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Essays on International Trade, Welfare and Inequality

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Export-Import Bank of India (Exim Bank) instituted the BRICS Economic Research Annual Award in 2016.The objective of the Award is to promote advanced doctoral research in international economics, trade, development and related financing, by nationals of any of the five member nations of BRICS, from any university/ educational institution globally. This study is based on the doctoral dissertation titled "Essays on International Trade, Welfare and Inequality" selected as the award winning entry for the Exim Bank BRICS Economic Research Annual Award (BRICS Award) 2018, written by Dr. Zheli He, currently Economist at the Penn Wharton Public Policy Initiative, USA. Dr. He received her doctoral degree in 2017 from the Columbia University, USA.

Introduction

How important are the distributional effects of international trade? This has been one of the most central questions pursued by international economists, particularly because much of the public opposition towards increased openness is due to the belief that welfare changes are unevenly distributed. This study relies on counterfactual analysis and natural experiments to study topics of international trade, welfare and inequality in the context of both developing and developed economies. In particular, it combines theoretical modeling and empirical analysis to examine the effects of international trade on (1) real wages of individuals within and across regions; (2) within-sector wage dispersion caused by heterogeneous responses of firms with different productivity levels to cheaper imported inputs.

Each of the three chapters in the study, contributes to the existing literature by relaxing simplifying assumptions that have proved to be inconsistent with data and exploring new mechanisms that link international trade to inequality.

Trade and Real Wages with Demand and Productivity Heterogeneity

This chapter presents a general equilibrium model that incorporates the effects of trade liberalization on both individuals' nominal wages and their consumer price indices. The changes in their nominal wages depend on changes in producer prices and the jobs in which they are employed, where the jobs of their employment are determined by their characteristics such as age, gender and educational attainment. On the other hand, the changes in their consumer price indices depend on changes in prices of the baskets of goods that they consume, where their consumption baskets are determined by their nominal wages in addition to prices. A vast majority of the literature focuses on the effect of trade on the distribution of nominal wages. A small number of studies consider its differential impact on consumer price indices. This chapter provides a unified framework that incorporates both the expenditure channel, i.e., changing consumer price indices, and the income channel, i.e., changing nominal wages, to measure the distributional effects of trade in a large cross-section of regions.

The study builds a model combining demand heterogeneity across consumers with productivity heterogeneity across workers. On the demand side, the Almost Ideal Demand System (AIDS) is used to capture non-homothetic preferences. This demand specification allows the consumption baskets of high-income and low-income individuals to differ so that price changes resulting from trade liberalization have a differential impact on their consumer price indices. On the supply side, an assignment model of the labor market parametrized with a Fréchet distribution is used to capture heterogeneity of workers across jobs. Individuals have comparative advantage across sectors—based on their age, gender and educational attainment—and, therefore, sort into different sectors. Consequently, price changes resulting from trade liberalization have a differential impact on individuals' nominal wages depending on the sectors in which they work. In addition, individuals are also allowed to differ in their absolute advantage such that labor groups differ in their average productivity and, therefore, have different nominal wages regardless of individuals' sectoral choices. This

assumption generates a potential link between the skill distribution and the wage distribution and, as a result, a potential correlation between the changes in individuals' nominal wages and the changes in their consumer price indices.

A vast body of research has examined the impact of trade on the distribution of earnings across workers. Most recently, Galle et al. (2015) develop the notion of "risk-adjusted gains from trade" to evaluate the full distribution of welfare changes in one measure which generalizes the specific-factors intuition to a setting with endogenous labor allocation. Similarly, this study focuses on changes in relative nominal wages across labor groups that result from changes in relative demand across sectors driven by international trade.

There are a small number of studies that have considered price indices as a channel through which trade liberalization can affect inequality. For example, Fajgelbaum and Khandelwal (2016) develop a methodology to measure the unequal gains from trade through the expenditure channel using only aggregate statistics. This study extends this approach to incorporate the differential impact of trade liberalization on individuals' nominal wages. Fally and Faber (2016) use detailed matched US home and store scanner microdata to explore the implications of firm heterogeneity for household price indices across the income distribution. This study complements the existing literature by incorporating both the expenditure and the income channels as well as their interaction in a unified framework to analyze the heterogeneous impact of counterfactual trade shocks across individuals in a large set of regions.

