	0.048	0.046	0.002
Markup distortion										
Low-income	0.389	0.392	0.379	0.376	0.393	0.372	0.396	0.414	0.309	0.217
Middle-income	0.364	0.370	0.362	0.367	0.363	0.345	0.371	0.385	0.329	0.209
High-income	0.363	0.332	0.374	0.388	0.346	0.361	0.363	0.356	0.382	0.206
Domestic tax distortion										
Low-income	0.053	0.050	0.050	0.052	0.053	0.025	0.064	0.054	0.049	0.000
Middle-income	0.115	0.112	0.120	0.123	0.112	0.115	0.116	0.114	0.117	0.000
High-income	0.172	0.182	0.169	0.173	0.172	0.186	0.168	0.172	0.172	0.000
Imported input distortion										
Low-income	0.012	0.005	0.018	0.023	0.008	0.042	0.000	0.006	0.031	0.014
Middle-income	0.020	0.007	0.032	0.038	0.012	0.079	0.000	0.003	0.049	0.021
High-income	0.007	0.003	0.010	0.013	0.002	0.028	0.000	0.001	0.023	0.014
Capital distortion										
Low-income	0.207	0.223	0.205	0.218	0.204	0.201	0.210	0.212	0.191	0.269
Middle-income	0.167	0.198	0.153	0.165	0.168	0.160	0.170	0.173	0.156	0.215
High-income	0.142	0.162	0.134	0.140	0.144	0.131	0.145	0.142	0.141	0.182
Labor distortion										
Low-income	0.232	0.219	0.246	0.230	0.233	0.263	0.220	0.231	0.235	0.000
Middle-income	0.240	0.240	0.249	0.249	0.235	0.265	0.231	0.234	0.250	0.000
High-income	0.268	0.237	0.280	0.266	0.270	0.273	0.267	0.271	0.261	0.000
Intermediate input distortion										
Low-income	0.205	0.199	0.211	0.206	0.205	0.211	0.203	0.205	0.205	0.174
Middle-income	0.201	0.198	0.204	0.207	0.198	0.207	0.199	0.200	0.202	0.168
High-income	0.192	0.190	0.192	0.191	0.193	0.195	0.191	0.193	0.189	0.161
Electricity distortion										
Low-income	0.141	0.140	0.145	0.148	0.138	0.143	0.139	0.138	0.148	0.130
Middle-income	0.112	0.114	0.112	0.116	0.110	0.129	0.106	0.106	0.122	0.099
High-income	0.088	0.090	0.085	0.080	0.092	0.103	0.083	0.087	0.090	0.082

Notes: Table reports the average size of the regulation, crime, markup and domestic tax distortions as a share of sales; the imported input tariff, capital, labor, intermediate input, and electricity distortions are reported as a share of their respective input cost to the purchasing firm. Country income groups are based on World Bank classifications as of 2013. Columns 2-9 break out formal firm average by small and large firms, by firm-level export and import status, and by tradable and non-tradable sectors. Column 10 reports averages for informal firms. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys (or informal-sector surveys in column 10). Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3 for descriptions of how each of the sales and input distortions are measured.

of heterogeneity across sectors. In addition, markups vary with firm size with larger producers tending to charge higher markups. Atkin et al. (2015) document a similar pattern among Pakistani soccer ball producers using the direct approach, although the median firm's self-reported markup is closer to 10%.

Whether markups are larger or more dispersed in the developing world is an important but still open question. On the one hand, there is evidence that certain industries in developing countries are dominated by politically-connected monopolists (Faccio and Zingales, 2017; Beirne and Kirchberger, 2020).[24] On the other hand, many developing country industries feature competition between a very large number of small (often informal) firms, a point emphasized by Hsieh and Olken (2014). Recent work by De Loecker and Eeckhout (2018) estimates markups using the cost minimization approach for (primarily publicly-traded) firms in the Worldscope database. They find that the developing world displays both the highest average markups (e.g. in Bolivia, Malawi, and Zambia) and the lowest (e.g. in India, Botswana, and Uganda). However, Worldscope's coverage of firms in developing countries is scant and, in general, we know little about markups in the small firms that dominate the firm size distribution in the developing world.

Measurement: To obtain markup estimates we again draw on the WBES data, though this is considerably harder than for the distortion measures discussed above. One approach would be to use the sales and inputs data in the WBES to recover markups from cost minimization and production function estimates. However, such an approach requires taking a stand on the production function and, as noted by (Bond et al., 2020) and others, requires output (rather than revenue) elasticities with respect to variable inputs, and such elasticities cannot be calculated with the limited set of variables in the WBES.

Instead we lean heavily on two sets of WBES questions that are plausibly related to markups: (i) how many competitors the respondent firm reports that it faces; and (ii) how much of an obstacle, according to the reporting firm, the practices of the informal sector pose to the firm's ability to do business. To convert the answers to these questions into estimates of price markups over costs, we project firm size-export status-industry averages of the dLGKP markup estimates described above on Indian WBES survey answers to the two aforementioned questions. The coefficients from this

[24] As a counterpoint, Leone et al. (2021) suggest that the high markups in the African cement industry dissipated substantially in the 2010s.

regression—using a split-sample IV to reduce attenuation due to measurement error—provide a mapping from WBES answers to markup levels for every firm in every country. Appendix Table A.7 presents these regression results, and Appendix A.2 provides further details.

Rows 7–9 of Table 1 report the size of these markups as a share of sales by income group and firm type. Markups appear to decrease only slightly in country income—from 39% of sales for low-income countries to 36% of sales for high-income countries, with similarly limited variation by firm size and exports status, at least in aggregate.

3.1.3 Taxes and Subsidies

Background: Taxes, while potentially less pernicious than corruption and crime, may be equally distortionary in terms of productive efficiency. Tax revenue as a share of GDP is generally low in developing countries. But as discussed in Besley and Persson (2014) and elsewhere, the difficulties of collecting tax in countries with high rates of informality and low state capacity mean that statutory tax rates can be high for certain sectors and firm-types. Thus, export and import taxes—which are easily collected at major ports and border crossings—constitute a disproportionate share of government revenues in developing countries. For example, 49% of Madagascan tax revenue is collected by customs officials, almost entirely at a single port (Chalendard et al., 2020). The size and variability of these import tariff and tax rates across products is likely to make them more distortionary and encourages bureaucratic corruption in order to evade them, a point Sequeira (2016) documents in Mozambique.

Many countries in the developing world also heavily utilize domestic production subsidies and price controls, often to achieve political goals. These are particularly common in agriculture, with price controls often designed to benefit important farming constituencies or net consumers of basic staples who live in large cities more prone to political unrest (see Bates, 1981 for a classic discussion of the African context). In an ambitious project whose findings we draw on below, Anderson (2009) quantifies the size of product-specific agricultural distortions operating on both domestic and international sales and purchases across 75 countries between 1955 and 2004. For the developing world as a whole, he finds that a historical policy bias against agriculture has abated in recent years. Average effective tax rates of around 25% in the first 30 years of his sample turn into subsidies of just under 10% by the mid 2000s. In contrast, similar calculations for non-agricultural sectors suggest effective subsidies of around 60 percent in the 1960s—primarily through import tariff protection—falling to levels below that of agriculture by the mid 2000s.

Measurement: Unfortunately the WBES do not record taxes paid. In lieue of such records, we draw on three sources. First, we extract country-industry level VAT and sales tax rates for all non-agricultural industries from Deloitte, a multinational accounting firm.[25] Second, we measure domestic net tax/subsidy distortions in agriculture, including price supports and subsidies, using the Anderson (2009) *ad valorem* domestic distortions measure described above. Rows 10–12 report the combination of these two domestic tax measures (with variation by firm type coming from industry-level variation in firm characteristics). The tax burden is substantially higher in high income countries at 17% compared to only 5% in low income countries.

Finally, product-level border taxes in the form of MFN import tariffs—which we treat as an input distortion affecting all buyers in the importing country—are available from the WITS database (World Integrated Trade Solution, 2021). Rows 13–15 of Table 1 report the size and distribution of these import tariff distortions, which we report as a share of imported input costs.

3.1.4 Informality

Background: Another large literature has highlighted the presence of a substantial informal sector as a defining feature of developing countries. For example, India's median manufacturing firm is informal, has two employees and $235 in capital (Nataraj, 2011). La Porta and Shleifer (2014) outline three competing views of informality: that regulations and red tape keep firms from growing large and formalizing (see, e.g. de Soto, 1989); that informal firms avoid the burden of tax and regulation and so provide an uneven playing field for formal firms (see, e.g. Levy, 2008); and that many unproductive informal entrepreneurs are simply waiting to be absorbed into the formal sector as wage labor (see, e.g. Rauch, 1991). La Porta and Shleifer (2014) present a range of descriptive evidence most consistent with the last of these views. Ulyssea (2018) takes this taxonomy further by estimating a model that nests all three explanations and finds that one sixth of informal firms in Brazil fall into the first category, around 40% are in the second, and the remainder lie in the third.

[25]Data obtained from https://www2.deloitte.com/uk/en/pages/tax/solutions/global-indirect-tax-rates.html accessed on July 20, 2021.

Regardless of its underlying causes, informality introduces distortions, on the margin, in our model only to the extent that it leads to $\mu_{ij} \neq 1$—and, especially, to dispersion in μ_{ij}—for informal firm buyers and sellers. This could happen simply because informal firms may avoid adhering to regulations or paying fees and taxes (including those on labor that we discuss below). However, remaining informal comes with the threat of fines, the cost of having to stay small and out of sight, and difficulties selling to formal and government-sector buyers (see Gadenne et al., 2019 for the role of value added tax reimbursements in limiting sales of informal firms).

Measurement: With the exception of taxes, which we set to zero for informal firms, we use the Informal WBES surveys to calculate sales distortions at informal firms in an analogous manner to how they are calculated for the formal firms using the regular WBES data, as described previously.[26] As shown in the last column of Table 1, these output distortions are substantially smaller for informal firms compared to formal firms. We discuss input distortions faced by informal firms below.

3.1.5 Production externalities

Background: A large body of work on industrial policy starts from the premise that certain firms or sectors generate production externalities such as external economies of scale or Marshallian agglomeration externalities. A common presumption is that these effects are positive—that production in one firm can benefit another "neighboring" firm—but congestion is also likely in many contexts so the net sign of externalities is not always clear. In our framework above, these effects would appear as distortions leading firms with positive net externalities to underproduce. Harrison and Rodriguez-Clare (2010) and Lane (2020) review this literature in detail. However, estimates of how these externalities vary across firms, industries and countries is limited and so we abstract from this distortion in our analysis.[27]

[26] As there are only 17 countries with Informal WBES surveys, we utilize the procedure for missing values described in footnote 2 of Appendix A.1. Non-WBES industries are imputed from the informal firms data as in the case of formal firms, with the exception of public administration which is assumed to have no informal sector.

[27] One exception is Bartelme et al. (2019) which uses trade data to infer heterogeneity in external economies of scale across various manufacturing sectors in a sample of countries at a range of levels of per-capita income.

3.2 Input Distortions

We now turn to input distortions, those which lead to a difference between the price that an input user pays for the input and the marginal cost to the input producer of supplying the input.

This requires some general comments on the need to avoid double-counting, especially since the previous section covered what was in some cases exactly this same distortion but viewed from the perspective of the seller rather than the buyer. First, two important import distortions that we discuss below concern those on the use of primary factors. These are not producers in our model (since factors are in fixed supply) and so there is no risk of double-counting since the distortions on these seller's sales were not discussed above. Second, when we discuss the case of firm-to-firm exchange below (i.e. potential distortions on the use of intermediate inputs) we focus on a set of additional potential distortions arising from failures of contract enforcement; the general sales distortions (markups, taxes, tariffs, etc.) do not appear again here. Finally, we discuss the case of electricity inputs, where the types of distortions involved could be thought of as sales distortions in the electricity-producing sector itself, but in line with prior literature we find it simpler to think of this as a distortion in the electricity-buying firms' electricity inputs.

3.2.1 Capital input distortions

Background: Of all the distortions we consider on the input side, the literature relating credit constraints and other capital distortions to underdevelopment is the most voluminous. King and Levine (1993), Rajan and Zingales (1998) and others document a strong relationship between a country's overall living standards and its financial development. Credit constraints and capital distortions also vary within countries. A lack of collateral or limited liability constraints may make credit particularly expensive for small firms (see Ghosh et al., 2000 for an overview of the literature on credit rationing). At the same time, the most productive firms may be particularly constrained by political constraints on capital allocation or an inefficient banking sector (see Song et al., 2011 and Brandt et al., 2013 for analyses of preferential access to credit for state-owned enterprises, SOEs, in China).

In terms of empirical evidence, the descriptive literature reviewed in Banerjee (2003) and Banerjee and Duflo (2005) suggests that interest rates are both high and dispersed in developing countries.

Banerjee and Duflo (2014) use variation in interest rates due to priority lending programs in India to reveal credit constraints among mid-sized firms, with marginal returns to capital in excess of 100% per annum, far above the market interest rates of 30% to 60%. de Mel et al. (2008) randomize cash grants and find marginal returns to capital that average 60% (compared to 12–20% market rates) for small Sri Lankan firms, with substantial heterogeneity along dimensions such as ability. Finally, Hsieh and Olken (2014) show that average products of capital (and labor) increase with firm size in India, Indonesia and Mexico, suggesting that larger firms are more constrained if average and marginal products move together. Finally, a number of recent papers quantitatively explore the implications of financial frictions for misallocation and productivity in developing countries. See, for example, Banerjee and Duflo (2005), Jeong and Townsend (2007), Banerjee and Moll (2010), Buera et al. (2011), Buera and Shin (2013), and Midrigan and Xu (2014).

Measurement: We draw on a rich set of questions about the borrowing behavior of firms in the World Bank Investment Climate (WBIC) surveys, a predecessor of the WBES, to arrive at measures of a capital distortion for each of our WBES firms. To begin, we use the actual interest rates that WBIC firms report on their loans as well as information on collateral requirements and loan duration to predict a "base rate" for each country-industry-firm size group. We then project these rates on WBES questions concerning firm's self-reported qualitative experience with access to finance—again using a split-sample IV strategy—to obtain a quantitative estimate of the interest rate that each firm would pay on a base-rate loan.[28] Appendix A.3 presents these regression results and provides further details.

Rows 16–18 of Table 1 report the size of these capital distortions as a share of capital costs by income group and firm type. Low-income countries are estimated to have the highest average capital distortions, at 21% of capital costs, while high-income countries face capital distortions of 14%. Capital distortions are larger for small (20%) and informal firms (22%) than for large firms (16%).

[28] While our "capital" input actually corresponds to all primary factors the firm might use other than labor, it seems that many candidates (such as land, to the extent that it is purchased or rented over long-lived leases) may incur similar financing constraints as would true capital.

3.2.2 Labor input distortions

Background: A sizable literature documents regulations and taxes on labor and concludes that they can have substantial distortionary effects on production efficiency in many settings. In a pioneering study of misallocation, Hopenhayn and Rogerson (1993) evaluate the effects of firing costs on productivity and welfare. Besley and Burgess (2004) link changes in state-level labor laws in India to economic growth. Botero et al. (2004) relate cross-country differences in labor regulation to labor force participation and unemployment. Haltiwanger et al. (2014) compare the speed of job reallocations across countries, with stringent hiring and firing regulations accounting for much of the cross-country variation.

Many countries impose more onerous labor regulations on larger employers or firms in specific industries. For example, in India most labor regulations and taxes only apply to firms with 10 or more employees, a discontinuity Amirapu and Gechter (2020) exploit to estimate that the distortion on labor use among Indian manufacturing firms due to these regulations is 35% on the margin.[29]

As discussed in Section 3.1.4 above, informal firms do not need to abide by labor regulations and thus any difference between formal and informal firms' labor distortions may potentially generate the largest labor-related distortion (e.g. see Meghir et al., 2015 and Ulyssea, 2018) in developing countries. We therefore assign a labor distortion of zero to all informal firms.[30]

Measurement: Similarly to our approach to measuring markups, we project the Indian state-level labor regulation wedges in Amirapu and Gechter (2020) onto answers Indian firms in the WBES give to questions about the severity of the obstacle that labor regulations pose to the business, again using a split-sample IV strategy. The coefficients from this regression provide predicted values for all firms in the WBES surveys that serve as our firm-level labor distortions. Appendix A.2 presents these regression results and provides further details.

Rows 19–21 of Table 1 report the size of these estimated labor distortions by income group and firm type. The size of the labor distortion is slightly higher for the richest countries (27% of labor costs compared to 23% for the lowest-income group), and is increasing with firm size.

[29] Indeed, India imposes an additional set of regulations for firms larger than 100 employees, although Amirapu and Gechter (2020) do not find evidence for a similar wedge at that point, potentially because of the extensive use of contract labor by large firms in order to avoid labor regulations documented by Bertrand et al. (2021).

[30] As documented in Ulyssea, 2018, formal firms may employ informal workers to evade regulations, a possibility we abstract from in our analysis.

3.2.3 Intermediate input distortions

Background: We now turn to distortions on the prices paid for intermediates used in production. An influential literature has argued that poor institutional environments substantially retard growth (see, e.g. Acemoglu et al. (2005b)). A plausible mechanism through which poor institutions affect growth is through weak contract enforcement that raises the costs of inputs and investment. While, of course, contracts govern the sale of products to final consumers, inputs more often require relationship-specific investments for which rule-of-law and a well functioning court system are particularly important.

Nunn (2007) provides evidence for this link, showing that a country's judicial quality generates a comparative advantage in products that intensively use relationship-specific inputs. More recently, Boehm and Oberfield (2020) show that sourcing decisions are more distorted in Indian states with more congested courts, with firms in such states that require relationship-specific inputs appearing more likely to bring the production of those inputs in-house than to source them at arms-length and bear the risk of hold-up that good courts might prevent. Through the lens of their model, cross-state variation in cost shares of particular inputs reveals the relative size of the input distortions across states.

In addition, firms often rely on trade credit from suppliers to bridge the time lag between ordering inputs and receiving payment from the buyer of the firm's final output. Poor legal institutions make it difficult to extend such credit although relational contracts appear to act as a partial substitute (e.g., see McMillan and Woodruff, 1999). These issues are particularly acute for international transactions where there are complications regarding which country's courts have jurisdiction and longer shipping times lengthen the gap between input purchase and output sale. Consistent with this, Antràs and Foley (2015) examine the contracts of a large US poultry exporter and show that only buyers in countries characterized by weak rule of law must pay in advance.

Measurement: Once again, we draw on Indian estimates to map the answers to WBES questions to quantitative measures of these distortions. We project Indian state-level variation in input-use distortions, estimated in the Boehm and Oberfield (2020) study described above, on Indian WBES firms' answers to a question regarding the severity of the obstacle that poorly-functioning courts pose to the business. The split-sample IV coefficients allow us to generate predicted values for all firms in the WBES surveys. Appendix A.5 presents these regression results and provides further details.

Rows 22–24 of Table 1 report the size of these estimated intermediate input distortions by income group and firm type. The intermediate input distortion is, on average, higher in poorer countries (21% of input costs versus 19% for higher income countries) and among larger firms and trading firms. Informal firms face significantly smaller distortions, averaging 17%.

3.2.4 Electricity and other input distortions

Background: There is also strong evidence for distortions affecting many of the remaining inputs into production. For example, a long literature has documented the poor functioning of land markets in many developing countries due to customary property rights, expropriation risk, poorly-functioning land-titling systems, and redistributive land regulations (see, e.g. Besley and Ghatak, 2010). Frictions in purchasing and renting land have obvious implications for misallocation in agriculture (see, e.g. Adamopoulos and Restuccia, 2014), but also make modern factory production difficult in many areas (see, e.g., Banerjee et al., 2007 for a discussion of the difficulties faced by Tata and the Indian state of West Bengal in obtaining a greenfield site for large-scale car production).

Low quality levels and service fluctuations in the provision of utilities such as electricity, water, and telecommunications may potentially act as another source of distortion in the developing world. Poorly-designed regulation, bureaucratic incompetence, and political failures or corruption that allow nonpayment or outright theft result in irregular electricity supply and require many firms to generate their own electricity, at far higher costs, in order to guarantee that their business can operate throughout the year. Allcott et al. (2016) carefully documents substantial impacts of electricity shortages on firm revenues in India. Also in India, Abeberese (2017) shows that high industrial electricity prices used to cross-subsidize politically powerful farmers distort firm technology decisions, leading them to choose less electricity-intensive production processes. At the same time, groundwater levels have been massively depleted as farmers pay close to nothing for electricity to pump water to the surface for irrigation. Water and telecommunications utilities are less studied but may suffer from equally large distortions.[31]

[31] Famously, there was an 8-year waiting list for a phone line in India in the 1980s despite requiring a hefty deposit equal to the average annual wage and most calls not connecting, with the delays attributed to a state monopoly and bureaucratic corruption and incompetence (Das, 2001 p. 208). Faccio and Zingales (2017) document differences in

Measurement: As our simplified framework does not explicitly feature land, and the WBES data only cover non-agricultural firms, we do not include land market distortions in our quantitative analysis. The WBES does, however, ask a number of questions that allow us to estimate the size of distortions in electricity inputs. Specifically, we first use firms' reports about the electricity prices they have paid and the reliability of recent electricity service in the WBIC, as well as their use of fuel-based generators, to estimate the quality-adjusted price of electricity via a hedonic regression. Electricity distortions are then revealed by variation in these quality-adjusted prices across firms. We then map this quantitative distortion to a WBES question regarding the severity of the obstacle that poor electricity provision poses to the business. Appendix A.5 presents these regression results and provides further details.

Rows 25–27 of Table 1 report the size of these electricity input distortions by income group and firm type. Our measure of this distortion falls, on average, with country income, from 14% of electricity costs for low-income countries to 9% in high-income countries, and there is limited variation across firm types.

4 The Effects of Lowering Trade Barriers in Economies with Fixed Distortions

We now turn to a series of calculations that aim to shed light on the potential welfare consequences of exposing developing countries to more trade. This draws on the theory described in Sections 2.2-2.4, the data on flows described in Section 2.5, and the distortion measures described in Section 3. Prior to presenting these results, we review the existing literature that highlights the effects of trade on the reallocation of resources towards or away from distorted firms and sectors.

4.1 Trade and reallocation in the literature

The reallocation of resources between activities lies at the heart of canonical models of trade. For example, in neoclassical economies (that is, those with convex technologies and no domestic distortions), trade openness tends to reallocate resources towards comparative advantage sectors (Deardorff, 1980). As discussed in Section 2, in the absence of domestic distortions, and holding

cellphone infrastructure across countries.

FTOT fixed, such reallocations deliver no first-order welfare benefits. But in the presence of domestic distortions, as we expect to prevail in developing country settings, if comparative advantage sectors face different initial distortions, trade may lead to even first-order welfare effects through what we refer to as a distortion revenue effect. More recent vintages of trade models emphasize within-sector heterogeneity, and often also firm-level distortions in the use of inputs. This creates the possibility that both within-sector and between-sector reallocations, such as those caused by increased trade openness, may have non-trivial welfare consequences.

Before discussing examples of these phenomena that have been covered in the literature, it is valuable to note the potential for confusing language surrounding the relationship between "productivity" and distortions. In the framework of Section 2, any two buyers of the same input will produce a different *value* marginal product (VMP) from that common input if and only if they face different distortions. In this sense, distortions and productivity are firmly connected: a reallocation from a low-distortion producer to a high-distortion producer is, by nature, one from a low-VMP use of the input to a high-VMP use, and such a reallocation would raise welfare, all else equal. On the other hand, conditional on VMP, the marginal products measured in *physical* units of the output made by these two producers—that is, based on conversions of the producers' output into equivalent goods—are not relevant to this discussion because of the critical need to incorporate the potentially distinct prices charged by the two producers, since those prices reflect the marginal utility created by the products. Similarly, other notions of productivity such as the average product of an input, or the total factor product in physical units (often referred to as TFPQ) of all inputs, whether each measured in value or physical terms, need not have any relation *per se* to VMP and hence to distortions.

However, as a practical matter there are reasons to suspect that distortions may be positively *correlated* with productivity measures such as TFPQ, in which case it would indeed be the case that a reallocation towards relatively high-TFPQ firms would raise welfare. For example, we would observe such a positive correlation if distortions are larger for larger firms—perhaps because of market power that derives from market share, or diseconomies of scale in a firm's ability to avoid enforcement of regulations—and if firm size is increasing in TFPQ. Alternatively, the correlation between size and distortions could be negative, such as in a case where firm size helps firms to overcome credit constraints. We explicitly discuss and analyze the case of such size-dependent distortions in Section 5.1.

4.1.1 Macro-level distortions

At the level of entire sectors, one salient case of differential distortions could derive from the historic bias against agriculture implicit in many developing countries' tax and subsidy policies, as detailed in Anderson (2009). This would imply that trade may bring about welfare gains by reallocating resources into agriculture—unless the net tax on agriculture corrects for other distortions as hypothesized in the structural change literature, e.g. Matsuyama (1992), Echevarria (1997), or Hayashi and Prescott (2008). Similarly, some sectors may create greater external economies of scale (within the same sector, or even across sectors) than others. As an example, Faber and Gaubert (2019) document how the growth of the tourism industry (a form of tradable services) in Mexico appears to have raised productivity in the manufacturing sector.

Another context in which high-level differences in distortions has been discussed is in the literature on trade and informality. Since informal firms, by definition, pay relatively low taxes and comply relatively weakly with a country's regulations, the basic logic sketched above suggests that if trade shifts economic activity out of informality and into the formal sector, the size of the relatively distorted formal sector would grow and so trade would increase welfare via the distortion revenue effect.

In this case, an important first step in the literature has been to evaluate when and where we should expect increased trade openness to change the size of the informal sector. Reductions in import tariffs are seen to have increased informality in Brazil by Dix-Carneiro and Kovak (2019), but Goldberg and Pavcnik (2003) present evidence for more muted responses in both Colombia and Brazil. On the exporting side, McCaig and Pavcnik (2018) show that reductions in US tariffs on Vietnamese goods led to a sizable shift of Vietnamese labor from household enterprises into larger and more productive formal firms. In a related investigation, several papers show that the restrictiveness of labor regulations and the intensity of enforcement can alter the extent of labor reallocations due to trade (see Hasan et al., 2007, Almeida and Poole, 2017, Ruggieri, 2019, and Ponczek and Ulyssea, 2020). Given a strength (and direction) of formal-informal reallocation, the size of the resulting distortion revenue effect will depend on the relative size of the distortions in the two sectors, as well as the possibility of changing levels of unemployment where factors may lie idle.

Dix-Carneiro et al. (2021) quantify these tradeoffs through a structural model finding that whether the welfare effects of tariff reductions are larger in the presence of informality is ambiguous and depends on the size of the tariff change and whether the disutility from unemployment is accounted for.

4.1.2 Firm-level distortions

Several literatures explore the interaction between firm-specific distortions and trade-induced reallocations. Brandt et al. (2017) and Baccini et al. (2019) document how trade reforms in China and Vietnam, respectively, reduced the market shares of SOEs. As discussed in Section 3.2.1, SOEs appear to face smaller distortions, at least in terms of credit constraints. Thus, by increasing the relative size of the private sector, trade is likely to generate a welfare-improving distortion revenue effect. The literature on trade and markups speaks to distortions that may vary even between two firms of the same type in the same industry. Epifani and Gancia (2011) perform an exercise close to that considered in this section, asking how the gains from trade depend on the initial distribution of markups via the distortion revenue effect. Of course, trade may also alter the size of the markups themselves via changes in competition or demand, a possibility we return to in Section 5.1.

A recent but growing literature takes up the case of trade in the presence of micro-level distortions without taking a stand on the source of the distortion (because the source *per se* is irrelevant for the size of the distortion revenue effect). For example, Bai et al. (2019) develop a Melitz (2003) model with firm-level distortions which allows them to extend the well-known gains-from-trade formula in Arkolakis et al. (2012) to include a distortion revenue term. Quantitatively estimating their model on Chinese manufacturing data—that is, estimating the underlying distribution of distortions and productivity, as well as model parameters, in order to match observed patterns of firm-level outputs, inputs and exports—they find a sizable negative distortion revenue effect. That is, less distorted firms are apparently already larger than they should be in this context. Opening to trade exacerbates this misallocation since larger firms are more willing to pay the fixed costs of exporting and so expand relative to smaller firms.[32] Berthou et al. (2019) also extend Melitz (2003) but focus on the aggregate productivity effects of trade in the presence of misallocation.

[32] Chung (2019) draws similar conclusions, again calibrating a Melitz (2003) model with distortions to firm-level Chinese manufacturing data.

They show numerically that greater import competition generates the following three patterns only in the presence of misallocation: a reduction in the covariance between employment shares and productivity alongside rising average and aggregate productivity—patterns they find in their sample of 14 European countries.

4.2 Changes in technological trade costs on imports

Our first counterfactual experiment works as follows. We take a given "Home" country in a specific year (2013) and reduce the technological barriers to trade on all of that country's 2013 imports by a small and uniform amount $\mathrm{d}\log\tau_H^{imp} < 0$. This takes place while all other economic fundamentals (technologies, preferences, endowments, and distortions) are held fixed both at Home and abroad. We then calculate the effect of this change on welfare in Home (i.e. $\mathrm{d}\log W_H$). Further, we decompose this welfare effect into the first three terms discussed in Section 2.2, since the fourth is absent in this exercise in which distortions are held constant. These are: (i) a mechanical effect that reflects the technological progress embodied in $\mathrm{d}\log\tau_H^{imp}$, (ii) an effect on Home's factoral terms of trade, and (iii) an effect on the welfare consequences of pre-existing domestic distortions that can be summarized by any change in distortion revenue.

This decomposition is useful because it sheds light on the reasons behind cross-country heterogeneity in the effects of a given trade cost shock on welfare. In particular, the mechanical effect will differ across countries but in ways that are summarized by the simple sufficient statistic, $\sum_{ij\in B_H}\widetilde{\Psi}_{H,ij}$, which is the appropriate measure of Home's consumption exposure to all import flows. The terms-of-trade effect will tend to offset the mechanical effect, and differ across countries in ways that primarily reflect countries' relative sizes and levels of openness. And the distortions-driven effect will be zero for countries that are free of domestic distortions, but it has the potential to be large in absolute value in any country with large domestic distortions; however, whether this effect is positive or negative depends on whether a country's relatively more distorted activities are pushed to grow or shrink as a result of the cheaper imports enabled by $\mathrm{d}\log\tau_H^{imp} < 0$, something that depends on the nature of the country's comparative advantage and the exact positioning of its domestic distortions relative to its comparative advantage sectors.

Figure 1 and Panel A of Table 2 report the effects of reducing by (approximately) 10% the Home country's technological import costs (i.e. $\mathrm{d}\log\tau_H^{imp} = -0.1$), one Home country at a time, as well as the decomposition into the three aforementioned channels.[33] The four panels of Figure 1 plot the total effect for each country against log GDP per-capita and similarly for each of the three channels, while Table 2 reports country-income group averages based on World Bank income groups (see Appendix Table B.2 for a list of our WBES sample countries by income group) alongside the standard deviation of the effects across countries.[34] For completeness, Appendix Table B.3 contains the estimates country-by-country.

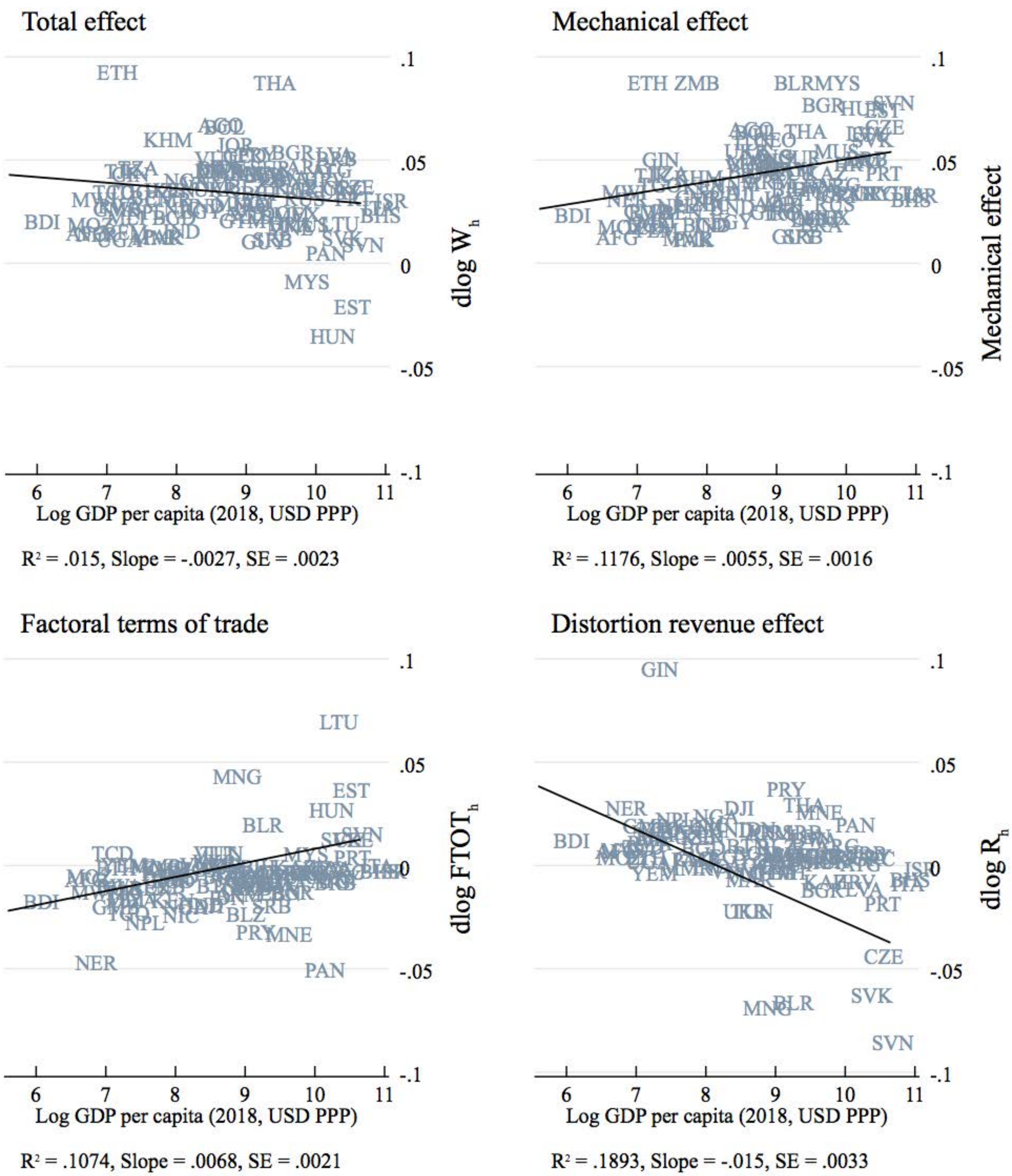
Our first finding is that almost all countries are net beneficiaries of the technological improvement embodied in the shock, $\mathrm{d}\log\tau_H^{imp} < 0$. This is consistent with the usual expectation that technological improvements raise welfare, but the presence of domestic distortions has the scope to generate exceptions and this is evidently a real possibility for some of the countries in our sample. In terms of magnitudes, the average welfare gain from the 10% reduction in trade costs is 3.3%, broadly in line with other quantitative estimates of the gains from trade (e.g., Costinot and Rodríguez-Clare 2014).

Turning to the decomposition, one lesson is that the mechanical effect is similar in magnitude to the total welfare impact of this trade shock for most countries (the top two panels of Figure 1); that is, on net, the distortion revenue and factoral terms of trade effects are relatively small in comparison to the direct effects of import-directed technical change. The mechanical effect is increasing in GDP per capita although the slope is modest. Factoral terms of trade effects are usually negative, as we would expect, and they are larger in magnitude in poorer countries (the third panel of Figure 1). In contrast, the signs of the distortion revenue effects across countries are more mixed with positive values for lower- and middle-income countries on average and negative values for high-income ones (the fourth panel of Figure 1). This means that the reallocations caused by the trade shock $\mathrm{d}\log\tau_H^{imp} < 0$ tend to reallocate resources towards relatively *more* distorted activities in developing countries—benefiting these countries by increasing the size of firms that are sub-optimally small—and towards relatively *less* distorted activities in developed ones. However, the larger magnitudes of the distortion revenue effect for poorer countries are counteracted by the

[33] In practice, for countries with many firms in the WBES, the full solution using all firms is computationally intractable so for these countries we proceed with a randomly chosen sample of 800 firms in the country.

[34] Here and in later tables, we winsorize values for the three channels beyond two standard deviations of the true mean and then report the mean of the winsorized value to ensure the averages are not heavily influenced by outliers. The total effect we report is then the country-income-group average of the sum of the three winsorized values for each country.

Figure 1: Welfare effects of a 10% reduction in technological import costs



Notes: The top left panel of this figure reports the proportional welfare impacts, $\mathrm{d}\log W_H$, associated with a 10% reduction in technological import costs τ_H^{imp}, against GDP per capita for each country in our sample. The remaining three quadrants plot the three subcomponents of $\mathrm{d}\log W_H$ (the mechanical effect, the factoral terms of trade effect, and the distortion revenue effect) defined in Section 2.2 against GDP per capita. Outliers are removed for readability but included when reporting slope of line of best fit under each panel.

Table 2: Welfare effects of a 10% reduction in trade costs by country income-group

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Panel A: 10% reduction in technological import costs				
Low-income	0.0323	0.0311	-0.0160	0.0172
	(0.0199)	(0.0185)	(0.0265)	(0.0224)
Middle-income	0.0397	0.0400	-0.0042	0.0038
	(0.0276)	(0.0184)	(0.0183)	(0.0310)
High-income	0.0242	0.0525	0.0119	-0.0402
	(0.0232)	(0.0161)	(0.0329)	(0.0563)

	Total effect	Direct distortion exposure effect	Factoral TOT	Distortion revenue effect
Panel B: 10% reduction in import tariffs				
Low-income	-0.0062	0.0177	-0.0543	0.0304
	(0.0275)	(0.0101)	(0.0843)	(0.0671)
Middle-income	0.0178	0.0193	-0.0210	0.0195
	(0.0601)	(0.0090)	(0.0611)	(0.0824)
High-income	0.0162	0.0228	-0.0201	0.0134
	(0.0349)	(0.0057)	(0.0895)	(0.1039)

Notes: Table reports the proportional welfare impacts, $\mathrm{d}\log W_H$, of a 10% reduction in technological import costs τ_H^{imp} (Panel A) and a 10% reduction in import tariffs t_H^{imp} (Panel B) using the quantitive model and data sources described in Sections 2 and 3. We average effect sizes over all countries within World Bank country-income groups after winsorizing values more than two standard deviations from the mean. Standard deviations across countries reported in parentheses. The first column reports the total effect with the subsequent three columns decomposing the total effect into the mechanical effect/direct distortion exposure effect, the factoral terms of trade effect, and the distortion revenue effect effect defined in Section 2.2.

somewhat smaller mechanical and factoral terms of trade effects. Thus, while the total effect is slightly larger in low- and middle-income countries on average, the downward-sloping relationship between the size of the total effect and log GDP per capita is shallow and insignificant.

4.3 Changes in import tariffs

Our second exercise is analogous to that in Section 4.2 but now we study the effects of changes in Home's import tariffs instead of its technological trade costs. Specifically, we hold everything in the model constant (including $\mathrm{d}\log\tau_H^{imp} = 0$) apart from a small and uniform reduction in the tariff (denoted $\mathrm{d}\log t_H^{imp} < 0$) that applies to all of Home's 2013 import flows.

This exercise serves two purposes. First, it is useful to compare the effects of a given percentage reduction in tariffs on all imports to an equivalent percentage reduction in technological trade costs. We expect the welfare effects of the latter to be substantially larger since technological trade costs have a sizable mechanical effect whereas the equivalent mechanical effect of tariffs (inclusive of the effects on tariff revenues) is zero. Second, this exercise induces a marginal change to a country's tariff policy starting from its observed policy level (which corresponds to our case since, as discussed in Section 3, the distortions that we include here incorporate our attempts to capture countries' tariff policies in 2013). Whether that change is good or bad for welfare therefore speaks to whether the current policy level is too low or two high. While recent work has examined such a question under the assumption that domestic distortions are absent or of only a limited scope, we are not aware of comparable attempts to assess the optimality of several nations' trade policy in the presence of a wide range of plausible domestic distortions.

The results of this exercise—modeled as a drop by 10% in all of Home's import tariffs—are presented in Panel B of Table 2 (with Appendix Figure B.1 displaying plots of country-level effects on log GDP per capita and Appendix Table B.4 reporting the country-by-country estimates). As expected, the welfare effects in column 1 are very different from their equivalents in Panel A of Table 2, which concerned technological improvements in importing. For all three country-income groups, the total effect is lower than in the case of a technological improvement to trade costs—as could be expected, since tariff reductions lower government revenue whereas technological trade barriers do not. In fact, for low-income countries the total effect turns negative.

In a model with no domestic distortions, calibrated to the same import tariff data as in our model, this negative effect should come as no surprise. Many countries have an existing import tariff that is plausibly lower than the level that would maximize welfare given only a trade-off between the deadweight loss of a tariff and the tariff revenue that can be extracted from foreigners, so that—absent foreign retaliation—a tariff reduction from this level would reduce welfare.[35]

However, as we have seen in Panel A of Table 2, in the presence of domestic distortions, importing can instigate improved allocative efficiency as we find for developing countries. Such a phenomenon moderates the negative welfare consequences of reducing tariffs and indeed, as we see in column 4, the distortion revenue effects (deriving from the reduction in tariff revenue and the reduction in allocative efficiency) remain positive, on average, for developing countries (and turn positive for developed ones). These allocative efficiency benefits ensure positive gains to middle-income countries and reduce the magnitude of losses in low-income ones.

4.4 Which Distortions Shape the Impact of Trade in Developing Countries?

The results thus far highlight a number of high-level distinctions between countries with large domestic distortions (on average, poorer countries) and those with smaller domestic distortions (which are, on average, richer). But economically distorted countries are typically distorted in multiple directions, and no doubt differ from less-distorted economies in many other structural respects as well. These features make it difficult to learn which sources of distortions—for example, bribe payments, market power, credit constraints or limits to firm-to-firm contracting—play the largest role in magnifying or dampening the impact of trade on welfare in developing countries and, thus, which types of domestic reforms would be most complementary with trade reforms. We now carry out a structural exploration of this heterogeneity across the different instances of market failure that we have so far built into our model as described in Section 3.

Our ideal thought experiment in this regard would be to expose Home to the same sorts of shocks as in the previous two subsections, but after first counterfactually reducing a certain set of distortions and yet still holding all other technologies, preferences and distortions fixed at Home and elsewhere. Doing so is non-trivial. In particular, an incorrect procedure for carrying out this experiment would be to simply change some μ_{ij} to μ'_{ij} while holding all observed flows X constant

[35] As discussed in Costinot and Rodríguez-Clare, 2014, the unilaterally optimal tariff in (efficient) one-sector gravity models is well approximated for all countries by the inverse of the trade elasticity (around 20% for commonly used estimates of that elasticity).

because such flows are equilibrium objects that correspond to the true set of distortions in the world economy. Instead, in order to apply the theory of Section 2.2 to a counterfactual Home economy with counterfactual levels for certain distortions we need to solve for the counterfactual flows, denoted X', that would prevail in this counterfactual scenario in which distortions are μ' rather than μ, yet all fundamentals remain fixed.

We therefore begin by solving for these counterfactual flows X' as follows. For each pair of entities, i and j, whose distortions are to be counterfactually reduced, we desire to move from the observed μ_{ij} equilibrium to the counterfactual equilibrium at which $\mu'_{ij} < \mu_{ij}$ (and where $\mu_{ij} = \mu'_{ij}$ for all distortions that are not to be reduced). We then apply the formulae in Section 2.4 (for the case of $\mathrm{d}\log\tau_{ij} = 0$) in order to solve for the effect of the changes in distortions on the flow matrix in order to arrive at X'. That is, X' is our model's prediction of what value each flow would take if the distortion matrix were μ' instead of μ. Given the first-order nature of the formulas, we consider a small change in μ_{ij} when carrying out this exercise.

On the basis of this X' we then shock Home's technological trade costs, for all of its import flows, by the uniform amount $\mathrm{d}\log\tau_H^{imp}$, just as we did above for the case of the baseline level of distortions. In practice we apply this procedure on one type of distortion (import tariffs, output taxes, markups, credit constraints, labor regulations, electricity costs, and informality distortions) at a time. And do so for one Home country at a time. Our main interest lies in the impact that reducing one of Home's distortions has on $\mathrm{d}\log W_H/\mathrm{d}\log\tau_H^{imp}$, while holding all else (including Home's other distortions) constant. This corresponds to an estimate of the cross-partial derivative $\mathrm{d}^2\log W_H/\mathrm{d}\log\tau_H^{imp}\mathrm{d}\log\mu_{ij}$.