There are only three case studies that have looked at these two channels jointly. Porto (2006) studies the distributional effects of Mercosur, a regional trade agreement among Argentina, Brazil, Paraguay and Uruguay, during the 1990s. Nicita (2009) extends Porto's approach by adding a link from trade policy to domestic prices and studies the trade liberalization that took place in Mexico during the period 1990-2000. Marchand (2012) allows the tariff pass-through to differ across geographical regions and studies the trade reforms in India between 1988 and 2000. The structure of the model in this study allows the estimation of the effects for more regions.

By looking at a wide range of regions, it is able to identify general patterns across regions with different characteristics. It is also able to conduct model-based counterfactuals of different trade shocks, which are important for policymakers. In addition, as critiqued in Goldberg and Pavcnik (2007), the predictions of these studies depend in a crucial way on estimates of the degree of pass-through from trade policy changes to product prices as well as the wage-price elasticities. These are difficult to estimate consistently with time-series data on wages and prices in a setting when many other policies change contemporaneously with trade.

Trade and Real Wage Inequality: Cross-Region Evidence

This chapter addresses the following question: what is the impact of trade liberalization on the distribution of real wages in a large cross-section of regions? Trade liberalization affects real wage inequality through two channels: the distribution of nominal wages across workers and, if the rich and the poor consume different bundles of goods, the distribution of price indices across consumers. Prior work has focused mostly on one or the other of these channels, but no paper has studied both jointly for a large set of regions. Based on the theoretical framework in Chapter 1, this chapter measures the distributional effects of trade liberalization incorporating both channels for a sample of 40 regions. More specifically, the model is parametrized using sector-level trade and production data. Because skill-intensive goods are also high-income elastic in the data, the study finds an intuitive, previously unexplored, and strong interaction between the two channels. According to the counterfactual analysis, trade cost reductions generate dramatically different results for both nominal wage inequality and price index inequality than what previous research has obtained by focusing on either channel alone.

In isolation, these two channels have well-understood implications. Shutting down the expenditure channel, the study finds that the income channel benefits the poor more than the rich in low-income regions and the rich more than the poor in high-income regions. This is consistent with standard factor proportions theory in which a reduction in trade costs raises the relative nominal wage of the abundant factor in every region, benefiting the unskilled (and poor) workers in skill-scarce regions that are low income and the skilled (and rich) workers in skill-abundant regions that are high income. Shutting down the income channel, the study finds that the expenditure channel benefits the poor more than the rich in every region and more so in high-income regions. Intuitively, lower trade costs increase real incomes and, therefore, decrease the relative demand for and the relative price of low-income elastic goods. Because low-income consumers spend more on these goods, they benefit relatively more. The expenditure channel benefits the poor relatively more in high-income regions because these regions are net importers of low-income elastic goods.

These two channels do not work in isolation. Studying either channel in the absence of the other leads to profoundly biased results qualitatively and quantitatively. Specifically, their interaction implies that the income channel benefits the rich in every region, which is consistent with a large body of empirical evidence; see e.g. Goldberg and Pavcnik (2007). Intuitively, when both channels are active, lower trade costs increase real incomes and, therefore, decrease the relative demand for and the relative price of low-income elastic goods as discussed above. Since the poor disproportionately produce unskilled-intensive goods, which are low-income elastic, their relative nominal wage falls in every region. This

effect is absent when only the income channel is active. Moreover, the interaction of these two mechanisms also implies that the poor's relative benefit from the expenditure channel is magnified in every region. Intuitively, because nominal wage inequality rises in every region, as just described, the relative demand for and the relative price of low-income elastic goods fall even further, reducing the relative price index for the poor in every region. This effect is absent when only the expenditure channel is active because nominal wage inequality is constant in that case.