Table 3 reports the change in the welfare effect of a 10% reduction in trade costs when a particular distortion is reduced by 10%. We report these changes for each of the various sales and input distortions covered in Section 3, again averaging country-level values over country-income groups (Appendix Table B.5 reports these results country by country). Comparing across columns the size of the cross-partials for different types of distortion tells us whether a reduction in the extent of a particular distortion will have substantial impacts on the welfare benefits from a reduction in the technological costs of international trade.[36] Put another way, the numbers in this table provide

[36]Note that because we consider proportional reductions in a particular distortion, this will reduce the absolute differences in the size of that distortion faced by different entities within a country and so flatten the distortion heterogeneity in addition to lowering the level of distortions.

Table 3: Changes in welfare effects with reductions in distortions

	Change in $\frac{\mathrm{d}\log W_H}{\mathrm{d}\log\tau}$ due to 10% reduction in specified distortion					
	Regulation and crime	Markup	Capital	Labor	Intermediate input	Electricity
Low-income	0.0021	0.0014	-0.0010	-0.0004	0.0048	0.0000
	(0.0089)	(0.0057)	(0.0038)	(0.0024)	(0.0198)	(0.0001)
Middle-income	0.0006	-0.0001	0.0003	0.0013	-0.0000	0.0001
	(0.0053)	(0.0064)	(0.0018)	(0.0064)	(0.0147)	(0.0006)
High-income	0.0030	-0.0016	-0.0001	-0.0002	0.0050	-0.0001
	(0.0142)	(0.0112)	(0.0050)	(0.0159)	(0.0284)	(0.0011)

Notes: Table reports the change in the welfare effect from a 10% reduction in trade costs when the specified distortion is reduced by 10%. Averages are reported by World Bank country-income groups after winsorizing values more than two standard deviations from the mean. Standard deviations across countries reported in parentheses.

estimated answers to the question: how complementary to increased trade openness would be different types of domestic reforms that try to reduce market distortions?

We find particularly sizable derivatives with respect to regulation and crime output distortions, and intermediate input distortions. For example, a 10 percent reduction in all intermediate input distortions would raise the proportional welfare gains from a 10% reduction in technological trade costs by 0.5 percentage points for low income countries (i.e. from 3.23% to 3.71%). Domestic reforms in these areas do appear to be more complementary in low-income countries in comparison to middle income countries (although we also find substantial complementarities for the few high income countries in our WBES sample). These results, coupled with the limited work in the literature reviewed in Section 4, suggest that the interactions between trade and distortions due to crime and regulation deserve further attention. While the literature on trade and contracting distortions is richer (see for example Antras, 2016), there is scope for work that thinks carefully about the complementarities between policies such as judicial reforms and trade openness.

In contrast, reductions in markups, capital or labor distortions that are the focus of much of the extant literature are estimated to have more muted impacts, and different signs across country-income groups, despite high initial levels of these distortions. These findings highlight the need to understand the full distribution of different distortions rather than simply their mean in order to make policy prescriptions on which distortions are most deleterious.

5 Effects of Trade Barriers On the Extent of Distortions

Up to this point, we have examined the role that distortions play in altering the impacts of trade, but through a model in which distortions are held fixed. This leaves an important role for trade to change the implications of those existing distortions, by reallocating factors towards or away from relatively distorted activities. But it has inherently been a partial analysis because there are reasons to expect trade shocks to also be the cause of changes in the extent of the distortions themselves.

The theory behind this case was discussed in Section 2. We now discuss existing work, plus our own calculations, that attempts to put that theory to practice. There are doubtless many channels of influence here that are deserving of future study. We divide our more limited analysis into two parts. First, we explore the point that trade shocks are likely to change the size distribution of firms in an economy, so any distortions that are inherently size-dependent will change in ways that are easy to examine. Second, trade shocks may have a more direct causal impact on various other distortions but in ways that may be more context-specific. In both cases we explore the importance of these two possibilities both in the existing literature and through the lens of our quantitative framework.

5.1 Size-dependent distortions

Models featuring firm heterogeneity predict that simple reductions in trade barriers will change the firm-size distribution, with large firms expanding relative to small ones in a broad class of trade models (see, e.g., Mrázová and Neary, 2018). If it happens to be the case that firm sizes are merely *correlated* with the level of firm-level distortions, but those distortions would not change in any systematic direction if the firm were to grow, then trade affects the implications of these fixed distortions, but not the level of the distortions themselves. This case was implicitly covered in Section 4 since those results were true for any fixed distribution of distortions.

However, economists such as Guner et al. (2008) have noted that many of the distortions discussed in previous sections are inherently size-dependent, in the sense that the size of the firm-level distortion is a *causal* function of firm size.[37] In such a context, not only will the presence of distortions modify the effects of trade shocks as we analyze above, but trade will also change the size of the distortions themselves through altering the firm-size distribution.

In this section, we first summarize the existing literature on size-dependent distortions (in this latter, causal sense of the word) in the developing world before turning to estimates of the size-dependence that appears to prevail among the distortions used in our analysis. Finally, we analyze the effects of trade in our model when we allow for the possibility that trade shocks change distortions by changing the firm size distribution.

5.1.1 Size-dependent distortions in the literature

Whether a particular distortion is size-dependent is ultimately an empirical question that will surely depend on the legal and institutional context. For example, in the case of sales distortions, many regulations target firms of a specific size. Both Garcia-Santana and Pijoan-Mas (2014) and Martin et al. (2017) document this in India by analyzing the small-scale industry reservation scheme, which restricted production of certain products to small and medium enterprises. On the other hand, India's industrial licensing practices limited large firms from expanding capacity (see Aghion et al., 2008 and Alfaro and Chari, 2014). Even when regulations legally apply to all firms, whether those regulations are actually enforced or not may depend on the size and visibility of the firm. This is particularly the case for taxation, with governments often setting up offices with the specific goal of collecting taxes from larger firms (see Basri et al., 2019). More generally, Bachas et al. (2019) use WBES data to document that tax enforcement and compliance increases with firm size. And of course, informality generates size-dependent distortions since only small firms can avoid detection and hence the regulations and taxes associated with formality.

A firm's markups are also likely to depend on its size, or at least its market share (size relative to competitors' size). Outside of knife-edge cases, markups will either rise or fall with firm size depending on whether the demand elasticity faced by the firm increases or decreases with sales. The empirical papers cited in Section 3.1.2 find that larger firms charge higher markups, as is consistent

[37] Also see Costa-Scottini, 2018 for an analysis of how the benefits of reducing size dependent distortions depend on trade openness that is agnostic to the origin of the size dependencies.

with both the case of CES preferences with oligopolistic competition as in Edmond et al. (2015), and the case of variable elasticity preferences as in, for example, Arkolakis et al. (2018) or Edmond et al. (2018).[38]

At a higher level, this latter case is analogous to an externality whose function of primitives is not isoelastic, such that the distortion on the margin varies with the level of economic activity. Many externalities, such as pollution, agglomeration or external economies of scale may have this feature (even if the functional forms estimated in econometric studies often focus on isoleastic parametric forms for the sake of parsimony).

Finally, input distortions are likely to vary with firm size for a number of reasons. As noted in Section 3.2.1, effective interest rates may vary with firm size both because small firms lack collateral and because governments may direct subsidized credit to firms of a certain size. David and Venkateswaran (2019) disentangle numerous sources of capital misallocation in China, noting the importance of size-dependent factors, while Bai et al. (2018) document that small Chinese firms face the highest borrowing costs and state-owned firms the lowest.

Turning to labor distortions, many countries either place more onerous labor regulations on larger firms—a fact Amirapu and Gechter (2020) use to measure the size of the labor wedge in India—or only chose to enforce labor laws at the biggest employers. Materials, land and utilities distortions may also vary if larger firms receive favorable legal treatment or are provided with easier access to land and utilities, for example through special economic zones, industrial parks and the like.

5.1.2 Estimating size-dependent distortions

To explore the interaction between trade and size-dependent distortions through the lens of our framework we require estimates of how specific distortions vary with firm size. Ideally we would find exogenous shocks to firm size in a set of WBES countries, and use those shocks to estimate how distortions change with firm size at each point of the distribution. Such an exercise is beyond the scope of this chapter, though certainly an area for useful future work. Instead we take the simpler approach of treating the cross-sectional relationship between distortions and firm size in

[38] Gupta (2020) also documents a positive relationship between markups and firm size in India but provides an alternative explanation: larger firms sell to wealthier consumers who are more price inelastic.

Table 4: Distortions by firm size

	Coefficient on log employment						
	Regulation	Crime	Markup	Capital	Labor	Inter. input	Electricity
Low-income	-0.001	-0.008	0.001	-0.009	0.003	0.001	0.001
Middle-income	0.000	-0.006	0.001	-0.010	0.003	0.001	-0.000
High-income	-0.001	-0.005	0.004	-0.007	0.005	-0.000	-0.001

Notes: Table reports average coefficients by country income group from regressing distortion levels on log firm employment. All statistics incorporate survey sampling weights and are sales-weighted averages of firms. Weights are normalized to give all countries within an income group equal weight.

each country as a causal relationship. This comes with the important caveat that such a correlation may provide a biased estimate of the true causal function.

Specifically, for any specific type of distortion μ^x (e.g. the sales distortion, markups, or capital input distortion), we estimate a regression of the distortion on log firm size, $\log Size_{ic}$ (proxied by metrics discussed below), using all firms i in all countries c:

$$\mu^x_{ic} = \alpha_c + \beta^x_c \log Size_{ic} + \epsilon_{ic}. \tag{6}$$

We let the coefficients and intercept in this regression vary by country. Recall that in the counterfactuals in Section 4, we allowed $\mathrm{d}\log \tau^{imp}_H$ to change but set all $d\log \mu_{ij}$ terms equal to zero. We now modify these earlier counterfactuals by further incorporating the change in distortions induced by changes in trade costs. The estimated coefficients from (6) provide the function determining how distortions change with firm size, with the changes in the firm-size distribution coming from our original counterfactuals in Section 4. The resulting $d\log \mu^x_{ic}$s are then fed into our original counterfactual to provide a more complete picture of the effects of trade on welfare.

There are several reasonable metrics for firm size, $Size_{ic}$. Given that many of the mechanisms described in Section 5.1.1 involve stronger enforcement of regulations for larger firms or regulations that explicitly depend on the number of employees, we measure firm size by employment.[39]

Table 4 reports these size-dependencies for each type of distortion, averaging the β^x_c coefficients within country-income groups. Echoing the heterogeneity discussions in Section 3, the crime output distortion and the capital input distortion have the most substantial size dependencies, particularly

[39]Employment has the additional benefit that it is typically a less noisy measure of firm size than alternative proxies such as revenues or profits.

in low and lower-middle income countries. In low income countries, a one log-point increase in firm size is associated with a reduction in the crime distortion faced by a firm by 8 percent of sales and a reduction in capital input distortions by 9 percent of capital costs. In proportional terms, the size dependencies are most acute for regulation and crime distortions, with both falling 6 percent for every log point increase in firm size.

5.1.3 The effects of trade shocks in the presence of size-dependent distortions

While holding the μ^xs fixed as we did in Section 4, the more-substantial size dependencies discussed above favor larger firms and so distortion heterogeneity by firm size will generate positive distortion revenue effects whenever trade shocks reallocate resources towards smaller firms. But these reallocations will, in turn, change the size of the distortions firms face, moderating or magnifying both the distortion revenue term and the direct effect of distortions term (and potentially the factoral terms of trade effect as well). We now turn to quantifying how large this moderation or magnification is through the lens of our model.

To do so, we start with our estimates of the effects of a uniform 10% reduction in technological trade costs as reported in Section 4.2. We then proceed in a similar fashion to Section 4.4 and solve for the counterfactual flows X' under the new vector of technological trade costs τ'_{ij}. We compute employment at each firm in this counterfactual economy to generate the change in employment $d\log Size_{ic}$, which in turn provides us with estimates of $d\log\mu^x_{ic}$ from the country-specific size-dependencies $\hat{\beta}^x_c$ estimated above. Finally, we use these distortion changes to shock the counterfactual economy and obtain the additional welfare change from allowing distortions to respond to the reduction in technological trade costs.[40]

Table 5 reports these additional changes to the welfare effect (relative to the results in Table 2 of Section 4.2) when distortions are size-dependent. As elsewhere, we report changes to both the total effect and its three constituent parts, averaging values over countries in different income groups (Appendix Table B.6 reports results country-by-country).

While allowing distortions to respond to changes in trade costs does change the welfare gains

[40] An alternative but computationally more challenging approach would be to solve for the fixed point such that the estimated firm size changes are consistent with the new level of distortions that results from the trade-induced change in the firm size distribution. As in effect we are performing the first step of an iterative procedure to find a fixed point, we expect our approach to provide a reasonable approximation to this more involved counterfactual.

Table 5: Change in welfare effects due to size-dependent distortions

	Change in specified effect due to incorporation of size-dependent distortions			
	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Low-income	-0.0028	0.0015	-0.0043	0.0000
	(0.0167)	(0.0055)	(0.0177)	(0.0011)
Middle-income	0.0014	0.0006	0.0009	-0.0000
	(0.0083)	(0.0030)	(0.0079)	(0.0017)
High-income	0.0041	0.0006	0.0104	-0.0068
	(0.0444)	(0.0073)	(0.0263)	(0.0465)

Notes: Table reports the additional changes to the welfare effect and its subcomponents in response to a 10% reduction in technological import costs, τ_H^{imp}, when distortions are size-dependent. All columns are averages of simple differences relative to the welfare effect reported in Panel A of Table 2. Averages reported by World Bank country-income groups after winsorizing values more than two standard deviations from the mean. Standard deviations across countries reported in parentheses.

from reductions in the technological costs of trade, in our simulations the resulting additional gains or losses are relatively small for low- and middle-income countries. For example, the welfare gains *fall* by 0.3 percentage points (i.e. from 3.23% to 2.95%) in low income countries when we allow for this new margin. The impacts are more pronounced in high-income countries, with the endogenous distortion responses due to changes in the firm size distribution *raising* welfare gains by 0.41 percentage points from 2.42% to 2.83%. These changes primarily come from movements in the factoral terms of trade although the distortion revenue term also declines substantially for high-income countries, negating what would be an even larger increase in welfare. This reduction in distortion revenues implies that the reallocations of economic activity induced by trade lead to changes in the firm-size distribution in high-income countries that exacerbate the heterogeneity in distortions across economic activities.

5.2 Direct effects of trade on distortions

We now turn to mechanisms through which trade directly changes the size of firm-level distortions, rather than indirectly through changing the firm size distribution as above. We first review the trade literature that explicitly or implicitly explores such possibilities, before extending our quantitative framework to incorporate some of these mechanisms and analyze how they magnify or mitigate the effects of trade calculated in previous sections.

5.2.1 Direct effects of trade on distortions in the literature

The most prominent mechanism in the literature through which trade shocks directly change the size of distortions is by increasing competition. Levinsohn (1993), Harrison (1994) and Krishna and Mitra (1998) find support for the premise that import competition leads domestic firms to behave more competitively in Turkey, Côte d'Ivoire, and India respectively. De Loecker et al. (2016) find similar pro-competitive effects from falling output tariffs in India, but document countervailing rises in markups from tariff reductions on intermediate goods that are not fully passed through to consumers. In the context of China's WTO accession, Lu and Yu (2015) show that trade liberalization reduced the within-industry dispersion of (unweighted) markups, although this comes from both existing firms changing markups and firm entry and exit.

A set of recent papers explore this question and pay explicit attention to the welfare effects of misallocation. As discussed in Section 5.1.1, the change in markups may be solely due to size-dependent forces—either because size is a sufficient statistic for changes in the consumer's demand elasticity or the competitive pressure a firm faces. For example, if consumer demands are CES and firms compete oligopolistically as in Atkeson and Burstein (2008), each firm's markup depends explicitly on its market share, and so trade-induced changes in the firm-size distribution change markups even if consumer demands are constant elasticity and the nature of competition and the number of competitors do not change. Holmes et al. (2014) and Edmond et al. (2015) take this approach, with trade tending to reduce markups and increase allocative efficiency. Arkolakis et al. (2018) propose a more general demand system that nests this case and find that, per unit change in a country's level of openness, in cases where firms display incomplete pass-through, any welfare improvements due to reductions in markups on domestic firms are more than offset by rising markups among foreign firms selling to the market.

Finally, a wider literature has explored the impacts of trade on firm productivity. As discussed in Section 2, if productivity improvements arise because firms adopt new technologies that were not previously worth investing in (as in Bustos, 2011, for example), then, due to the envelope theorem, such effects have no first-order welfare gains and hence they should not be included in our expressions. If instead, productivity gains come from knowledge transfers from foreign partners that are not priced—often dubbed "learning by exporting" for the case of outbound flows—as in Clerides et al. (1998) or Atkin et al. (2017), there is the potential for first-order gains. Trade may also reduce so-called "X-inefficiency" (changes in the extent to which firms pursue privately-optimal profit-maximization, for example due to asymmetric information within the firm) in firms as they face stiffer foreign competition. Depending on how it is modeled, this effect can change the size of distortions within the firm. Influential work—such as the pioneering study by Pavcnik (2002), which documents how tariff reductions in Chile substantially raised measured TFP among import-competing firms—identifies the sum of these knowledge-spillover and X-inefficiency effects, but we are not aware of work that attempts to distinguish them.

There are a number of other channels through which trade may directly change the size of distortions. For many of the world's poorest countries, trade taxes are a key source of revenue. If that revenue falls, for example due to a tariff cut, governments may need to raise other taxes to try to make up for the shortfall. These new taxes may be more or less distortionary but are certainly harder to collect. Cage and Gadenne (2018) show that almost half of developing countries who reduced tariffs were in worse fiscal positions 5 years later.

Trade shocks can also affect labor regulations. Tian (2019) shows how Chinese prefectures adjusted the Hukou system governing migrant labor in response to WTO accession. Harrison and Scorse (2010) demonstrate that US anti-sweatshop activism, and the resulting pressure from multinationals sourcing from Indonesia, led the Indonesian government to quadruple its minimum wage in the 1990s. Tanaka (2019) and Boudreau (2019) document settings in which firms adhere more strongly to workplace safety regulations after they begin exporting to high-income countries.

Trade shocks may also affect the size and distribution of credit distortions. For example, Rappoport et al. (2019) show that customers of banks whose other clients were heavily exposed to Chinese import competition received less credit and grew slower than similar firms borrowing from less exposed banks.

Finally, openness to trade may alter a country's institutions, with ramifications for a range of distortions that originate from a weak rule of law, a poorly functioning court system, or public sector corruption. Given the hypothesized importance of institutions in long run growth, Nunn and Trefler (2014) argue that “the impact of international trade on domestic institutions is the single most important source of long-run gains from trade”.

While our evidence base is still limited, there are a number of compelling historical examples. Acemoglu et al. (2005a) make the case that the dramatic growth of Western Europe in the second half of the last millennium came in part from Atlantic trade increasing the power of the merchant class, helping them to improve institutions so as to better protect domestic private property. Puga and Trefler (2014) document a similar mechanism. The growth of Venetian trading opportunities in the 10th to 12th century generated a sizable merchant class who successfully pushed for both constraints on the executive and the establishment of robust contracting institutions (although, in this case, many of the institutional improvements were reversed as an oligarchic political structure emerged at the end of the 13th century).

Pascali (2017) shows that changes in trade costs due to the invention of the steamship—and the resulting reorientation of global trade routes—had very heterogeneous effects; generating growth in countries like those of Western Europe who already had strong constraints on the executive but lowering growth for less-constrained countries where extractive rulers where the main beneficiaries of openness. Jha (2015) provides more direct evidence, showing that ownership of assets in overseas joint-stock companies led members of the English parliament to push for greater constraints on the monarch in the 1640s in what became known as the English Civil War—a key juncture along England’s path to parliamentary sovereignty.

A related mechanism through which trade reforms can alter institutions and reduce distortions is by reducing or eliminating the ability of the state to allocate scarce trading rights to politically-connected firms. Khandelwal et al. (2013) explore the effects of the removal of quotas for Chinese exports of textiles and clothing to high income countries that came with the end of the Multi Fibre Arrangement. Prior to the reform, SOEs were awarded most of the export licenses. When the quotas were removed, market share was reallocated to private firms (who, as discussed above, faced greater distortions than SOEs through less favorable access to credit). Similarly, Javervall and Khoban (2020) show that connections to politicians in India became substantially less valuable when tariffs on inputs were dramatically reduced in the 1990s, particularly in the most corrupt states.

5.2.2 The effects of trade shocks when trade directly changes the size of distortions

Quantifying the myriad mechanisms reviewed in Section 5.2.1 is challenging as we require knowledge of the structural relationships between trade and the various distortions under study. Unlike for the analysis of size-dependent distortions—where cross-sectional relationships in the WBES provides some guidance—the potential for omitted variable problems are too severe for us to attempt a similar exercise using the cross-sectional correlations between trade openness (either across countries or industries) and the size of distortions that exist in our dataset. Thus, we leave a quantitative exploration of the aforementioned claim in Nunn and Trefler (2014)—that "the impact of international trade on domestic institutions is the single most important source of long-run gains from trade"—to future work.

6 Concluding Remarks

The goal of this chapter has been to develop a framework with which to interpret and survey the recent trade and development literature—with a particular focus on understanding interactions between trade and the misallocation that is thought to be rife in the developing world. This framework emphasizes a classical idea in the study of trade and development: the presence of domestic distortions can amplify (or undo) the traditional gains from trade in developing countries if heightened trade causes a reallocation of resources towards (or away from) relatively distorted sectors.

As simple as this idea is, we believe that future work on trade and development would benefit from doing more to ask, and focus on buttressing robust answers to, three essential questions that we have emphasized:

- Which activities in the economy are relatively distorted (especially when including a full set of potential sources of distortions)?
- When will a trade shock result in reallocations of factors towards those relatively distorted activities?
- When will a trade shock change the extent of distortions themselves?

In order to illustrate these forces we have outlined a set of numerical simulations centered on most of the world's developing countries. In particular, we have walked through the measurement requirements—concerning trade flows between all economic actors and the distortions that operate on each transaction—as well as the elasticities that must be estimated in order to pin down counterfactual reallocations. Our main goal in pursuing such an exercise has been to illustrate the steps involved and, in particular, to highlight the difficulties a researcher must confront in order to discover whether shocks to a country's trading environment will improve or worsen its allocative efficiency. We see making progress on all three of these measurement challenges—including through the use of tailored surveys as in Startz (2018), detailed administrative data as in Adao et al. (2020), and randomized control trials as in Atkin et al. (2017)—as important directions for future work.

Much of the existing literature reviewed in Section 4 and 5 has focused on two particular sources of distortion that potentially interact with trade openness: markups and credit frictions. Given our quantitative findings, as well as the development economics literature related to the size of distortions reviewed in Section 3, explorations of complementarities between trade reforms and market frictions generated by other distortions—regulation, crime, contracting institutions, etc.—seem particularly fruitful avenues for research.

Finally, we end by re-iterating the caveat that our discussion has focused on aggregate welfare, at the significant cost of ignoring distributional concerns. Another area for future research would probe interactions between domestic distortions, trade and inequality, particularly when earnings inequality includes the distribution of distortion revenue which may be highly uneven across income strata.

References

Abeberese, A. B. (2017): "Electricity Cost and Firm Performance: Evidence from India," *Review of Economics and Statistics*, 99, 839–852.

Acemoglu, D., S. Johnson, and J. Robinson (2005a): "The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth," *American Economic Review*, 95, 546–579.

Acemoglu, D., S. Johnson, and J. A. Robinson (2005b): "Institutions as a fundamental cause of long-run growth," in *Handbook of Economic Growth*, ed. by P. Aghion and S. Durlauf, Elsevier, vol. 1, 385–472.

Acemoglu, D. and J. Ventura (2002): “The World Income Distribution,” *The Quarterly Journal of Economics*, 117, 659–694.

Ackigit, U. and M. Melitz (2021): “Innovation and Trade,” in *Handbook of International Economics*, ed. by E. Helpman, G. Gopinath, and K. Rogoff, Elsevier, vol. 5.

Adamopoulos, T. and D. Restuccia (2014): “The Size Distribution of Farms and International Productivity Differences,” *American Economic Review*, 104, 1667–97.

Adao, R., P. Carrillo, A. Costinot, D. Donaldson, and D. Pomeranz (2020): “Imports, Exports, and Earnings Inequality: Measures of Exposure and Estimates of Incidence,” NBER Working Paper 28263.

Aghion, P., R. Burgess, S. J. Redding, and F. Zilibotti (2008): “The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India,” *American Economic Review*, 98, 1397–1412.

Alessandria, G. A., C. Arkolakis, and K. J. Ruhl (2021): “Firm dynamics and trade,” *Annual Review of Economics*, 13, 253–280.

Alfaro, L. and A. Chari (2014): “Deregulation, misallocation, and size: Evidence from India,” *The Journal of Law and Economics*, 57, 897–936.

Allcott, H., A. Collard-Wexler, and S. D. O’Connell (2016): “How Do Electricity Shortages Affect Industry? Evidence from India,” *American Economic Review*, 106, 587–624.

Almeida, R. K. and J. P. Poole (2017): “Trade and labor reallocation with heterogeneous enforcement of labor regulations,” *Journal of Development Economics*, 126, 154–166.

Amirapu, A. and M. Gechter (2020): “Labor regulations and the cost of corruption: Evidence from the Indian firm size distribution,” *Review of Economics and Statistics*, 102, 34–48.

Anderson, K. (2009): *Distortions to Agricultural Incentives*, The World Bank.

Antras, P. (2016): *Global Production: Firms, Contracts, and Trade Structure*, Princeton University Press.

Antras, P. and R. J. Caballero (2009): “Trade and Capital Flows: A Financial Frictions Perspective,” *Journal of Political Economy*, 117, 701–744.

Antràs, P. and C. F. Foley (2015): “Poultry in Motion: A Study of International Trade Finance Practices,” *Journal of Political Economy*, 123, 853–901.

Arkolakis, C., A. Costinot, D. Donaldson, and A. Rodríguez-Clare (2018): “The Elusive Pro-Competitive Effects of Trade,” *The Review of Economic Studies*, 86, 46–80.

Arkolakis, C., A. Costinot, and A. Rodríguez-Clare (2012): “New Trade Models, Same Old Gains?” *American Economic Review*, 102, 94–130.

Atkeson, A. and A. Burstein (2008): “Pricing-to-Market, Trade Costs, and International Relative Prices,” *American Economic Review*, 98, 1998–2031.

Atkin, D. (2016): “Endogenous Skill Acquisition and Export Manufacturing in Mexico,” *American Economic Review*, 106, 2046–2085.

Atkin, D., A. Chaudhry, S. Chaudhry, A. K. Khandelwal, and E. Verhoogen (2015): "Markup and Cost Dispersion across Firms: Direct Evidence from Producer Surveys in Pakistan," *American Economic Review*, 105, 537–544.

Atkin, D., B. Faber, and M. Gonzalez-Navarro (2018): "Retail Globalization and Household Welfare: Evidence from Mexico," *Journal of Political Economy*, 126, 1–73.

Atkin, D., A. Khandelwal, and A. Osman (2017): "Exporting and Firm Performance: Evidence from a Randomized Experiment," *Quarterly Journal of Economics*, 132, 1101–1164.

Atkin, D. and A. K. Khandelwal (2020): "How Distortions Alter the Impacts of International Trade in Developing Countries," *Annual Review of Economics*, 12, 213–238.

Baccini, L., G. Impullitti, and E. J. Malesky (2019): "Globalization and State Capitalism: Assessing Vietnam's Accession to the WTO," *Journal of International Economics*, 119, 75–92.

Bachas, P., R. N. Fattal Jaef, and A. Jensen (2019): "Size-dependent tax enforcement and compliance: Global evidence and aggregate implications," *Journal of Development Economics*, 140, 203 – 222.

Bai, Y., K. Jin, and D. Lu (2019): "Misallocation Under Trade Liberalization," NBER Working Paper 26188.

Bai, Y., D. Lu, and X. Tian (2018): "Do Financial Frictions Explain Chinese Firms' Saving and Misallocation?" NBER Working Paper 24436.

Banerjee, A., R. Hanna, and S. Mullainathan (2012): "Corruption," in *The Handbook of Organizational Economics*, ed. by R. Gibbons and J. Roberts, Princeton University Press, 1109–1147.

Banerjee, A. V. (2003): *Contracting Constraints, Credit Markets, and Economic Development*, Cambridge University Press, vol. 3 of *Econometric Society Monographs*, 1–46.

Banerjee, A. V., P. Bardhan, K. Basu, M. D. Chaudhury, M. Ghatak, A. S. Guha, M. Majumdar, D. Mookherjee, and D. Ray (2007): "Beyond Nandigram: Industrialisation in West Bengal," *Economic and Political Weekly*, 42, 1487–1489.

Banerjee, A. V. and E. Duflo (2005): "Growth Theory Through the Lens of Development Economics," in *Handbook of Economic Growth, Volume 1a*, ed. by P. Aghion and S. Durlauf, Amsterdam: Elsevier, 473–552.

——— (2014): "Do Firms Want to Borrow More? Testing Credit Constraints Using a Directed Lending Program," *The Review of Economic Studies*, 81, 572–607.

Banerjee, A. V. and B. Moll (2010): "Why Does Misallocation Persist?" *American Economic Journal: Macroeconomics*, 2, 189–206.

Baqaee, D. R. and E. Farhi (2019): "Networks, Barriers, and Trade," NBER Working Paper 26108.

——— (2020): "Entry vs. Rents," NBER Working Paper 27140.

Bartelme, D., A. Costinot, D. Donaldson, and A. Rodriguez-Clare (2019): "The Textbook Case for Industrial Policy: Theory Meets Data," NBER Working Paper 26193.

Basri, M. C., M. Felix, R. Hanna, and B. A. Olken (2019): "Tax Administration vs. Tax Rates: Evidence from Corporate Taxation in Indonesia," NBER Working Paper 26150.

Bates, R. H. (1981): *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*, University of California Press.

Beirne, K. and M. Kirchberger (2020): "Concrete thinking about development," Working Paper, Oxford University.

Berthou, A., J. J.-H. Chung, K. Manova, and C. Sandoz Dit Bragard (2019): "Trade, productivity and (mis) allocation," Working Paper, UCL.

Bertrand, M., C.-T. Hsieh, and N. Tsivanidis (2021): "Contract Labor and Firm Growth in India," NBER Working Paper 29151.

Besley, T. and R. Burgess (2004): "Can Labor Regulation Hinder Economic Performance? Evidence from India," *The Quarterly Journal of Economics*, 119, 91–134.

Besley, T. and M. Ghatak (2010): "Property Rights and Economic Development," in *Handbook of Development Economics, Volume 5*, ed. by D. Rodrik and M. Rosenzweig, Amsterdam: North-Holland, chap. 68, 4525–4595.

Besley, T. and H. Mueller (2018): "Predation, Protection, and Productivity: A Firm-Level Perspective," *American Economic Journal: Macroeconomics*, 10, 184–221.

Besley, T. and T. Persson (2014): "Why do developing countries tax so little?" *Journal of Economic Perspectives*, 28, 99–120.

Bhagwati, J. (1958): "Immiserizing Growth: A Geometrical Note," *The Review of Economic Studies*, 25, 201–205.

Bhagwati, J. and V. Ramaswami (1963): "Domestic Distortions, Tariffs, and the Theory of Optimum Subsidy," *Journal of Political Economy*, 71, 44–50.

Bhagwati, J. N. (1971): "The generalized theory of distortions and welfare," in *Trade, balance of payments and growth*, ed. by J. N. Bhagwati, North-Holland.

Boehm, J. and E. Oberfield (2020): "Misallocation in the Market for Inputs: Enforcement and the Organization of Production," *The Quarterly Journal of Economics*, 135, 2007–2058.

Bond, S., A. Hashemi, G. Kaplan, and P. Zoch (2020): "Some Unpleasant Markup Arithmetic: Production Function Elasticities and their Estimation from Production Data," NBER Working Paper 27002.

Botero, J. C., S. Djankov, R. L. Porta, F. Lopez-de Silanes, and A. Shleifer (2004): "The Regulation of Labor," *The Quarterly Journal of Economics*, 119, 1339–1382.

Boudreau, L. (2019): "Workplace Safety and Employment Decisions: Evidence from a Pilot Information Experiments with Bangladeshi Garment Workers," Working Paper, Columbia.

Brandt, L., T. Tombe, and X. Zhu (2013): "Factor market distortions across time, space and sectors in China," *Review of Economic Dynamics*, 16, 39 – 58.

Brandt, L., J. Van Biesebroeck, L. Wang, and Y. Zhang (2017): "WTO Accession and Performance of Chinese Manufacturing Firms," *American Economic Review*, 107, 2784–2820.

Buera, F. J., J. P. Kaboski, and Y. Shin (2011): "Finance and Development: A Tale of Two Sectors," *The American Economic Review*, 101, 1964–2002.

Buera, F. J. and Y. Shin (2013): "Financial Frictions and the Persistence of History: A Quantitative Exploration," *Journal of Political Economy*, 121, 221–272.

Burstein, A. and J. Cravino (2015): "Measured Aggregate Gains from International Trade," *American Economic Journal: Macroeconomics*, 7, 181–218.

Bustos, P. (2011): "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms," *American Economic Review*, 101, 304–340.

Cage, J. and L. Gadenne (2018): "Tax revenues and the fiscal cost of trade liberalization, 1792-2006," *Explorations in Economic History*, 70, 1 – 24.

Chalendard, C. R., A. Duhaut, A. M. Fernandes, A. Mattoo, G. J. Raballand, and B. Rijkers (2020): "Does Better Information Curb Customs Fraud?" World Bank Policy Research Working Paper 9254.

Cherniwchan, J., B. R. Copeland, and M. S. Taylor (2017): "Trade and the Environment: New Methods, Measurements, and Results," *Annual Review of Economics*, 9, 59–85.

Chipman, J. S. (1965): "A Survey of the Theory of International Trade: Part 1, The Classical Theory," *Econometrica*, 33, 477–519.

Chung, J. H. (2019): "Firm heterogeneity, misallocation, and trade," Working Paper, Auburn University.

Cirera, X., R. Fattal-Jaef, and H. Maemir (2019): "Taxing the Good? Distortions, Misallocation, and Productivity in Sub-Saharan Africa," *The World Bank Economic Review*, 34, 75–100.

Clerides, S., S. Lach, and J. R. Tybout (1998): "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco," *Quarterly Journal of Economics*, 113, 903–947.

Copeland, B., J. Shapiro, and S. Taylor (2021): "Globalization and the Environment," in *Handbook of International Economics*, ed. by E. Helpman, G. Gopinath, and K. Rogoff, Elsevier, vol. 5.

Costa-Scottini, L. (2018): "Firm-level Distortions, Trade, and International Productivity Differences," Unpublished Manuscript.

Costinot, A. and A. Rodríguez-Clare (2014): "Trade Theory with Numbers: Quantifying the Consequences of Globalization," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, Elsevier, vol. 4.

Das, G. (2001): *India Unbound*, Knopf Doubleday Publishing Group.

David, J. M. and V. Venkateswaran (2019): "The Sources of Capital Misallocation," *American Economic Review*, 109, 2531–67.

De Loecker, J. and J. Eeckhout (2018): "Global Market Power," NBER Working Paper 24768.

De Loecker, J., P. K. Goldberg, A. K. Khandelwal, and N. Pavcnik (2016): "Prices, Markups, and Trade Reform," *Econometrica*, 84, 445–510.

de Mel, S., D. McKenzie, and C. Woodruff (2008): "Returns to Capital in Microenterprises: Evidence from a Field Experiment," *The Quarterly Journal of Economics*, 123, 1329–1372.

de Soto, H. (1989): *The Other Path: The Invisible Revolution in the Third World*, Perennial library, Harper & Row.

Deardorff, A. V. (1980): "The General Validity of the Law of Comparative Advantage," *Journal of Political Economy*, 88, 941–957.

Deaton, A. (1989): "Rice Prices and Income Distribution in Thailand: a Non-Parametric Analysis," *The Economic Journal*, 99, 1–37.

Dix-Carneiro, R., P. K. Goldberg, C. Meghir, and G. Ulyssea (2021): "Trade and Informality in the Presence of Labor Market Frictions and Regulations," NBER Working Paper 28391.

Dix-Carneiro, R. and B. K. Kovak (2019): "Margins of Labor Market Adjustment to Trade," *Journal of International Economics*, 117, 125–142.

Dixit, A. (1985): "Tax Policy in Open Economies," in *Handbook of Public Economics*, ed. by A. J. Auerbach and M. Feldstein, Elsevier, vol. 1, 313–374.

Djankov, S., R. La Porta, F. Lopez-de Silanes, and A. Shleifer (2002): "The regulation of entry," *The Quarterly Journal of Economics*, 117, 1–37.

Echevarria, C. (1997): "Changes in sectoral composition associated with economic growth," *International Economic Review*, 431–452.

Edmond, C., V. Midrigan, and D. Y. Xu (2015): "Competition, Markups, and the Gains from International Trade," *American Economic Review*, 105, 3183–3221.

——— (2018): "How Costly Are Markups?" NBER Working Paper 24800.

Epifani, P. and G. Gancia (2011): "Trade, markup heterogeneity and misallocations," *Journal of International Economics*, 83, 1 – 13.

Faber, B. and C. Gaubert (2019): "Tourism and Economic Development: Evidence from Mexico's Coastline," *American Economic Review*, 109, 2245–93.

Faccio, M. and L. Zingales (2017): "Political Determinants of Competition in the Mobile Telecommunication Industry," NBER Working Paper 23041.

Fafchamps, M. and C. Moser (2003): "Crime, isolation and law enforcement," *Journal of African economies*, 12, 625–671.

Fisman, R. and J. Svensson (2007): "Are corruption and taxation really harmful to growth? Firm level evidence," *Journal of Development Economics*, 83, 63–75.

Gadenne, L., T. K. Nandi, and R. Rathelot (2019): "Taxation and Supplier Networks: Evidence from India," Working Paper, University of Warwick.

Garcia-Santana, M. and J. Pijoan-Mas (2014): "The reservation laws in India and the misallocation of production factors," *Journal of Monetary Economics*, 66, 193 – 209.

Gaviria, A. (2002): "Assessing the effects of corruption and crime on firm performance: evidence from Latin America," *Emerging Markets Review*, 3, 245 – 268.

Ghosh, P., D. Mookherjee, D. Ray, et al. (2000): "Credit rationing in developing countries: an overview of the theory," *Readings in the theory of economic development*, 383–401.

Goldberg, P. and N. Pavcnik (2007): "Distributional Effects of Globalization in Developing Countries," *Journal of Economic Literature*, 45, 39–82.

Goldberg, P. K. and N. Pavcnik (2003): "The Response of the Informal Sector to Trade Liberalization," *Journal of Development Economics*, 72, 463–496.

Guner, N., G. Ventura, and Y. Xu (2008): "Macroeconomic implications of size-dependent policies," *Review of Economic Dynamics*, 11, 721 – 744.

Gupta, A. (2020): "Firm Heterogeneity, Demand for Quality and Prices: Evidence from India," Working Paper, Dartmouth.

Hallward-Driemeier, M. and L. Pritchett (2015): "How Business Is Done in the Developing World: Deals versus Rules," *Journal of Economic Perspectives*, 29, 121–40.

Haltiwanger, J., S. Scarpetta, and H. Schweiger (2014): "Cross country differences in job reallocation: The role of industry, firm size and regulations," *Labour Economics*, 26, 11 – 25.

Harrison, A. (1994): "Productivity, Imperfect Competition and Trade Reform: Theory and Evidence," *Journal of International Economics*, 36, 53–73.

Harrison, A. and A. Rodriguez-Clare (2010): "Trade, Foreign Investment, and Industrial Policy for Developing Countries," in *Handbook of Development Economics*, ed. by D. Rodrik and M. Rosenzweig, Amsterdam: Elsevier/North-Holland, vol. 5, chap. 63, 4039–4214.

Harrison, A. and J. Scorse (2010): "Multinationals and Anti-Sweatshop Activism," *American Economic Review*, 100, 247–273.

Hasan, R., D. Mitra, and K. Ramaswamy (2007): "Trade Reforms, Labor Regulations, and Labor-Demand Elasticities: Empirical Evidence from India," *Review of Economics and Statistics*, 89, 466–481.

Hayashi, F. and E. C. Prescott (2008): "The Depressing Effect of Agricultural Institutions on the Prewar Japanese Economy," *Journal of Political Economy*, 116, 573–632.

Head, K. and T. Mayer (2014): "Gravity Equations: Workhorse,Toolkit, and Cookbook," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, Elsevier, vol. 4.

Holmes, T. J., W.-T. Hsu, and S. Lee (2014): "Allocative efficiency, mark-ups, and the welfare gains from trade," *Journal of International Economics*, 94, 195 – 206.

Hopenhayn, H. and R. Rogerson (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *Journal of Political Economy*, 101, 915–938.

Hsieh, C.-T. and P. J. Klenow (2009): "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 124, 1403–1448.

Hsieh, C.-T. and B. A. Olken (2014): "The Missing 'Missing Middle'," *Journal of Economic Perspectives*, 28, 89–108.

International Labor Organization (2021): "Statistics on the Informal Economy," Data retrieved from the ILOSTAT database, https://ilostat.ilo.org/topics/informality/.

Javervall, S. and R. Khoban (2020): "The Impact of Trade Liberalization in the Presence of Political Distortions," Working Paper, Stockholm University.

Jeong, H. and R. M. Townsend (2007): "Sources of TFP growth: occupational choice and financial deepening," *Economic Theory*, 32, 179–221.

Jha, S. (2015): "Financial Asset Holdings and Political Attitudes: Evidence from Revolutionary England," *Quarterly Journal of Economics*, 130, 1485–1545.

Khandelwal, A. K., P. K. Schott, and S.-J. Wei (2013): "Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters," *American Economic Review*, 103, 2169–2195.

King, R. G. and R. Levine (1993): "Finance and Growth: Schumpeter Might Be Right," *The Quarterly Journal of Economics*, 108, 717–737.

Krishna, P. and D. Mitra (1998): "Trade liberalization, market discipline and productivity growth: new evidence from India," *Journal of Development Economics*, 56, 447 – 462.

Krueger, A. O. (1984): "Trade Policies in Developing Countries," in *Handbook of International Economics, Volume 1*, ed. by R. W. Jones and P. B. Kenen, Amsterdam: North-Holland.

La Porta, R. and A. Shleifer (2014): "Informality and Development," *Journal of Economic Perspectives*, 28, 109–26.

Lane, N. (2020): "The new empirics of industrial policy," *Journal of Industry, Competition and Trade*, 20, 209–234.

Lenzen, M., K. Kanemoto, D. Moran, and A. Geschke (2012): "Mapping the Structure of the World Economy," *Environmental Science & Technology*, 46, 8374–8381.

Leone, F., R. Macchiavello, and T. Reed (2021): "The Falling Price of Cement in Africa," CEPR Discussion Paper 16253.

Levinsohn, J. (1993): "Testing the Imports-as-Market-Discipline Hypothesis," *Journal of International Economics*, 35, 1–22.

Levy, S. (2008): *Good Intentions, Bad Outcomes: Social Policy, Informality, and Economic Growth in Mexico*, Brookings Institution Press.

Lipsey, R. and K. Lancaster (1956): "The General Theory of Second Best," *Review of Economic Studies*, 24, 11–32.

LU, Y. AND L. YU (2015): "Trade Liberalization and Markup Dispersion: Evidence from China's WTO Accession," *American Economic Journal: Applied Economics*, 7, 221–53.

MARTIN, L. A., S. NATARAJ, AND A. E. HARRISON (2017): "In with the Big, Out with the Small: Removing Small-Scale Reservations in India," *American Economic Review*, 107, 354–86.

MATSUYAMA, K. (1992): "Agricultural productivity, comparative advantage, and economic growth," *Journal of economic theory*, 58, 317–334.

MCCAIG, B. AND N. PAVCNIK (2018): "Export Markets and Labor Allocation in a Low-Income Country," *American Economic Review*, 108, 1899–1941.

MCMILLAN, J. AND C. WOODRUFF (1999): "Interfirm Relationships and Informal Credit in Vietnam," *The Quarterly Journal of Economics*, 114, 1285–1320.

MEGHIR, C., R. NARITA, AND J.-M. ROBIN (2015): "Wages and Informality in Developing Countries," *American Economic Review*, 105, 1509–46.

MELITZ, M. J. (2003): "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, 71, 1695–1725.

MIDRIGAN, V. AND D. Y. XU (2014): "Finance and Misallocation: Evidence from Plant-Level Data," *American Economic Review*, 104, 422–58.

MRÁZOVÁ, M. AND J. P. NEARY (2018): "Selection Effects with Heterogeneous Firms," *Journal of the European Economic Association.*

NATARAJ, S. (2011): "The Impact of Trade Liberalization on Productivity: Evidence from India's Formal and Informal Manufacturing Sectors," *Journal of International Economics*, 85, 292–301.

NUNN, N. (2007): "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," *Quarterly Journal of Economics*, 122, 569–600.