The study parametrizes the model for a sample of 40 regions (27 European regions and 13 other large regions) and 35 sectors using a range of datasets including the World Input-Output Database (WIOD) and the Integrated Public Use Microdata Series, International (IPUMS-I). WIOD provides information on bilateral trade flows and production data. A sectoral non-homothetic gravity equation is derived that allows the estimation of the elasticity of substitution and the income elasticity of goods as follows. First, the elasticity of substitution is estimated by projecting regions' sectoral expenditure shares on trade costs. Second, the income elasticity of each good is estimated using the following insight: if high-income or more unequal regions spend relatively more on a good, then it is inferred that this good is high-income elastic. IPUMS-I provides publicly available nationally representative survey data for 82 regions that are coded and documented consistently across regions and over time. It reports individual-level information including age, gender, educational attainment, labor income and sector of work. This rich database enables the estimation of the Fréchet dispersion parameter of the within-group distribution of efficiency units across sectors which determines the extent of worker reallocation and, thus, the responsiveness of group average wages to changes in sectoral output prices. In addition, the comparative advantage of different labor groups across sectors is estimated based on observed worker sorting patterns. Intuitively, if a worker type (relative to another worker type) is more likely to sort into a sector (relative to another sector), then it is inferred that they are relatively more productive in that sector. Using the estimates of group average wages and other parameters, the absolute advantage of different labor groups can also be backed out.

With these parameter estimates, two counterfactual analyses are conducted to quantify the distributional effects of trade liberalization. To demonstrate how the model works, the study begins with a simple counterfactual exercise in which a 5% reduction in all bilateral trade costs is considered. It finds that within each region, as one moves up the initial nominal wage distribution, gains decline. Specifically, moving up from one decile to the next reduces gains by 0.1 percentage point: the bottom 10^{th} percentile experiences a real wage gain that is larger than the top 10^{th} percentile in every region, and the difference is 0.8 percentage points in the average region. The study obtains the result that the poor gain relative to the rich in spite of the fact that it finds the opposite result for nominal wages. In the average region, the bottom 10^{th} percentile sees their nominal wage decrease by 0.2 percentage points relative to the top 10^{th} percentile. Hence, the reduction in the poor's relative price index must fall substantially. In the average region, the bottom 10^{th} percentile sees their consumer price index decrease by 1 percentage point more than the top 10^{th} percentile.

The theoretical framework in Chapter 1 also allows the re-examination of the impact of a significant increase in U.S. manufacturing imports from China on U.S. real wage inequality while accounting for both channels and their interaction. The study considers a uniform reduction in trade costs between the U.S. and China that would yield a $1000 per U.S. worker increase in Chinese manufacturing imports. It finds that individuals whose nominal wages are at the 10^{th} percentile of the initial distribution see a further 0.35 percentage point reduction in their consumer price indices compared to the representative consumer, while individuals whose nominal wages are at the 90^{th} percentile see their consumer price indices decrease by 0.1 percentage point less than the representative consumer. This result arises because Chinese manufacturing goods are low-income elastic and, consequently, their lower prices benefit more the poor individuals who spend relatively more on these goods. Although the former see a bigger decline in their nominal wages (0.13% vs. 0.11%) because they are more likely to work in manufacturing sectors that are in direct competition with cheaper Chinese imports, this income effect is more than offset by their much lower consumer price indices. Rising Chinese import competition increases the real wage of the poor by 0.43 percentage points more than that of the rich in the U.S.

Imported Inputs and Within-Sector Wage Dispersion

This chapter proposes a new mechanism through which trade liberalization affects wage inequality within a country: the use of imported inputs. The traditional Heckscher-Ohlin model predicts that countries export goods that use intensively the factor they are most abundantly endowed with. According to the Stolper-Samuelson theorem, trade increases the relative return to unskilled labor in developing countries, decreasing wage inequality. However, that prediction is at odds with many empirical findings. Take China as an example, the overall wage inequality, measured as the difference between the 90^{th} and the 10^{th} percentile of the log wage distribution, has been going up consistently in the last two decades. This period of rapid wage inequality increase coincided with China's implementation of dramatic economic reforms and an open door policy that promoted its trade with the rest of the world. So two important questions arise: did trade liberalization contribute to China's rising wage inequality? If so, through which channels?