NUNN, N. AND D. TREFLER (2014): "Domestic Institutions as a Source of Comparative Advantage," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, Amsterdam: Elsevier/North-Holland, vol. 4, chap. 5, 263–315.

OLKEN, B. A. AND R. PANDE (2012): "Corruption in Developing Countries," *Annual Review of Economics*, 4, 479–509.

PASCALI, L. (2017): "The Wind of Change: Maritime Technology, Trade, and Economic Development," *American Economic Review*, 107, 2821–2854.

PAVCNIK, N. (2002): "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *The Review of Economic Studies*, 69, 245–276.

——— (2017): "The Impact of Trade on Inequality in Developing Countries," in *The Jackson Hole Economic Policy Symposium Proceedings: Fostering A Dynamic Global Economy*, Federal Reserve Bank of Kansas City.

PONCZEK, V. AND G. ULYSSEA (2020): "Enforcement of Labor Regulation and the Labor Market Effects of Trade: Evidence from Brazil," Working Paper, UCL.

Porto, G. (2006): “Using Survey Data to Assess the Distributional Effects of Trade Policy,” *Journal of International Economics*, 70, 140–160.

Puga, D. and D. Trefler (2014): “International Trade and Institutional Change: Medieval Venice’s Response to Globalization,” *Quarterly Journal of Economics*, 129, 753–821.

Rajan, R. and L. Zingales (1998): “Financial development and growth,” *American Economic Review*, 88, 559–586.

Rappoport, V., S. Federico, and F. Hassan (2019): “Trade shocks and credit reallocation,” Working Paper, CEP.

Rauch, J. E. (1991): “Modelling the informal sector formally,” *Journal of Development Economics*, 35, 33 – 47.

Restuccia, D. and R. Rogerson (2008): “Policy distortions and aggregate productivity with heterogeneous establishments,” *Review of Economic Dynamics*, 11, 707 – 720.

Ruggieri, A. (2019): “Trade and Labor Market Institutions: A Tale of Two Liberalizations,” Working Paper, University of Nottingham.

Sequeira, S. (2016): “Corruption, Trade Costs, and Gains from Tariff Liberalization: Evidence from Southern Africa,” *American Economic Review*, 106, 3029–3063.

Shleifer, A. and R. W. Vishny (1993): “Corruption,” *The Quarterly Journal of Economics*, 108, 599–617.

Song, Z., K. Storesletten, and F. Zilibotti (2011): “Growing Like China,” *American Economic Review*, 101, 196–233.

Startz, M. (2018): “The Value of Face-to-Face: Search and Contracting Problems in Nigerian Trade,” Working Paper, Dartmouth.

Svensson, J. (2003): “Who Must Pay Bribes and How Much? Evidence from a Cross Section of Firms,” *The Quarterly Journal of Economics*, 118, 207–230.

——— (2005): “Eight questions about corruption,” *Journal of Economic Perspectives*, 19, 19–42.

Tanaka, M. (2019): “The Impact of Exporting on Factory Working Conditions in Myanmar,” Working Paper, Hitotsubashi University.

Tian, Y. (2019): “International Trade Liberalization and Domestic Institutional Reform: Effects of WTO Accession on Chinese Internal Migration Policy,” Working Paper, Carnegie Mellon.

Tørsløv, T. R., L. S. Wier, and G. Zucman (2018): “The missing profits of nations,” NBER working paper 24701.

Ulyssea, G. (2018): “Firms, Informality, and Development: Theory and Evidence from Brazil,” *American Economic Review*, 108, 2015–2147.

Ventura, J. (1997): “Growth and Interdependence,” *The Quarterly Journal of Economics*, 112, 57–84.

Verhoogen, E. (2020): “Firm-Level Upgrading in Developing Countries,” CDEP-CGEG working paper no. 83.

Winters, L. A., N. McCulloch, and A. McKay (2004): "Trade Liberalization and Poverty: The Evidence So Far," *Journal of Economic Literature*, 42, 72–115.

World Bank (2021a): "Enterprise Surveys," Data retrieved from the World Bank Microdata Library, https://microdata.worldbank.org/index.php/catalog/enterprise_surveys.

——— (2021b): "Doing Business: Measuring Business Regulations," Data retrieved from the World Bank Doing Business database on enforcing contracts, https://www.doingbusiness.org/en/data/exploretopics/enforcing-contracts.

World Integrated Trade Solution (2021): "MFN Weighted Average Tariff Rates," Data retrieved from the WITS database on tariff rates, https://wits.worldbank.org/country-indicator.aspx?lang=en.

Appendices (Not Intended for Publication)

A Measuring Distortions

A.1 Regulations, corruption and crime

Our first regulation and bribery distortion measure simply documents bribe payments (deliberately asked about peer firms in order to encourage honest answers):

> *We've heard that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services, etc. On average, what percent of total annual sales do establishments like this one pay in informal payments or gifts to public officials for this purpose?*

The average firm in our data reports that bribes of this sort correspond to 0.7% of sales in a peer firm.[1] We take this value to be representative of the respondent firm itself.

As highlighted in the literature, firms may also spend considerable resources on the directly unproductive activity of complying with regulations. An attempt to measure such resource costs is asked in WBES too:

> *In a typical week, what percentage of total senior management's time was spent in dealing with requirements imposed by government regulations?*

We transform this into a share of sales by multiplying this percentage by the management wage bill as a share of total sales obtained from the WBIC surveys (World Bank, 2021a).[2,3] On average, a cost equivalent of 0.4% of sales is devoted towards the attention that a firm's senior management pays to its regulation requirements.

[1] Recall that all statistics incorporate survey sampling weights and are sales-weighted averages across firms within countries that are then averaged across countries in an unweighted manner.

[2] When this statistic (management wages as a percent of sales) is not available for a particular firm or even a whole country, we impute it using observations from other firms and countries. Here, and elsewhere in our analysis, we use the following imputation algorithm. If available, we replace the missing value with the average value for the same firm size bin, the same industry, the same World Bank income group and the same geographic region. If that average is also missing, we drop the region restriction, or, failing that, we drop the income-group restriction while retaining the region restriction. If an average is still missing, we take averages over the following groups, in order, until we obtain a non-missing average: firm size-country; firm size-income group-region; firm size-income group; firm size-region.

[3] Management wages comprise 28% of the firm wage bill or 10% of firm sales for the average firm, a number that decreases in firm size (35% of wage bill for firms with under 10 employees and 22% of wage bill for firms with over 100 employees).

Finally, turning to crime, the WBES directly asks firms about their encounters with theft, etc., (both at the establishment and in transit) as well as the costs of avoiding such theft through the use of security payments and resources (another activity that we treat as directly unproductive):

What are the estimated losses as a result of theft, robbery, vandalism or arson that occurred on establishment's premises calculated as a percent of annual sales?

What percent of the consignment value of products this establishment shipped (to domestic and export markets separately) was lost while in transit because of theft?

What percent of its total annual sales is paid for security,?

Theft, which we take to be the sum of the first question and the two components of the second question, and preventing theft via security cause distortions that are equal to a striking 5.2% and 2.9% of firms' total sales, respectively. These losses occur primarily on the firm's premises rather than in transit. Tables A.1 and A.2 summarize the global distribution of each of these various regulation and crime distortions, respectively, that we extract from the WBES.

Seventeen countries have WBES surveys covering informal firms. Across all industries and countries, the percent of sales lost due to on-site and in-transit theft is 0.5% for informal firms (versus 4.8% for formal firms). Similarly, security spending equals 2.8% of annual sales for formal firms, but only 0.1% for informal firms. Distortions due to bribes paid, while equal to 0.7% of formal firms' sales, amount to only 0.01% of sales for informal firms.

Tables A.3 and A.4 display the distribution of the combined regulations and crime distortions (i.e. the sum of the two and four separate sources of distortion described above, respectively), across country income groups and regions. The regulations and crime distortions equal 1% and 8% of firm sales on average, respectively, but vary considerably with country income (ranging from 2% of sales for low-income countries to 0.5% of sales for high-income countries for the regulation distortion and from 14% of sales for low-income countries to 5% of sales for high-income countries for the crime distortion). Crime distortions are highest in Sub-Saharan Africa, at 12% of sales, compared to only 5% of sales in Latin America and the Caribbean. Tables A.3 and A.4 further distinguish the size of the output distortion by firm size and trading behavior—two relevant characteristics when thinking about the effects of trade on allocative efficiency—as well as by informality as discussed above. Similar regulation distortions are faced regardless of firm type. Smaller firms face outsized

Table A.1: Components of regulation distortions

	Mean	10th percentile	90th percentile
Bribes paid	0.0068	0.0000	0.0188
Time spent w/ regulations	0.0040	0.0000	0.0108

Notes: All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys within countries that are then averaged across countries in an unweighted manner. See Section 3.1.1 for descriptions of how the various distortion components are measured.

Table A.2: Components of crime distortions

	Mean	10th percentile	90th percentile
Theft	0.0425	0.0009	0.1053
Theft during transit: domestic	0.0093	0.0000	0.0156
Theft during transit: exports	0.0005	0.0000	0.0000
Security spending	0.0289	0.0005	0.0700

Notes: All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys within countries that are then averaged across countries in an unweighted manner. See Section 3.1.1 for descriptions of how the various distortion components are measured.

sales distortions; the smallest firms (fewer than 20 employees) have an average sales distortion of 11% of sales, while the largest firms (over 100 employees) face an average distortion of 7%. Crime distortions vary to a lesser extent for exporting versus non-exporting firms, as well as importing versus non-importing firms. But, as with the averages across all firms, these differences by firm type mask substantial heterogeneity across countries (and across industries). Appendix Table B.1 presents summary statistics separately for each country.

A.2 Markups

To convert the answers to WBES questions plausibly related to markups into estimates of markups, we draw on the firm-level Indian markup estimates of De Loecker et al. (2016) (dLGKP) described in the main text. Note that WBES firms typically report substantial non-markup sales distortions, as detailed above, which would appear as markups in the cost-minimization method. The same is true for input distortions (discussed below). Thus, in the first step, we transform the firm-specific markup estimates from the last year (2001) covered by the estimates in dLGKP into a 'pure' markup

Table A.3: Regulation distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.011	0.000	0.012	0.010	0.010	0.011	0.010	0.011	0.011	0.011
Low-income	0.018	0.001	0.022	0.015	0.015	0.019	0.018	0.018	0.019	0.015
Lower-middle-income	0.013	0.000	0.014	0.014	0.012	0.014	0.011	0.014	0.013	0.013
Upper-middle-income	0.008	0.000	0.008	0.007	0.009	0.007	0.006	0.008	0.007	0.009
High-income	0.005	0.000	0.006	0.003	0.004	0.006	0.004	0.006	0.005	0.004
East Asia and Pacific	0.016	0.000	0.009	0.023	0.018	0.015	0.014	0.016	0.014	0.018
Europe and Central Asia	0.009	0.000	0.010	0.008	0.009	0.010	0.007	0.010	0.009	0.011
Latin America and Caribbean	0.006	0.000	0.007	0.006	0.006	0.007	0.005	0.007	0.006	0.006
Middle East and North Africa	0.008	0.000	0.009	0.010	0.007	0.009	0.005	0.010	0.010	0.005
South Asia	0.015	0.000	0.014	0.014	0.012	0.017	0.010	0.018	0.020	0.013
Sub-Saharan Africa	0.013	0.000	0.018	0.009	0.010	0.014	0.014	0.013	0.014	0.011

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm average as a share of sales by small and large firms, by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.1.1 for descriptions of how the sales distortions are measured.

Table A.4: Crime distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.081	0.008	0.109	0.067	0.071	0.086	0.073	0.084	0.086	0.071
Low-income	0.135	0.015	0.162	0.110	0.152	0.129	0.135	0.134	0.138	0.123
Lower-middle-income	0.087	0.010	0.130	0.069	0.077	0.091	0.074	0.093	0.095	0.075
Upper-middle-income	0.065	0.004	0.084	0.059	0.054	0.071	0.046	0.070	0.070	0.055
High-income	0.048	0.002	0.062	0.042	0.041	0.052	0.037	0.051	0.048	0.046
East Asia and Pacific	0.074	0.006	0.097	0.061	0.078	0.072	0.048	0.080	0.075	0.071
Europe and Central Asia	0.056	0.003	0.061	0.055	0.045	0.063	0.040	0.060	0.058	0.052
Latin America and Caribbean	0.051	0.003	0.078	0.044	0.040	0.057	0.039	0.055	0.056	0.040
Middle East and North Africa	0.092	0.006	0.140	0.071	0.076	0.101	0.062	0.103	0.098	0.081
South Asia	0.079	0.005	0.123	0.051	0.053	0.093	0.064	0.085	0.094	0.069
Sub-Saharan Africa	0.124	0.016	0.155	0.100	0.124	0.124	0.118	0.126	0.132	0.105

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm average as a share of sales by small and large firms, by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.1.1 for descriptions of how the sales distortions are measured.

by removing these other distortions (with the value of each distortion obtained from merging in sales-weighted averages of the relevant distortion in the WBES dataset for firms of the same type based on combinations of firm size, exports and industry).[4] In the second step, we collapse these pure markups into sales-weighted averages for each firm size-export status-industry bin and regress them on responses to the following questions from the WBES survey for India, averaged using sales weights over the same bin:

> *Do you think that the practices of competitors in the informal sector are No Obstacle, a Minor Obstacle, a Moderate Obstacle, a Major Obstacle, or a Very Severe Obstacle (coded 0-4, increasing in severity) to the current operations of this establishment?*
>
> *For the main market in which this establishment sold its main product/service, how many competitors did the main product/service face?*

In the final step, we use the coefficients from this prediction regression to transform answers to these two questions in all WBES surveys, not just India's, to markup estimates.

Substantial measurement error in these types of question will generate attenuation bias in our prediction regressions, which would lead us to understate true heterogeneity across firms in our predicted values. To mitigate this issue—here and in the additional prediction regressions below—we use a split-sample IV strategy. Specifically, rather than regressing our markup estimates on WBES averages for a particular bin, we calculate WBES averages using only half the firms in the bin and instrument these averages with those calculated using the other half of firms in the bin. Assuming measurement error is uncorrelated across firms, this IV strategy addresses attenuation bias. As expected, coefficients become larger in magnitude and the variance of predicted markups rises. The regression output can be found in Appendix Table A.5.

[4]Specifically, for any firm we set the estimated pure markup, denoted $\breve{\mu}$, to be $\ln \breve{\mu} = \ln \mu_{dLGKP} + \ln(1 - \mu^Y) - \ln(1 + \mu^{input})$, where μ_{dLGKP} is the markup reported in De Loecker et al. (2016), and μ^Y and μ^{input} are (group averages of) other *ad valorem* distortions on outputs and inputs, respectively.

Table A.5: Predicted markup

	(1) Log markup
Severity of obstacle = informal sector (0-4)	-0.080
	(0.096)
Log. no. competitors	-0.059
	(0.018)
Constant	0.530
	(0.094)
Cragg-Donald Wald F statistic	25.64
R^2	0.239
N	41

Notes: The estimation includes all firms present in the WBES formal firm surveys for India; all observations are sales-weighted. Firms are collapsed into firm size-exporter status-industry bins for a split-sample IV regression. Firm size is proxied by within-industry sales tercile. See Section 3.1.2 for descriptions of how the markup distortions is measured.

As shown in Table A.6, these predicted markup values average 0.368 (i.e. prices are 37 percent of sales) across all countries. In the aggregate, estimated markup variation is somewhat limited. Markups appear to decrease in country income—from 0.389 for low-income countries to 0.363 for high-income countries—and are highest in Latin America and the Caribbean (0.402) and lowest in Europe and Central Asia (0.308). In aggregate, markups vary little with firm size and export status, but they are smaller for informal firms (0.210) for firms in nontradable sectors (0.334) . However, these aggregates mask substantial heterogeneity across firms within countries, with markups at the 10th percentile as low as 0 and as high as 100% at the 90th percentile.

As expected from the fact that our prediction regression used their estimates as the dependent variable, aggregate differences in Indian markups by firm size and export status line up well with dLGKP. Appendix Table A.7 reports markup variation for India using both the firm-level markups in their paper, the 'pure markups' adjusted for other distortions, and the markups derived from WBES data for firms in the same industries covered by dLGKP (but here as a multiplicative markup over costs for comparison with their numbers). Comparing firms below and above median sales, we find higher average markups for larger firms (1.31 versus 1.47 compared to 1.26 and 1.49 using the

Table A.6: Markups by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.368	0.210	0.368	0.366	0.373	0.366	0.353	0.374	0.385	0.334
Low-income	0.389	0.217	0.392	0.379	0.376	0.393	0.372	0.396	0.414	0.309
Lower-middle-income	0.358	0.209	0.356	0.358	0.378	0.350	0.340	0.367	0.388	0.318
Upper-middle-income	0.370	0.210	0.380	0.366	0.357	0.376	0.353	0.374	0.382	0.344
High-income	0.363	0.206	0.332	0.374	0.388	0.346	0.361	0.363	0.356	0.382
East Asia and Pacific	0.401	0.225	0.430	0.377	0.394	0.404	0.359	0.412	0.435	0.344
Europe and Central Asia	0.308	0.175	0.278	0.329	0.341	0.289	0.352	0.297	0.290	0.351
Latin America and Caribbean	0.402	0.228	0.424	0.385	0.384	0.410	0.354	0.417	0.426	0.346
Middle East and North Africa	0.334	0.180	0.320	0.335	0.379	0.307	0.356	0.325	0.321	0.356
South Asia	0.371	0.226	0.373	0.392	0.405	0.353	0.352	0.379	0.446	0.323
Sub-Saharan Africa	0.386	0.224	0.394	0.374	0.377	0.390	0.351	0.403	0.421	0.304

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm average of markups as a share of sales by small and large firms, by export and import status, and by tradable and non tradable sector. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.1.2 for descriptions of how the markups are measured.

pure dLGKP markups). Comparing exporters and non exporters, markups are substantially higher for exporters (1.59 versus 1.35 compared to 1.50 and 1.30 using dLGKP) in the Indian sample.

A.3 Capital input distortions

We draw on a rich set of questions about the borrowing behavior of firms in the WBIC surveys to arrive at measures of a capital distortion for each of our WBES firms. To begin, we use the actual interest rates that WBIC firms report on their loans and/or overdraft, as well as information on the amount of collateral required and the loan duration, to predict a "base rate" for each country-industry-firm size group as the rate of a loan with the average collateral requirement (100%) and average duration (3.5 years).[5] Specifically, we regress the WBIC interest rate on the following two variables:

What is the duration (term) of the loan?

Did the financing require collateral or a deposit? What was the approximate value of the collateral required as a percentage of the loan value?

Furthermore, we include firm size-country-industry fixed effects with the regression coefficients reported in Appendix Table A.8. Our base rate is then the predicted value for a firm in a particular

[5] In cases where firms report that they were unable to take out a loan due to credit collateral constraints or high interest rates we top-code them with the 90th percentile values of interest rate, loan duration, and collateral requirement.

Table A.7: Indian Markups: comparison to De Loecker et al., 2016

	All Firms	Firm Size		Exporter	
		Small	Large	Yes	No
dLGKP markup values	2.027	1.626	2.072	2.080	1.714
Adjusted dLGKP markups	1.472	1.263	1.494	1.501	1.300
WBES markups	1.451	1.312	1.468	1.589	1.353

Notes: Markup values are trimmed for outliers at the 10th and 90th percentiles in the de Loecker et al. (2016) data. Firm size for this comparison is determined by within-industry sales tercile: small firms are those in the lowest tercile; large firms are those in the highest tercile. All statistics incorporate survey sampling weights and are sales-weighted averages of firms. Adjusted markups are those which have been adjusted to account for the intermediate input and output distortions. See Section 3.1.2 for descriptions of how the markups are measured.

firm size-country-industry putting down 100% collateral and borrowing for 3.5 years.

We match these base rate values to the WBES data on the basis of the aforementioned firm size-country-industry groups. Finally, we project the WBES question concerning each firm's self-reported qualitative experience with access to finance in order to convert the qualitative answers to that question into a quantitative estimate of the interest rate that each firm would pay on a base-rate loan. Again, we perform a split-sample IV regression to reduce attenuation bias, where groups are defined by the firm size-country-industry bins already in use.[6] This regression output is shown in Appendix Table A.9. This value is then our measure of the capital input distortion faced by each firm.[7] The average capital distortion, across countries and industries, is 17%, but variance across countries is high (Table A.10). There is considerable income group and regional variation. Low-income countries have the highest capital distortions, at 21% of annual sales, while high-income countries face capital distortions of 14%. The lowest capital distortions are present in East Asia and the Pacific and Europe and Central Asia, 14% each; Sub-Saharan Africa has an average capital distortion of just over 20%. Capital distortions are larger for small firms (20%) than large firms (16%); they are about 1% higher for non-exporting and non-importing firms,

[6]Specifically, this qualitative question asked firms to report (using a 0-4 scale, increasing in severity) on the the extent to which "access to financing, which includes availability and cost, is an obstacle to the current operations of this establishment".

[7]While our "capital" input actually corresponds to all primary factors the firm might use other than labor, it seems that many candidates (such as land, to the extent that it is purchased or rented over long-lived leases) may incur similar financing constraints as would true capital.

compared to exporting and importing firms respectively, and 2% higher for tradeable sectors than nontradeable; similarly, they are much larger for informal firms (22%) (Table A.10). See Appendix Table B.1 for country-level capital distortions.

Table A.8: Predicted base loan rate

	(1) Loan base rate
Loan duration (yrs.)	0.963
	(0.216)
Missing: loan duration	4.901
	(2.814)
Collateral required (% of loan)	0.011
	(0.008)
Missing: collateral required	1.459
	(2.805)
Firm size - country - industry FE	Yes
R^2	0.343
N	2814

Notes: The estimation includes all firms present in the WBIC surveys which either reported taking out a line of credit or overdraft or being unable to due so due to collateral or interest rate burdens (and thus were top-coded). Observations are weighted such that all countries receive equal weight, while employing sales and sampling weights within each country. See Section 3.2.1 for descriptions of how the capital distortion is measured.

A.4 Labor input distortions

We merge the state-level labor regulation wedges in Amirapu and Gechter (2020) into our WBES data for Indian firms sized between 10 and 99 employees. We then project these distortions on the following qualitative WBES question concerning the severity of the obstacle that labor regulations pose, grouped at the state level within India. From this, we obtain predicted values that serve as our firm-level labor distortions:

> *Please tell us if labor regulations are a problem for the operation and growth of your business. Please judge its severity as an obstacle (0-4, increasing in severity).*

Table A.9: Predicted capital distortions

	(1) Base loan rate
Severity of obstacle = access to finance (0-4)	10.389
	(1.974)
Constant	3.651
	(2.771)
Cragg-Donald Wald F statistic	458.81
R^2	0.089
N	297

Notes: The estimation includes all firms present in the WBES surveys; sampling and sales weights are used. Firms are collapsed into firm size-industry-region bins for a split-sample IV regression. See Section 3.2.1 for descriptions of how the capital distortion is measured.