New theoretical developments have been made to provide insights into the effects of trade on wage inequality. Most prominently, Verhoogen (2008) proposes the quality-upgrading mechanism as an explanation. In his model with heterogeneous plants and quality

differentiation, an exchange-rate devaluation leads more productive Southern plants to increase exports, upgrade quality, and raise wages relative to less productive ones, increasing within-sector wage dispersion. This chapter proposes an alternative mechanism: the use of imported inputs. Intuitively, a firm with higher initial productivity is better at using higher quality foreign inputs. This justifies paying the fixed cost for a larger set of imported inputs when input tariff liberalization decreases their relative price. The firm becomes more import intensive, which enhances its productivity advantage. As a result, the firm hires higher quality workers, produces higher quality products and pays higher wages to its workers, increasing within-sector wage dispersion.

First, the ASIF (Annual Survey of Industrial Firms) from China's National Bureau of Statistics that reports key operational data on Chinese manufacturing firms is used to document some stylized facts that are both new and interesting. The study finds that both the mean and the dispersion of the distribution of firm productivity, markup and size went up during a period when China reduced its tariffs on imported inputs. More importantly, these results still hold when the subset of firms that survived throughout the sample period, from 1998 to 2007, is considered. Therefore, openness to trade has fundamental effects on the underlying characteristics of firms. Most of recent models of firm heterogeneity assume that these characteristics are fixed and examine the impact of trade on aggregate variables, for example, the average productivity of firms in the economy as a result of change in the composition of surviving firms. On the contrary, this study investigates the differential impact of trade liberalization on heterogeneous firms allowing these characteristics to be endogenous.

Firm-level TFP is measured based on OLS, Olley and Pakes, Levinsohn and Petrin, and Ackerberg, Caves and Frazer to ensure that the estimate of firm productivity is as accurate as possible. For firm-level markup calculation, De Loecker and Warzynski (2012) is adopted, which is the best available method that can be used given the data limitations. Both a Cobb-Douglas gross output production function and, more generally, a translog gross output production function, are considered. Finally, firm size is measured both in terms of output value and total employment as a robustness check. The empirical patterns are very similar when different approaches are used to measure these three key firm-level variables.

Second, Chinese Customs Data on imports and exports are used, which provide detailed information on the universe of China's firm-level trade transactions for the years 2000 to 2006, to highlight firms' different responses to a dramatic decrease in import tariffs. These observations emphasize the large and growing importance of trade in intermediates, and provide some empirical evidence that supports the hypothesis that the differential change in the import intensity of firms with different productivity levels in response to input tariff liberalization explains the increase in both the average and the dispersion of firm-level variables that are observed in the data.

Finally, a partial equilibrium, heterogeneous firm model with endogenous imported inputs and labor quality choice that is consistent with these observations is developed. On the demand side, the “quality-Melitz” model in Kugler and Verhoogen (2012) is adopted, where higher price decreases demand but higher quality increases demand. On the supply side, firms differ from each other in the usual dimension of productivity, as in Melitz (2003). In the model, firms combine labor and intermediate inputs to produce physical quantity, in the spirit of Amiti et al. (2014). Output quality, on the other hand, is determined by labor and input qualities, and the advantage of imported inputs over domestic counterparts is augmented by a firm's own productivity. Since Amiti et al. (2014) focus on exchange rate pass-through, and assume that firms do not foresee fluctuations in exchange rates, they hold the set of imported inputs of each firm fixed. This study, on the other hand, investigates precisely how firms adjust the set of foreign varieties they import in response to input tariff liberalization and changes in firm-level variables that follow. Consequently, the model deviates from theirs in obvious ways, which is explained in more detail in the theory section.

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