Table A.10: Capital distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.170	0.219	0.197	0.158	0.167	0.171	0.163	0.172	0.175	0.159
Low-income	0.207	0.269	0.223	0.205	0.218	0.204	0.201	0.210	0.212	0.191
Lower-middle-income	0.168	0.219	0.215	0.153	0.162	0.171	0.162	0.171	0.177	0.156
Upper-middle-income	0.166	0.211	0.186	0.152	0.168	0.165	0.156	0.169	0.171	0.156
High-income	0.142	0.182	0.162	0.134	0.140	0.144	0.131	0.145	0.142	0.141
East Asia and Pacific	0.137	0.178	0.152	0.130	0.129	0.140	0.117	0.142	0.145	0.123
Europe and Central Asia	0.138	0.174	0.155	0.135	0.141	0.136	0.136	0.138	0.136	0.142
Latin America and Caribbean	0.175	0.228	0.200	0.155	0.186	0.170	0.156	0.181	0.177	0.171
Middle East and North Africa	0.179	0.213	0.193	0.182	0.184	0.177	0.164	0.185	0.182	0.175
South Asia	0.170	0.210	0.222	0.150	0.154	0.179	0.171	0.169	0.158	0.177
Sub-Saharan Africa	0.203	0.267	0.246	0.181	0.190	0.208	0.192	0.208	0.217	0.171

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm averages of cost of capital by small and large firms, by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.2.1 for descriptions of how the capital distortion is measured.

Table A.11: Predicted labor distortions

	(1) Labor wedge
Severity of obstacle = labor regulation (0-4)	0.096
	(0.108)
Constant	0.132
	(0.134)
Cragg-Donald Wald F statistic	593.82
R^2	0.047
N	18

Notes: The estimation includes all firms present in the WBES surveys in India; sampling and sales weights are used. Firms are collapsed into state-level bins for a split-sample IV regression. See Section 3.2.2 for descriptions of how the labor distortion is measured.

As for markups and materials distortions, we once again use a split sample IV to deal with attenuation bias. Appendix Table A.11 reports the coefficients of this regression. The global average value of $\mu^L - 1$ for a firm is 24% (see Table A.12). It increases slightly with firm size, at 25% for large firms, compared to 23% for small firms, as well as with trading activity. On average, the size of the distortion is flat across income groups, although it rises slightly for the few high income countries in our sample (27% compared to 23% for the lowest-income group). In terms of regional variation, the size of the distortion is largest for Latin America and the Caribbean at 27% and smallest for the Middle East and North Africa (22%).

A.5 Intermediate input distortions

We build our estimates of μ^M by drawing on the state-level variation in input-use distortions for India in Boehm and Oberfield (2020). Before matching these state-level measures to our WBES data for India, we first scale them to account for the fact that the distortions in Boehm and Oberfield (2020) are only identified up to a normalization . To do this, we use the country-level cost of contract enforcement (as a percent of contract values) in the World Bank Doing Business (WBDB) survey (World Bank, 2021b). We take a sales-weighted average of the distortions for each of the states in Boehm and Oberfield (2020) and scale this all-India average distortion so that it equals the ratio of the WBDB cost of contract enforcement for India (31%) to the lowest cost of

Table A.12: Labor distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.243	0.000	0.235	0.253	0.250	0.240	0.266	0.235	0.240	0.249
Low-income	0.232	0.000	0.219	0.246	0.230	0.233	0.263	0.220	0.231	0.235
Lower-middle-income	0.241	0.000	0.244	0.248	0.248	0.238	0.274	0.226	0.232	0.253
Upper-middle-income	0.238	0.000	0.236	0.250	0.251	0.232	0.252	0.235	0.235	0.245
High-income	0.268	0.000	0.237	0.280	0.266	0.270	0.273	0.267	0.271	0.261
East Asia and Pacific	0.239	0.000	0.246	0.258	0.264	0.228	0.292	0.225	0.222	0.267
Europe and Central Asia	0.228	0.000	0.213	0.234	0.243	0.220	0.240	0.225	0.234	0.214
Latin America and Caribbean	0.273	0.000	0.255	0.288	0.283	0.267	0.285	0.269	0.267	0.285
Middle East and North Africa	0.221	0.000	0.217	0.230	0.211	0.226	0.222	0.220	0.224	0.214
South Asia	0.249	0.000	0.243	0.253	0.259	0.243	0.280	0.236	0.224	0.265
Sub-Saharan Africa	0.240	0.000	0.241	0.242	0.236	0.242	0.269	0.227	0.238	0.245

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm averages of labor distortions as a share of the wagebill by small and large firms,by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.2.2 for descriptions of how the labor distortion is measured.

contract enforcement for any country (9%; Iceland), implying a zero intermediate input distortion for Iceland in doing so. We then scale each state-level value by the same factor. Matching to (state-level averages) of the WBES firm-level data for India, we then generate fitted values for the μ^M by projecting these distortions on the following WBES question:

> *Please tell us if courts are a problem for the operation and growth of your business. Please judge its severity as an obstacle (0-4, increasing in severity).*

Once again we use a split sample IV to deal with attenuation bias. This regression generates a predicted value of μ^M for each WBES firm; the regression output can be found in Appendix Table A.13.

The global average intermediate input distortion is equal to 20% (i.e. $\mu^M = 1.2$). Table A.14 displays the variation by income group, region and firm type. The intermediate input distortion is, on average, lower in higher income countries, although the total range is limited. Europe and Central Asia face the lowest distortion (19%), while Latin America and the Caribbean and South Asia face the highest (21%). Intermediate input distortions are significantly smaller for informal firms, which face an average input distortion of 16.8%; it is slightly larger for larger firms, as well as those that import and export. Appendix Table B.1 presents the country-level distortions.

Table A.13: Predicted intermediate input distortions

	(1) Material distortion (+1)
Severity of obstacle = courts (0-4)	0.028
	(0.092)
Constant	1.170
	(0.076)
Cragg-Donald Wald F statistic	280.67
R^2	-0.011
N	20

Notes: The estimation includes all firms present in the WBES surveys in India; sampling and sales weights are used. Firms are collapsed into state-level bins for a split-sample IV regression. See Section 3.2.3 for descriptions of how the intermediate input distortion is measured.

Table A.14: Intermediate input distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.200	0.168	0.197	0.203	0.203	0.199	0.206	0.198	0.200	0.201
Low-income	0.205	0.174	0.199	0.211	0.206	0.205	0.211	0.203	0.205	0.205
Lower-middle-income	0.203	0.170	0.203	0.205	0.208	0.201	0.209	0.200	0.202	0.204
Upper-middle-income	0.199	0.166	0.194	0.202	0.206	0.195	0.204	0.198	0.199	0.199
High-income	0.192	0.161	0.190	0.192	0.191	0.193	0.195	0.191	0.193	0.189
East Asia and Pacific	0.194	0.162	0.189	0.196	0.199	0.191	0.199	0.192	0.191	0.198
Europe and Central Asia	0.189	0.156	0.189	0.189	0.192	0.187	0.193	0.187	0.190	0.186
Latin America and Caribbean	0.210	0.175	0.202	0.213	0.215	0.208	0.216	0.208	0.209	0.213
Middle East and North Africa	0.194	0.162	0.192	0.193	0.193	0.194	0.193	0.194	0.195	0.192
South Asia	0.210	0.172	0.209	0.211	0.217	0.206	0.220	0.206	0.201	0.216
Sub-Saharan Africa	0.205	0.174	0.203	0.207	0.207	0.204	0.208	0.203	0.206	0.202

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm averages of distortions as a share of input costs by small and large firms, by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.2.3 for descriptions of how the intermediate input distortion is measured.

A.6 Electricity and other input distortions

We again begin by leveraging the firm-level information in the WBIC. This contains detailed questions on the price that each respondent firm paid for electricity, as well as its reliability, use of generators, etc. We first work only with firms who report that electricity provision is "no obstacle" to the operation of their business, and among such firms estimate a quality-adjusted price of electricity by estimating a hedonic regression of reported electricity prices (per kWh) on a number of variables related to electricity source (generator ownership and percent of electricity from a personal generator) and quality (number and duration of outages and sales lost from outages). Table A.15 reports the regression results.The difference between the actual price that all other firms report paying and their fitted values (from the estimated hedonic function) are then what we treat as each WBIC firm's electricity distortion (i.e. the price that they pay for a unit of quality-adjusted electricity, where we assume that in an undistorted market this price would be the same for all firms).

Finally, we map this quantitative measure for WBIC firms to the following qualitative measure:

> *Please tell us if electricity is a problem for the operation and growth of your business.*
> *Please judge its severity as an obstacle (0-4, increasing in severity),*

that is available for both WBIC and WBES firms by regressing the former on the latter (and interpreting the answer of "no obstacle" as $\mu^E = 1$). The regression output is found in Appendix Table A.16. The global average of $\mu^E - 1$ that we obtain is 11% (see Table A.17), but can be as high as 28% for the 12% of the sample who report that electricity poses a severe obstacle. The distortion falls with country income, from 14% of sales for low-income countries to 9% in high-income countries. Regional variation is similarly large: South Asia and Sub-Saharan Africa face average electricity distortions of 14%, compared to averages of 7% in Europe and Central Asia and 9% in East Asia and the Pacific. The electricity distortion is equal for formal versus informal firms (see Appendix Table B.1). Similarly, it is the same across firm size and trading activity (Table A.17).

Table A.15: Predicted electricity price

	(1) Electricity price
No. outages per year	-0.000
	(0.000)
Missing: no. outages	-0.053
	(0.094)
Avg. outage duration (hrs.)	0.003
	(0.002)
Missing: avg. outage duration	0.052
	(0.088)
% sales lost to outages	0.000
	(0.001)
Missing: sales lost to outages	-0.009
	(0.016)
Owns generator	-0.020
	(0.030)
% electricity from generator	-0.001
	(0.001)
Missing: % electricity from generator	-0.058
	(0.032)
Country FE	Yes
R^2	0.399
N	76

Notes: The estimation includes all firms present in the WBIC surveys for which electricity prices (per kilowatt-hour, 2009 USD) are reported and the firm reports that electricity is "no obstacle." Sampling and sales weights are used within countries; weights are normalized so that each country has equal weight. Country fixed effects are included. See Section 3.2.4 for descriptions of how the electricity distortion is measured.

Table A.16: Predicted electricity distortions

	(1) Electricity wedge (scaled)
Severity of obstacle = electricity (0-4)	0.062
	(0.102)
Country FE	Yes
R^2	0.004
N	268

Notes: The estimation includes all firms present in the WBES surveys in India; sampling and sales weights are used. See Section 3.2.4 for descriptions of how the electricity distortion is measured.

Table A.17: Electricity distortions by income-group, region and firm type

	Formal	Informal	Firm Size		Exporter		Importer		Tradable	
			Small	Large	Yes	No	Yes	No	Yes	No
World	0.113	0.102	0.115	0.113	0.112	0.113	0.128	0.108	0.109	0.121
Low-income	0.141	0.130	0.140	0.145	0.148	0.138	0.143	0.139	0.138	0.148
Lower-middle-income	0.122	0.106	0.124	0.125	0.120	0.123	0.132	0.117	0.114	0.132
Upper-middle-income	0.103	0.093	0.107	0.098	0.113	0.098	0.125	0.097	0.100	0.108
High-income	0.088	0.082	0.090	0.085	0.080	0.092	0.103	0.083	0.087	0.090
East Asia and Pacific	0.094	0.080	0.071	0.118	0.098	0.093	0.141	0.082	0.084	0.111
Europe and Central Asia	0.074	0.067	0.082	0.068	0.077	0.071	0.094	0.068	0.071	0.079
Latin America and Caribbean	0.120	0.108	0.124	0.115	0.134	0.113	0.126	0.118	0.119	0.122
Middle East and North Africa	0.112	0.102	0.133	0.098	0.096	0.121	0.102	0.116	0.116	0.105
South Asia	0.140	0.125	0.151	0.129	0.135	0.143	0.147	0.137	0.114	0.157
Sub-Saharan Africa	0.142	0.129	0.146	0.139	0.137	0.144	0.144	0.140	0.139	0.149

Notes: Country income groups based on World Bank classifications as of 2013. Columns 3-10 break out formal firm averages of electricity premiums by small and large firms,by export and import status, and by tradable versus not tradable. Small firms are those with under 20 employees; large firms are those with over 100 employees. All statistics incorporate survey sampling weights and are sales-weighted averages of firms in the WBES formal-sector surveys. Averages across countries within a region or income group are re-weighted to give each country equal weight. See Section 3.2.4 for descriptions of how the electricity input distortion is measured.

B Measuring Distortions: Summary Statistics by Country and Firm Type

Table B.1: Distortion summary statistics

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
World	0.011	0.076	0.024	0.103	0.353	0.169	0.253	0.197	0.109
Afghanistan	0.058	0.183	0.008	0.000	0.336	0.267	0.225	0.234	0.194
Albania	0.027	0.057	0.006	0.186	0.261	0.116	0.158	0.177	0.070
Algeria	0.007	0.101	0.030	0.161	0.314	0.173	0.211	0.194	0.111
Andorra	0.007	0.040	0.008	0.047	0.355	0.137	0.288	0.187	0.085
Angola	0.015	0.238	0.010	0.099	0.342	0.348	0.371	0.227	0.203
Antigua and Barbuda	0.002	0.053	0.019	0.148	0.404	0.221	0.311	0.200	0.129
Argentina	0.014	0.030	0.042	0.199	0.336	0.218	0.362	0.230	0.121
Armenia	0.006	0.063	0.006	0.168	0.309	0.216	0.184	0.175	0.026
Aruba	0.006	0.046	0.011	0.015	0.407	0.166	0.261	0.197	0.108
Australia	0.004	0.043	0.005	0.073	0.379	0.144	0.271	0.189	0.097
Austria	0.007	0.040	0.005	0.174	0.355	0.137	0.288	0.187	0.085
Azerbaijan	0.002	0.057	0.003	0.169	0.258	0.169	0.132	0.170	0.015
Bahamas, The	0.003	0.065	0.041	0.119	0.449	0.103	0.207	0.183	0.078
Bahrain	0.003	0.046	0.024	0.049	0.419	0.110	0.218	0.178	0.082
Bangladesh	0.006	0.043	0.041	0.143	0.365	0.196	0.190	0.210	0.139
Barbados	0.004	0.031	0.078	0.173	0.430	0.219	0.223	0.193	0.155
Belarus	0.009	0.039	0.036	0.184	0.316	0.133	0.192	0.177	0.072
Belgium	0.006	0.040	0.006	0.180	0.356	0.137	0.288	0.187	0.084
Belize	0.002	0.044	0.050	0.123	0.399	0.311	0.308	0.223	0.166
Benin	0.017	0.098	0.031	0.178	0.401	0.242	0.213	0.216	0.156

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Bermuda	0.004	0.043	0.027	-0.000	0.383	0.144	0.271	0.189	0.097
Bhutan	0.010	0.070	0.029	0.000	0.417	0.134	0.232	0.183	0.072
Bolivia	0.012	0.039	0.017	0.123	0.306	0.179	0.343	0.226	0.104
Bosnia and Herzegovina	0.008	0.041	0.023	0.156	0.272	0.155	0.212	0.199	0.038
Botswana	0.003	0.074	0.013	0.138	0.390	0.160	0.243	0.196	0.141
Brazil	0.009	0.061	0.031	0.448	0.311	0.243	0.415	0.231	0.136
British Virgin Islands	0.006	0.046	0.022	0.000	0.397	0.170	0.260	0.198	0.109
Brunei	0.004	0.043	0.014	-0.000	0.382	0.144	0.271	0.189	0.097
Bulgaria	0.018	0.033	0.004	0.186	0.290	0.108	0.232	0.187	0.039
Burkina Faso	0.007	0.074	0.027	0.168	0.331	0.330	0.314	0.227	0.183
Burundi	0.007	0.076	0.022	0.160	0.347	0.205	0.178	0.226	0.155
Cambodia	0.019	0.063	0.013	0.098	0.376	0.137	0.270	0.197	0.071
Cameroon	0.022	0.126	0.035	0.189	0.335	0.281	0.231	0.205	0.126
Canada	0.004	0.043	0.012	0.096	0.373	0.144	0.271	0.189	0.097
Cape Verde	0.003	0.064	0.030	0.148	0.439	0.141	0.229	0.218	0.125
Cayman Islands	0.007	0.046	0.012	0.000	0.402	0.170	0.259	0.199	0.107
Central African Republic	0.029	0.155	0.007	0.188	0.440	0.170	0.214	0.198	0.166
Chad	0.033	0.154	0.042	0.000	0.378	0.209	0.281	0.221	0.189
Chile	0.004	0.025	0.007	0.179	0.357	0.163	0.313	0.201	0.103
China	0.002	0.019	0.010	0.102	0.305	0.126	0.186	0.177	0.028
Colombia	0.005	0.031	0.062	0.129	0.315	0.178	0.286	0.207	0.113
Congo	0.013	0.144	0.028	0.187	0.350	0.217	0.275	0.209	0.148
Congo, Dem. Rep.	0.012	0.143	0.021	0.157	0.351	0.197	0.277	0.208	0.127

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Costa Rica	0.003	0.024	0.028	0.107	0.370	0.244	0.292	0.206	0.186
Croatia	0.015	0.040	0.024	0.235	0.335	0.128	0.224	0.196	0.014
Cuba	0.007	0.048	0.013	0.106	0.393	0.192	0.282	0.212	0.129
Cyprus	0.005	0.049	0.006	0.138	0.245	0.151	0.206	0.195	0.111
Czech Republic	0.016	0.045	0.010	0.185	0.285	0.179	0.261	0.195	0.133
Côte d'Ivoire	0.012	0.081	0.035	0.000	0.271	0.262	0.336	0.219	0.176
Denmark	0.006	0.040	0.005	0.242	0.348	0.138	0.288	0.187	0.085
Djibouti	0.006	0.114	0.030	0.000	0.270	0.144	0.217	0.196	0.157
Dominica	0.001	0.046	0.045	0.143	0.447	0.290	0.169	0.174	0.193
Dominican Republic	0.014	0.076	0.025	0.177	0.365	0.144	0.314	0.225	0.142
Ecuador	0.011	0.041	0.042	0.112	0.331	0.175	0.302	0.229	0.122
Egypt, Arab Rep.	0.010	0.149	0.057	0.126	0.304	0.155	0.216	0.185	0.103
El Salvador	0.007	0.069	0.033	0.123	0.362	0.150	0.250	0.217	0.097
Eritrea	0.001	0.130	0.005	0.000	0.474	0.062	0.137	0.170	0.012
Estonia	0.003	0.019	0.007	0.154	0.358	0.065	0.179	0.178	0.049
Eswatini	0.004	0.245	0.021	0.148	0.366	0.169	0.250	0.194	0.069
Ethiopia	0.003	0.063	0.070	0.117	0.210	0.186	0.243	0.185	0.174
Fiji	0.016	0.066	0.201	0.088	0.457	0.150	0.258	0.193	0.126
Finland	0.006	0.041	0.004	0.215	0.354	0.138	0.288	0.187	0.085
France	0.006	0.040	0.011	0.183	0.352	0.138	0.288	0.187	0.085
French Polynesia	0.004	0.043	0.010	0.187	0.381	0.144	0.271	0.189	0.097
Gabon	0.007	0.068	0.030	0.176	0.422	0.181	0.256	0.199	0.171
Gambia, The	0.027	0.086	0.024	0.000	0.347	0.269	0.261	0.190	0.207

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Georgia	0.003	0.060	0.014	0.165	0.307	0.134	0.142	0.179	0.070
Germany	0.006	0.039	0.007	0.164	0.361	0.136	0.287	0.187	0.084
Ghana	0.016	0.109	0.019	0.029	0.394	0.192	0.182	0.189	0.177
Greece	0.003	0.022	0.009	0.209	0.273	0.179	0.280	0.211	0.135
Greenland	0.006	0.040	0.007	0.242	0.342	0.138	0.288	0.188	0.085
Grenada	0.005	0.052	0.048	-0.000	0.406	0.177	0.266	0.202	0.098
Guatemala	0.009	0.061	0.024	0.115	0.350	0.167	0.249	0.217	0.124
Guinea	0.025	0.139	0.023	0.000	0.373	0.212	0.253	0.211	0.122
Guinea-Bissau	0.029	0.077	0.015	0.001	0.346	0.371	0.180	0.217	0.229
Guyana	0.004	0.049	0.044	0.098	0.416	0.147	0.191	0.210	0.144
Haiti	0.019	0.123	0.005	0.099	0.289	0.203	0.238	0.204	0.148
Honduras	0.021	0.131	0.017	0.000	0.349	0.159	0.292	0.235	0.117
Hong Kong	0.004	0.043	0.000	-0.000	0.386	0.144	0.271	0.189	0.097
Hungary	0.012	0.154	0.008	0.223	0.308	0.112	0.216	0.178	0.034
Iceland	0.006	0.040	0.025	0.176	0.346	0.139	0.288	0.188	0.086
India	0.004	0.042	0.009	0.117	0.321	0.136	0.237	0.190	0.090
Indonesia	0.013	0.100	0.009	0.094	0.326	0.126	0.203	0.183	0.070
Iran	0.009	0.104	0.040	0.045	0.273	0.220	0.232	0.192	0.140
Iraq	0.030	0.187	0.004	0.014	0.318	0.248	0.294	0.202	0.183
Ireland	0.006	0.041	0.005	0.146	0.352	0.139	0.288	0.187	0.085
Israel	0.002	0.057	0.027	0.150	0.439	0.074	0.211	0.175	0.019
Italy	0.003	0.060	0.007	0.182	0.337	0.142	0.271	0.184	0.093
Jamaica	0.002	0.038	0.014	0.183	0.499	0.173	0.239	0.192	0.120

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Japan	0.004	0.043	0.005	0.098	0.382	0.144	0.271	0.189	0.097
Jordan	0.003	0.067	0.042	0.154	0.330	0.225	0.230	0.188	0.049
Kazakhstan	0.009	0.123	0.027	0.119	0.282	0.109	0.187	0.186	0.065
Kenya	0.009	0.091	0.069	0.124	0.306	0.160	0.314	0.214	0.128
Kosovo	0.024	0.088	0.018	0.140	0.251	0.214	0.166	0.197	0.146
Kuwait	0.003	0.046	0.006	-0.001	0.423	0.109	0.211	0.178	0.083
Kyrgyz Republic	0.028	0.068	0.030	0.052	0.198	0.202	0.162	0.191	0.105
Lao PDR	0.038	0.051	0.016	0.000	0.430	0.161	0.216	0.187	0.116
Latvia	0.007	0.027	0.008	0.191	0.312	0.135	0.210	0.177	0.073
Lebanon	0.006	0.065	0.018	0.108	0.342	0.197	0.186	0.185	0.133
Lesotho	0.008	0.198	0.019	0.000	0.359	0.221	0.306	0.203	0.137
Liberia	0.025	0.170	0.020	0.001	0.342	0.223	0.218	0.202	0.168
Libya	0.009	0.093	0.000	-0.000	0.310	0.219	0.236	0.191	0.133
Liechtenstein	0.007	0.040	0.015	0.063	0.355	0.137	0.289	0.187	0.084
Lithuania	0.003	0.039	0.011	0.137	0.303	0.085	0.193	0.178	0.070
Luxembourg	0.007	0.039	0.002	0.157	0.368	0.135	0.291	0.186	0.083
Macao SAR	0.004	0.043	0.000	-0.000	0.384	0.144	0.271	0.189	0.097
Madagascar	0.019	0.096	0.032	0.000	0.402	0.179	0.215	0.191	0.103
Malawi	0.008	0.131	0.018	0.001	0.388	0.171	0.179	0.190	0.121
Malaysia	0.064	0.268	0.006	0.079	0.259	0.209	0.298	0.210	0.116
Maldives	0.008	0.054	0.039	0.059	0.340	0.166	0.244	0.198	0.110
Mali	0.042	0.111	0.026	0.000	0.313	0.292	0.387	0.237	0.186
Malta	0.004	0.048	0.013	0.148	0.366	0.126	0.225	0.186	0.128

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Mauritania	0.014	0.088	0.043	0.000	0.367	0.215	0.312	0.223	0.188
Mauritius	0.004	0.093	0.019	0.145	0.399	0.155	0.213	0.196	0.080
Mexico	0.008	0.040	0.032	0.155	0.373	0.177	0.300	0.236	0.169
Micronesia	0.007	0.100	0.068	0.000	0.443	0.136	0.217	0.199	0.103
Moldova	0.005	0.057	0.011	0.192	0.260	0.086	0.192	0.188	0.080
Monaco	0.007	0.040	0.008	0.148	0.351	0.137	0.288	0.187	0.085
Mongolia	0.016	0.059	0.009	0.093	0.257	0.196	0.180	0.176	0.074
Montenegro	0.008	0.043	0.005	0.129	0.327	0.162	0.185	0.181	0.049
Morocco	0.007	0.057	0.070	0.164	0.289	0.203	0.209	0.204	0.096
Mozambique	0.006	0.218	0.016	0.000	0.392	0.149	0.218	0.200	0.085
Myanmar	0.024	0.046	0.019	0.000	0.368	0.159	0.223	0.190	0.114
Namibia	0.008	0.075	0.012	0.143	0.407	0.159	0.210	0.187	0.066
Nepal	0.006	0.056	0.029	0.128	0.365	0.228	0.238	0.203	0.185
Netherlands	0.006	0.040	0.006	0.178	0.350	0.138	0.288	0.188	0.084
Netherlands Antilles	0.007	0.045	0.008	0.166	0.404	0.170	0.261	0.198	0.107
New Caledonia	0.004	0.043	0.013	-0.000	0.382	0.144	0.271	0.189	0.097
New Zealand	0.004	0.043	0.005	0.139	0.362	0.144	0.271	0.189	0.097
Nicaragua	0.007	0.056	0.030	0.000	0.327	0.170	0.270	0.213	0.115
Niger	0.042	0.122	0.008	0.067	0.309	0.217	0.233	0.195	0.170
Nigeria	0.039	0.221	0.014	0.065	0.315	0.176	0.225	0.189	0.142
North Korea	0.019	0.123	0.016	0.030	0.288	0.203	0.238	0.204	0.148
North Macedonia	0.007	0.039	0.021	0.121	0.243	0.161	0.190	0.191	0.103
Norway	0.006	0.040	0.009	0.221	0.353	0.138	0.288	0.187	0.085

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Oman	0.003	0.046	0.020	0.048	0.416	0.109	0.217	0.179	0.081
Pakistan	0.014	0.135	0.014	0.158	0.365	0.143	0.259	0.221	0.187
Panama	0.016	0.095	0.002	0.064	0.411	0.109	0.201	0.219	0.056
Papua New Guinea	0.015	0.058	0.066	0.000	0.303	0.096	0.239	0.211	0.163
Paraguay	0.010	0.042	0.039	0.087	0.302	0.148	0.291	0.215	0.118
Peru	0.011	0.035	0.031	0.171	0.326	0.157	0.314	0.221	0.071
Philippines	0.009	0.045	0.030	0.073	0.347	0.081	0.175	0.190	0.057
Poland	0.006	0.039	0.007	0.179	0.341	0.139	0.289	0.187	0.085
Portugal	0.008	0.027	0.009	0.192	0.351	0.133	0.258	0.200	0.175
Qatar	0.003	0.046	0.009	-0.001	0.415	0.110	0.218	0.179	0.080
Romania	0.008	0.037	0.031	0.129	0.286	0.170	0.260	0.196	0.088
Russian Federation	0.013	0.051	0.014	0.183	0.283	0.163	0.207	0.191	0.085
Rwanda	0.004	0.069	0.045	0.178	0.416	0.199	0.188	0.183	0.069
Samoa	0.007	0.089	0.009	-0.000	0.471	0.117	0.185	0.191	0.160
San Marino	0.007	0.040	0.007	-0.000	0.349	0.138	0.288	0.188	0.085
Sao Tome and Principe	0.013	0.143	0.019	0.000	0.353	0.220	0.274	0.210	0.148
Saudi Arabia	0.003	0.046	0.007	0.145	0.412	0.109	0.217	0.179	0.080
Senegal	0.007	0.090	0.013	0.194	0.371	0.223	0.243	0.211	0.163
Serbia	0.008	0.104	0.009	0.137	0.289	0.157	0.224	0.195	0.034
Seychelles	0.005	0.122	0.041	0.148	0.418	0.182	0.232	0.196	0.092
Sierra Leone	0.064	0.223	0.006	0.002	0.352	0.254	0.323	0.207	0.139
Singapore	0.004	0.043	0.000	0.070	0.386	0.144	0.271	0.189	0.097
Slovak Republic	0.010	0.056	0.007	0.186	0.376	0.158	0.283	0.189	0.067

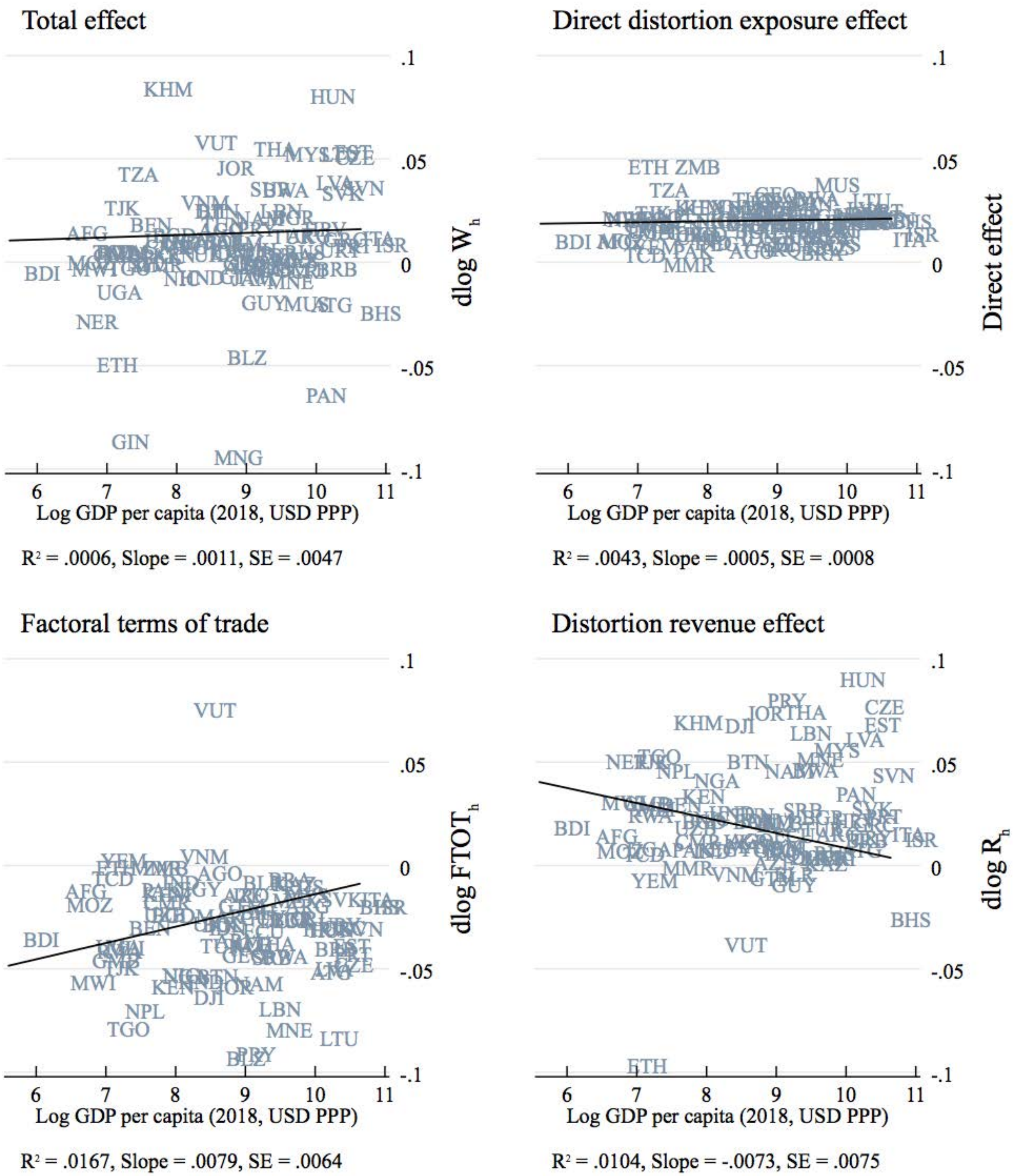
	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Slovenia	0.014	0.028	0.009	0.180	0.360	0.181	0.230	0.198	0.039
Solomon Islands	0.013	0.069	0.056	0.000	0.361	0.117	0.314	0.217	0.081
Somalia	0.020	0.133	0.017	0.000	0.370	0.217	0.238	0.204	0.142
South Africa	0.005	0.033	0.033	0.145	0.366	0.068	0.203	0.174	0.111
South Korea	0.004	0.043	0.029	0.099	0.383	0.144	0.271	0.189	0.097
South Sudan	0.044	0.132	0.016	0.000	0.352	0.273	0.245	0.203	0.201
Spain	0.007	0.040	0.006	0.172	0.352	0.140	0.289	0.188	0.085
Sri Lanka	0.007	0.053	0.041	0.090	0.392	0.147	0.267	0.190	0.083
St. Kitts and Nevis	0.005	0.039	0.038	0.000	0.404	0.228	0.237	0.192	0.155
St. Lucia	0.001	0.045	0.022	-0.000	0.445	0.236	0.235	0.193	0.174
St. Vincent and the Grenadines	0.003	0.052	0.043	-0.000	0.465	0.155	0.222	0.187	0.086
Sudan	0.005	0.128	0.005	0.000	0.377	0.177	0.274	0.198	0.074
Suriname	0.008	0.038	0.001	-0.000	0.355	0.220	0.323	0.232	0.088
Sweden	0.007	0.012	0.008	0.207	0.438	0.088	1.000	0.171	0.085
Switzerland	0.006	0.041	0.010	0.065	0.360	0.137	0.288	0.187	0.085
Syria	0.028	0.115	0.051	0.002	0.249	0.198	0.280	0.232	0.157
Taiwan	0.004	0.043	0.021	0.049	0.381	0.144	0.271	0.189	0.097
Tajikistan	0.022	0.186	0.008	0.177	0.270	0.226	0.257	0.179	0.115
Tanzania	0.007	0.158	0.046	0.177	0.348	0.260	0.349	0.225	0.157
Thailand	0.003	0.073	0.002	0.068	0.415	0.079	0.172	0.179	0.073
Timor-Leste	0.028	0.129	0.050	0.000	0.315	0.136	0.230	0.189	0.060
Togo	0.008	0.097	0.037	0.000	0.362	0.240	0.231	0.227	0.186
Tonga	0.008	0.116	0.080	-0.000	0.391	0.166	0.515	0.198	0.094

	Regulation	Crime	Imported input	Dom. tax	Markup	Capital	Labor	Intermed. input	Electricity
Trinidad and Tobago	0.012	0.043	0.073	0.124	0.360	0.208	0.256	0.203	0.071
Tunisia	0.013	0.043	0.072	0.154	0.348	0.128	0.180	0.177	0.053
Turkey	0.010	0.069	0.014	0.165	0.279	0.125	0.213	0.186	0.084
Turkmenistan	0.012	0.060	0.008	-0.000	0.306	0.152	0.188	0.185	0.065
UAE	0.003	0.045	0.012	0.047	0.414	0.109	0.216	0.179	0.081
UK	0.007	0.040	0.003	0.166	0.355	0.138	0.288	0.187	0.084
USA	0.004	0.043	0.035	0.080	0.380	0.144	0.271	0.189	0.097
Uganda	0.010	0.238	0.022	0.177	0.301	0.199	0.232	0.193	0.111
Ukraine	0.055	0.097	0.007	0.133	0.271	0.164	0.191	0.184	0.034
Uruguay	0.006	0.024	0.028	0.168	0.357	0.127	0.330	0.195	0.079
Uzbekistan	0.008	0.051	0.054	0.123	0.319	0.066	0.143	0.174	0.066
Vanuatu	0.003	0.089	0.174	0.000	0.426	0.211	0.269	0.195	0.097
Venezuela, RB	0.022	0.067	0.037	0.131	0.370	0.148	0.294	0.210	0.153
Vietnam	0.026	0.062	0.067	0.088	0.340	0.093	0.178	0.182	0.031
West Bank and Gaza	0.004	0.160	0.050	0.153	0.284	0.246	0.246	0.206	0.150
Yemen, Rep.	0.028	0.117	0.018	0.021	0.255	0.216	0.289	0.232	0.166
Zambia	0.012	0.256	0.020	0.158	0.346	0.198	0.264	0.195	0.092
Zimbabwe	0.009	0.089	0.062	0.114	0.313	0.234	0.275	0.196	0.110

Notes: All statistics are unweighted averages across countries and sales-weighted across the 26 EORA industries. These country-industry averages are calculated as sales-weighted and sampling-weighted averages of firms in the WBES formal-sector surveys within country-industry pairs. Values for non-WBES countries and industries are imputed as described in Sections 3.1 and 3.2.

C Additional Figures and Tables

Figure B.1: Welfare effects of a 10% reduction in import tariffs



Notes: The first panel of this figure reports the proportional welfare impacts, $d\log W_H$, associated with a 10% reduction in import tariffs t_H^{imp}, against GDP per capita for each country in our sample. The remaining three quadrants plot the three subcomponents of $d\log W_H$: the direct distortion exposure effect, the factoral terms of trade effect, and the distortion revenue effect defined in Section 2.2 against GDP per capita. Outliers removed for readability but included when reporting slope of line of best fit under each panel.

Table B.2: World Bank income groups of WBES sample countries

Income group	
Low	Afghanistan, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of the Congo, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Tajikistan, Togo, Uganda, Yemen, Rep.
Lower-middle	Angola, Bangladesh, Benin, Bhutan, Bolivia, Cambodia, Cameroon, Cape Verde, Congo, Côte d'Ivoire, Djibouti, Egypt, Arab Rep., El Salvador, Eswatini, Ghana, Honduras, India, Kenya, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Myanmar, Nepal, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Philippines, Senegal, Solomon Islands, Sri Lanka, Tanzania, Timor-Leste, Tunisia, Ukraine, Uzbekistan, Vanuatu, Vietnam, West Bank and Gaza, Zambia, Zimbabwe
Upper-middle	Albania, Argentina, Armenia, Azerbaijan, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, Fiji, Gabon, Georgia, Grenada Guatemala, Guyana, Indonesia, Iraq, Jamaica, Jordan, Kazakhstan, Kosovo, Lebanon, Libya, Malaysia, Mexico, Montenegro, Namibia, North Macedonia, Paraguay, Peru, Russian Federation, Samoa, Serbia, South Africa, St. Lucia, St. Vincent and the Grenadines, Suriname, Thailand, Tonga, Turkey, Venezuela
High	Antigua and Barbuda, The Bahamas, Barbados, Chile, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Israel, Italy, Latvia, Lithuania, Malta, Mauritius, Panama, Portugal, Romania, Slovak Republic, Slovenia, St. Kitts and Nevis, Sweden, Trinidad and Tobago, Uruguay

Table B.3: Welfare effects of a 10% reduction in technological import costs

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Afghanistan	0.0157	0.0136	-0.0056	0.0078
Albania	0.0238	0.0296	-0.0097	0.0038
Angola	0.0680	0.0663	0.0002	0.0015
Antigua	0.0462	0.0507	-0.0064	0.0019
Argentina	0.0475	0.0393	-0.0025	0.0107
Armenia	0.0445	0.0406	-0.0130	0.0169
Azerbaijan	0.0255	0.0301	-0.0049	0.0003
Bahamas	0.0246	0.0321	-0.0018	-0.0058
Bangladesh	0.0232	0.0200	-0.0065	0.0097
Barbados	0.0516	0.0517	-0.0071	0.0070
Belarus	0.1014	0.1460	0.0206	-0.0652
Belize	0.0384	0.0509	-0.0225	0.0099
Benin	0.0330	0.0258	-0.0100	0.0171
Bhutan	0.0474	0.0457	-0.0088	0.0105
Bolivia	0.0671	0.0645	-0.0042	0.0068
Bosnia and Herzegovina	0.0351	0.0370	0.0003	-0.0022
Botswana	0.0428	0.0369	-0.0076	0.0135
Brazil	0.0202	0.0196	-0.0022	0.0029
Bulgaria	0.0549	0.0778	-0.0119	-0.0110
Burundi	0.0211	0.0243	-0.0163	0.0131
Cambodia	0.0610	0.0425	-0.0014	0.0199
Cameroon	0.0321	0.0332	-0.0054	0.0043
Chad	0.0356	0.0186	0.0071	0.0099
Costa Rica	0.0372	0.0342	-0.0023	0.0053

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Croatia	0.0418	0.0493	-0.0006	-0.0069
Czech Republic	0.0378	0.0673	0.0136	-0.0430
Djibouti	0.0455	0.0350	-0.0182	0.0287
Dominican Republic	0.0256	0.0224	-0.0023	0.0054
Ecuador	0.0442	0.0449	-0.0069	0.0061
Egypt	0.0263	0.0213	-0.0007	0.0056
Eritrea	0.0489	0.0214	0.0083	0.0191
Estonia	-0.0198	0.0754	0.0375	-0.1327
Ethiopia	0.1525	0.1475	-0.0000	0.0051
Gambia	0.0276	0.0266	-0.0190	0.0201
Georgia	0.0536	0.0608	-0.0100	0.0028
Greece	0.0376	0.0350	-0.0020	0.0047
Guatemala	0.0216	0.0258	-0.0022	-0.0020
Guinea	-0.0241	0.0511	-0.1712	0.0959
Guyana	0.0116	0.0142	-0.0044	0.0018
Honduras	0.0287	0.0286	-0.0180	0.0181
Hungary	-0.1395	0.0765	0.0277	-0.2436
India	0.0167	0.0199	-0.0041	0.0009
Indonesia	0.0479	0.0437	-0.0143	0.0185
Iraq	0.0294	0.0253	-0.0027	0.0068
Israel	0.0313	0.0338	-0.0019	-0.0007
Italy	0.0281	0.0350	0.0010	-0.0079
Jamaica	0.0311	0.0322	-0.0078	0.0066
Jordan	0.0584	0.0473	-0.0058	0.0169
Kazakhstan	0.0382	0.0447	0.0003	-0.0068
Kenya	0.0366	0.0382	-0.0162	0.0145
Latvia	0.0536	0.0642	0.0000	-0.0106

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Lebanon	0.0415	0.0387	-0.0121	0.0149
Lithuania	0.0205	0.0638	0.0709	-0.1142
Malawi	0.0319	0.0354	-0.0117	0.0083
Malaysia	-0.0012	0.0948	0.0066	-0.1026
Mali	0.0234	0.0218	-0.0148	0.0164
Mauritius	-0.0230	0.0554	0.4045	-0.4829
Mexico	0.0251	0.0234	-0.0020	0.0036
Mongolia	0.0297	0.0530	0.0444	-0.0677
Montenegro	0.0182	0.0234	-0.0322	0.0270
Morocco	0.0461	0.0500	0.0015	-0.0055
Mozambique	0.0198	0.0189	-0.0042	0.0051
Myanmar	0.0138	0.0129	0.0009	-0.0000
Namibia	0.0445	0.0468	-0.0083	0.0061
Nepal	0.0260	0.0290	-0.0266	0.0235
Nicaragua	0.0274	0.0299	-0.0230	0.0205
Niger	0.0150	0.0317	-0.0459	0.0291
Nigeria	0.0413	0.0356	-0.0192	0.0249
Pakistan	0.0139	0.0128	-0.0026	0.0038
Panama	0.0060	0.0348	-0.0493	0.0205
Paraguay	0.0536	0.0468	-0.0310	0.0379
Portugal	0.0322	0.0446	0.0052	-0.0175
Russia	0.0324	0.0299	-0.0026	0.0052
Rwanda	0.0291	0.0259	-0.0090	0.0122
Serbia	0.0128	0.0142	-0.0185	0.0171
Slovakia	0.0129	0.0611	0.0138	-0.0620
Slovenia	0.0101	0.0786	0.0164	-0.0849
Suriname	0.1051	0.0522	0.1606	-0.1077

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Tajikistan	0.0457	0.0437	-0.0120	0.0140
Tanzania	0.0473	0.0449	-0.0159	0.0183
Thailand	0.0884	0.0653	-0.0074	0.0306
Togo	0.0357	0.0390	-0.0221	0.0187
Tunisia	0.0459	0.0597	0.0071	-0.0209
Turkey	0.0367	0.0352	-0.0044	0.0059
Uganda	0.0127	0.0196	-0.0097	0.0029
Ukraine	0.0369	0.0551	0.0029	-0.0212
Uruguay	0.0358	0.0351	-0.0046	0.0053
Uzbekistan	0.0365	0.0301	-0.0089	0.0153
Vanuatu	0.0518	0.0483	0.0069	-0.0034
Venezuela	0.0213	0.0196	-0.0015	0.0032
Vietnam	0.0396	0.0398	0.0015	-0.0018
Yemen	0.0162	0.0174	0.0016	-0.0027

Notes: Table reports the welfare impacts, $d \log W_H$, of a 10% reduction in technological import costs τ_H^{imp} using the quantitive model and datasources described in Sections 2 and 3. The first column reports the total effect with the subsequent three columns decomposing the total effect into the mechanical effect, the factoral terms of trade effect, and the distortion revenue effect effect defined in Section 2.2.

Table B.4: Welfare effects of a 10% reduction in import tariffs

	Total effect	Direct distortion exposure effect	Factoral TOT	Distortion revenue effect
Afghanistan	0.0154	0.0115	-0.0113	0.0152
Albania	0.0053	0.0207	-0.0373	0.0219
Angola	0.0168	0.0064	-0.0025	0.0130
Antigua	-0.0195	0.0230	-0.0508	0.0083
Argentina	0.0142	0.0168	-0.0185	0.0159
Armenia	0.0098	0.0225	-0.0355	0.0228
Azerbaijan	-0.0009	0.0097	-0.0132	0.0026
Bahamas	-0.0235	0.0205	-0.0191	-0.0250
Bangladesh	0.0142	0.0146	-0.0228	0.0224
Barbados	-0.0022	0.0241	-0.0394	0.0131
Belarus	-0.0008	0.0098	-0.0073	-0.0033
Belize	-0.0448	0.0267	-0.0922	0.0207
Benin	0.0194	0.0182	-0.0292	0.0305
Bhutan	0.0259	0.0274	-0.0526	0.0510
Bolivia	0.0109	0.0164	-0.0276	0.0222
Bosnia and Herzegovina	0.0067	0.0192	-0.0218	0.0093
Botswana	0.0362	0.0322	-0.0431	0.0472
Brazil	0.0044	0.0055	-0.0055	0.0045
Bulgaria	0.0227	0.0231	-0.0250	0.0245
Burundi	-0.0040	0.0113	-0.0347	0.0194
Cambodia	0.0850	0.0279	-0.0131	0.0703
Cameroon	0.0085	0.0133	-0.0171	0.0123
Chad	0.0057	0.0043	-0.0052	0.0066
Costa Rica	-0.0033	0.0169	-0.0248	0.0046
Croatia	0.0169	0.0237	-0.0296	0.0229

	Total effect	Direct distortion exposure effect	Factoral TOT	Distortion revenue effect
Czech Republic	0.0519	0.0213	-0.0472	0.0779
Djibouti	0.0256	0.0198	-0.0628	0.0685
Dominican Republic	-0.0029	0.0182	-0.0257	0.0047
Ecuador	0.0043	0.0192	-0.0308	0.0158
Egypt	0.0086	0.0102	-0.0105	0.0089
Eritrea	0.0131	0.0069	-0.0056	0.0118
Estonia	0.0542	0.0228	-0.0376	0.0691
Ethiopia	0.0305	0.1264	0.0001	-0.0959
Gambia	0.0045	0.0186	-0.0452	0.0311
Georgia	0.0001	0.0339	-0.0423	0.0085
Greece	0.0120	0.0207	-0.0293	0.0205
Guatemala	-0.0058	0.0180	-0.0184	-0.0053
Guinea	-0.1767	0.0199	-0.4429	0.2464
Guyana	-0.0185	0.0137	-0.0238	-0.0084
Honduras	-0.0064	0.0225	-0.0550	0.0261
Hungary	0.0813	0.0204	-0.0303	0.0912
India	0.0109	0.0106	-0.0074	0.0078
Indonesia	0.0062	0.0127	-0.0294	0.0230
Iraq	0.0007	0.0073	-0.0135	0.0069
Israel	0.0095	0.0146	-0.0188	0.0137
Italy	0.0126	0.0121	-0.0155	0.0159
Jamaica	-0.0070	0.0210	-0.0381	0.0101
Jordan	0.0468	0.0297	-0.0575	0.0746
Kazakhstan	0.0018	0.0078	-0.0078	0.0019
Kenya	0.0043	0.0275	-0.0579	0.0347
Latvia	0.0395	0.0266	-0.0492	0.0621
Lebanon	0.0259	0.0295	-0.0685	0.0649

	Total effect	Direct distortion exposure effect	Factoral TOT	Distortion revenue effect
Lithuania	0.0535	0.0310	-0.0828	0.1053
Malawi	-0.0022	0.0221	-0.0557	0.0314
Malaysia	0.0534	0.0100	-0.0134	0.0568
Mali	0.0050	0.0157	-0.0390	0.0283
Mauritius	-0.2564	0.0386	1.4210	-1.7161
Mexico	0.0025	0.0135	-0.0160	0.0050
Mongolia	-0.0931	0.0250	0.1888	-0.3068
Montenegro	-0.0085	0.0182	-0.0788	0.0521
Morocco	0.0120	0.0253	-0.0238	0.0106
Mozambique	0.0011	0.0112	-0.0181	0.0079
Myanmar	-0.0000	0.0000	-0.0001	0.0000
Namibia	0.0220	0.0316	-0.0562	0.0467
Nepal	0.0002	0.0230	-0.0694	0.0466
Nicaragua	-0.0070	0.0212	-0.0522	0.0240
Niger	-0.0275	0.0218	-0.1006	0.0513
Nigeria	0.0104	0.0212	-0.0527	0.0419
Pakistan	0.0038	0.0064	-0.0110	0.0084
Panama	-0.0633	0.0217	-0.1203	0.0353
Paraguay	0.0172	0.0270	-0.0905	0.0807
Portugal	0.0088	0.0259	-0.0419	0.0248
Russia	0.0060	0.0083	-0.0091	0.0069
Rwanda	0.0060	0.0211	-0.0402	0.0252
Serbia	-0.0020	0.0133	-0.0433	0.0280
Slovakia	0.0347	0.0216	-0.0154	0.0285
Slovenia	0.0371	0.0219	-0.0297	0.0449
Suriname	0.1805	0.0242	0.4673	-0.3110
Tajikistan	0.0275	0.0247	-0.0487	0.0515

	Total effect	Direct distortion exposure effect	Factoral TOT	Distortion revenue effect
Tanzania	0.0439	0.0362	-0.1202	0.1279
Thailand	0.0559	0.0174	-0.0366	0.0751
Togo	-0.0018	0.0223	-0.0778	0.0538
Tunisia	0.0192	0.0317	-0.0380	0.0255
Turkey	0.0137	0.0206	-0.0255	0.0187
Uganda	-0.0132	0.0161	-0.0381	0.0089
Ukraine	0.0052	0.0195	-0.0272	0.0128
Uruguay	0.0072	0.0204	-0.0278	0.0146
Uzbekistan	0.0117	0.0146	-0.0224	0.0194
Vanuatu	0.0591	0.0199	0.0765	-0.0373
Venezuela	-0.0004	0.0068	-0.0069	-0.0002
Vietnam	0.0301	0.0280	0.0054	-0.0034
Yemen	0.0058	0.0084	0.0035	-0.0061

Notes: Table reports the welfare impacts, $d\log W_H$, of a 10% reduction in import tariffs t_H^{imp} using the quantitive model and datasources described in Sections 2 and 3. The first column reports the total effect with the subsequent three columns decomposing the total effect into the direct distortion exposure effect, the factoral terms of trade effect, and the distortion revenue effect effect defined in Section 2.2.

Table B.5: Change in $\frac{dlogW_h}{d\tau}$ with 10% reduction in specified distortion

	Regulation and crime	Markup	Capital	Labor	Intermed. input	Electricity
Afghanistan	-0.0001	-0.0000	-0.0000	-0.0000	0.0000	-0.0000
Albania	0.0002	0.0004	0.0000	0.0002	0.0002	0.0000
Angola	-0.0014	-0.0008	-0.0000	0.0001	-0.0009	-0.0000
Antigua	0.0002	0.0003	-0.0000	0.0003	0.0001	-0.0000
Argentina	0.0002	0.0013	-0.0001	-0.0000	0.0011	-0.0000
Armenia	0.0000	0.0001	-0.0000	0.0002	0.0001	-0.0000
Azerbaijan	0.0001	0.0002	0.0000	0.0001	0.0001	-0.0000
Bahamas	0.0000	0.0003	0.0000	0.0001	0.0001	0.0000
Bangladesh	-0.0000	-0.0001	-0.0000	-0.0000	-0.0000	-0.0000
Barbados	0.0000	0.0002	0.0001	0.0002	-0.0000	-0.0000
Belarus	0.0001	0.0002	-0.0000	-0.0016	0.0002	0.0000
Belize	0.0005	0.0019	0.0004	0.0012	0.0021	0.0001
Benin	-0.0001	-0.0003	0.0000	0.0000	-0.0003	-0.0000
Bhutan	-0.0002	-0.0003	-0.0001	0.0001	-0.0002	-0.0000
Bolivia	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000
Bosnia and Herzegovina	0.0001	0.0003	0.0000	0.0002	0.0002	0.0000
Botswana	0.0000	0.0000	0.0000	0.0001	-0.0001	-0.0000
Brazil	0.0000	-0.0001	0.0000	0.0000	0.0000	0.0000
Bulgaria	-0.0001	-0.0002	-0.0000	0.0004	-0.0004	-0.0000
Burundi	0.0003	0.0005	0.0000	0.0002	0.0004	0.0000
Cambodia	-0.0007	-0.0008	-0.0000	-0.0001	-0.0005	-0.0000
Cameroon	-0.0002	-0.0001	0.0000	0.0001	-0.0002	-0.0000
Chad	-0.0005	-0.0002	-0.0000	-0.0002	-0.0001	-0.0000
Costa Rica	0.0000	0.0001	-0.0000	0.0000	0.0003	-0.0000

	Regulation and crime	Markup	Capital	Labor	Intermed. input	Electricity
Croatia	0.0001	0.0002	0.0000	0.0003	0.0001	-0.0000
Czech Republic	-0.0022	-0.0030	0.0002	0.0001	0.0001	-0.0014
Djibouti	-0.0002	-0.0003	0.0001	0.0001	-0.0003	-0.0000
Dominican Republic	-0.0000	0.0001	0.0000	0.0000	0.0000	-0.0000
Ecuador	0.0000	-0.0000	0.0000	0.0002	-0.0001	-0.0000
Egypt	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
Eritrea	-0.0001	-0.0002	-0.0001	-0.0002	-0.0001	-0.0000
Estonia	0.0082	-0.0176	-0.0002	-0.0003	-0.0122	-0.0002
Ethiopia	0.0001	0.0002	0.0000	0.0001	0.0002	0.0000
Gambia	0.0001	0.0001	0.0000	0.0003	0.0000	0.0000
Georgia	0.0003	0.0004	0.0000	0.0004	0.0002	0.0000
Greece	0.0002	0.0002	-0.0000	0.0001	0.0002	0.0000
Guatemala	-0.0005	-0.0009	-0.0001	0.0001	-0.0008	-0.0000
Guinea	0.0822	0.0229	-0.0631	-0.0093	0.3194	0.0004
Guyana	0.0002	0.0001	0.0000	0.0002	0.0001	0.0000
Honduras	0.0002	0.0001	-0.0000	0.0003	0.0001	-0.0000
Hungary	-0.0539	-0.0547	0.0009	-0.0027	-0.0295	-0.0002
India	0.0027	0.0013	0.0027	-0.0002	0.0027	-0.0002
Indonesia	0.0003	0.0003	-0.0000	0.0003	0.0003	-0.0000
Iraq	0.0015	0.0004	-0.0001	0.0001	0.0006	0.0000
Israel	0.0002	-0.0000	0.0000	0.0001	0.0000	0.0000
Italy	0.0002	0.0006	-0.0000	0.0001	0.0006	0.0000
Jamaica	0.0001	0.0001	0.0000	0.0002	0.0000	0.0000
Jordan	0.0001	0.0002	-0.0000	0.0001	0.0002	-0.0000
Kazakhstan	-0.0001	-0.0002	-0.0000	0.0001	-0.0002	-0.0000
Kenya	0.0002	0.0001	-0.0000	0.0004	0.0001	-0.0000
Latvia	0.0008	-0.0001	-0.0001	0.0001	-0.0001	-0.0000

	Regulation and crime	Markup	Capital	Labor	Intermed. input	Electricity
Lebanon	0.0001	0.0001	-0.0000	0.0001	0.0000	-0.0000
Lithuania	0.0035	-0.0084	-0.0001	0.0000	-0.0251	-0.0003
Malawi	0.0003	0.0002	-0.0000	0.0002	0.0001	0.0000
Malaysia	.	-0.0194	.	.	.	.
Mali	-0.0001	-0.0001	0.0000	0.0001	-0.0001	-0.0000
Mauritius	0.1229	0.0344	-0.0273	-0.2174	0.1137	-0.0143
Mexico	0.0001	0.0000	0.0001	0.0001	0.0000	-0.0000
Mongolia	0.0044	-0.0021	-0.0004	-0.0002	0.0005	-0.0002
Montenegro	0.0004	0.0004	0.0002	0.0006	0.0003	0.0000
Morocco	0.0002	0.0001	0.0000	0.0001	0.0001	0.0000
Mozambique	0.0002	0.0001	-0.0000	0.0001	0.0001	0.0000
Myanmar	-0.0014	-0.0003	0.0000	0.0000	-0.0004	-0.0000
Namibia	-0.0000	-0.0001	-0.0000	0.0002	-0.0001	-0.0000
Nepal	0.0001	-0.0000	-0.0001	0.0003	0.0000	-0.0000
Nicaragua	0.0002	0.0000	-0.0000	0.0004	0.0001	-0.0000
Niger	-0.0005	-0.0009	-0.0004	0.0011	-0.0005	-0.0000
Nigeria	-0.0000	0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Pakistan	0.0000	-0.0000	0.0000	0.0000	0.0000	-0.0000
Panama	0.0021	0.0005	-0.0001	0.0019	0.0020	0.0000
Paraguay	0.0001	-0.0000	0.0000	0.0003	-0.0000	-0.0000
Portugal	.	-0.0002	.	.	.	.
Russia	-0.0169	0.1168	-0.0002	-0.0001	-0.0237	-0.0000
Rwanda	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000
Serbia	0.0004	0.0003	0.0000	0.0003	0.0003	0.0000
Slovakia	0.0008	-0.0012	-0.0003	0.0001	-0.0014	-0.0000
Slovenia	0.0015	-0.0023	0.0000	0.0000	-0.0022	-0.0000
Suriname	0.0019	-0.0303	0.0012	0.0216	-0.1126	0.0036

	Regulation and crime	Markup	Capital	Labor	Intermed. input	Electricity
Tajikistan	-0.0025	-0.0012	-0.0000	0.0001	-0.0014	-0.0000
Tanzania	0.0001	0.0002	0.0000	0.0002	0.0001	0.0000
Thailand	-0.0001	-0.0014	-0.0001	-0.0001	-0.0001	-0.0001
Togo	-0.0000	0.0001	-0.0000	0.0004	-0.0001	0.0000
Tunisia	-0.0001	-0.0008	0.0000	0.0002	-0.0005	-0.0000
Turkey	0.0001	0.0002	-0.0000	0.0001	0.0001	-0.0000
Uganda	0.0004	0.0002	-0.0000	0.0002	0.0001	0.0000
Ukraine	-0.0003	-0.0003	-0.0000	0.0002	-0.0002	-0.0000
Uruguay	0.0000	0.0000	-0.0000	0.0001	0.0000	-0.0000
Uzbekistan	0.0000	0.0000	-0.0000	0.0001	-0.0001	-0.0000
Vanuatu	0.0079	0.0129	0.0007	0.0005	0.0098	0.0000
Venezuela	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000
Vietnam	0.0003	0.0002	0.0002	0.0002	0.0003	0.0002
Yemen	-0.0000	0.0000	-0.0000	-0.0000	0.0000	-0.0000

Notes: Table reports the change in the welfare effect from a 10% reduction in trade costs when the specified distortion is reduced by 10%.

Table B.6: Change in welfare effects due to size-dependent distortions

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Afghanistan	-0.0001	-0.0004	0.0002	0.0001
Albania	0.0002	0.0003	-0.0003	0.0002
Angola	-0.0029	0.0008	-0.0021	-0.0016
Antigua	-0.0003	0.0001	-0.0001	-0.0003
Argentina	0.0008	0.0005	-0.0001	0.0004
Armenia	0.0001	0.0001	-0.0002	0.0001
Azerbaijan	0.0000	0.0001	-0.0001	-0.0000
Bahamas	-0.0002	-0.0003	-0.0001	0.0002
Bangladesh	-0.0002	-0.0006	0.0004	-0.0000
Barbados	0.0000	0.0002	-0.0001	-0.0000
Belarus	0.0556	0.0584	-0.0019	-0.0007
Belize	0.0002	0.0001	-0.0005	0.0006
Benin	0.0003	0.0004	-0.0002	0.0001
Bhutan	0.0000	-0.0001	-0.0001	0.0002
Bolivia	0.0004	0.0005	-0.0006	0.0005
Bosnia and Herzegovina	0.0001	-0.0002	0.0002	0.0001
Botswana	0.0003	-0.0000	0.0000	0.0003
Brazil	0.0004	0.0002	0.0001	0.0000
Bulgaria	0.0004	0.0001	0.0010	-0.0007
Burundi	0.0001	0.0005	-0.0005	0.0000
Cambodia	-0.0004	-0.0006	0.0004	-0.0002
Cameroon	0.0009	0.0004	-0.0004	0.0010
Chad	-0.0005	-0.0003	-0.0000	-0.0001
Costa Rica	0.0010	0.0004	0.0001	0.0005

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Croatia	-0.0002	0.0011	-0.0008	-0.0005
Czech Republic	0.0054	0.0048	-0.0037	0.0041
Djibouti	-0.0007	-0.0016	0.0012	-0.0003
Dominican Republic	0.0003	0.0005	-0.0003	0.0001
Ecuador	0.0000	0.0002	-0.0004	0.0003
Egypt	-0.0001	-0.0001	0.0001	-0.0001
Eritrea	-0.0001	0.0000	-0.0000	-0.0000
Estonia	-0.0053	-0.0038	0.0030	-0.0042
Ethiopia	0.0593	0.0593	0.0000	0.0000
Gambia	0.0007	0.0012	-0.0018	0.0013
Georgia	-0.0000	-0.0001	-0.0000	0.0001
Greece	-0.0006	-0.0002	-0.0001	-0.0003
Guatemala	-0.0003	-0.0004	0.0004	-0.0003
Guinea	-0.0699	0.0067	-0.0772	0.0016
Guyana	0.0000	0.0001	-0.0000	-0.0000
Honduras	0.0009	0.0016	-0.0010	0.0004
Hungary	-0.3634	-0.0089	0.0705	-0.4241
India	-0.0001	-0.0001	0.0000	-0.0000
Indonesia	0.0005	0.0006	-0.0006	0.0005
Iraq	-0.0042	-0.0018	-0.0008	-0.0016
Israel	0.0000	-0.0001	-0.0000	0.0001
Italy	0.0002	0.0004	-0.0002	0.0000
Jamaica	0.0000	0.0001	-0.0002	0.0001
Jordan	-0.0013	-0.0009	0.0001	-0.0004
Kazakhstan	-0.0001	0.0004	0.0000	-0.0005
Kenya	-0.0000	0.0006	-0.0012	0.0006
Latvia	-0.0001	-0.0002	0.0000	0.0001

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Lebanon	0.0000	0.0001	0.0001	-0.0001
Lithuania	-0.0538	0.0219	0.0478	-0.1261
Malawi	-0.0001	-0.0002	0.0002	-0.0001
Malaysia	0.0095	-0.0004	-0.0001	0.0103
Mali	-0.0006	-0.0012	0.0006	-0.0001
Mauritius	-0.0494	-0.0270	0.3370	0.2909
Mexico	-0.0006	-0.0004	0.0000	-0.0003
Mongolia	0.0012	0.0032	0.0009	-0.0031
Montenegro	0.0001	0.0001	0.0001	-0.0000
Morocco	-0.0002	0.0014	-0.0006	-0.0010
Mozambique	-0.0000	-0.0000	-0.0000	0.0000
Myanmar	0.0000	0.0001	-0.0000	-0.0000
Namibia	0.0004	0.0002	-0.0003	0.0004
Nepal	0.0007	0.0024	-0.0020	0.0003
Nicaragua	-0.0002	-0.0008	0.0009	-0.0004
Niger	0.0002	-0.0012	0.0018	-0.0005
Nigeria	0.0007	0.0022	-0.0020	0.0006
Pakistan	-0.0001	-0.0002	0.0001	0.0000
Panama	-0.0009	0.0041	-0.0062	0.0013
Paraguay	0.0002	0.0003	-0.0003	0.0001
Portugal	0.0005	0.0011	-0.0003	-0.0003
Russia	0.0004	0.0003	-0.0001	0.0002
Rwanda	0.0010	0.0011	-0.0005	0.0004
Serbia	-0.0028	-0.0041	0.0015	-0.0003
Slovakia	0.0024	0.0057	-0.0010	-0.0027
Slovenia	0.0009	0.0034	-0.0012	-0.0014
Suriname	0.0602	0.0048	0.0599	-0.0049

	Total effect	Mechanical effect	Factoral TOT	Distortion revenue effect
Tajikistan	-0.0032	-0.0030	0.0033	-0.0036
Tanzania	-0.0003	-0.0005	0.0004	-0.0002
Thailand	-0.0012	-0.0008	0.0002	-0.0006
Togo	-0.0001	0.0001	-0.0004	0.0002
Tunisia	0.0007	0.0022	-0.0012	-0.0004
Turkey	-0.0002	-0.0001	0.0001	-0.0002
Uganda	-0.0001	0.0001	-0.0014	0.0013
Ukraine	0.0014	0.0038	-0.0008	-0.0017
Uruguay	0.0002	0.0001	-0.0001	0.0001
Uzbekistan	-0.0018	-0.0023	0.0012	-0.0008
Vanuatu	0.0001	-0.0001	0.0001	0.0001
Venezuela	0.0001	0.0000	0.0000	0.0001
Vietnam	-0.0001	-0.0003	0.0001	0.0002
Yemen	-0.0002	-0.0007	0.0001	0.0004

Notes: Table reports the additional changes to the welfare effect and its subcomponents in response to a 10% reduction in technological import costs, τ_H^{imp}, when distortions are size-dependent. All columns are simple differences relative to the welfare effect reported in Panel A of Table 2.