# Research Statement

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This statement summarizes my research activities and outcomes since graduating from University of Western Ontario and joining HKUST in the Summer of 2010.

As an ***empirical trade*** economist, my research interests are primarily in (i) quality upgrading of exports, (ii) knowledge spillovers, technology diffusion, and innovation (iii) heterogeneous firms' responses in various trade environments, especially for firms in emerging market economies such as China, and (iv) other related topics of Chinese economy. My research involves quantifying general-equilibrium macroeconomic models and exploring empirical evidence of micro-foundations in international macroeconomics. Therefore, my research also falls into the field of ***empirical international macroeconomics***. Below is a list of my papers based on themes (whereas some appear under more than one theme, I will summarize those papers based on their primary theme).

1. Endogenous Quality Choice of Exporting Firms [A1] [A2] [A5] [B2]
2. Knowledge Spillovers, Technology Diffusion, and Innovation [A3] [B1] [B3] [B11] [B12]
3. Micro Evidence on Heterogeneous Firms' Responses to Various Macroeconomic Shocks: Trade Liberalization, Exchange Rate Fluctuations and Credit Constraints, etc.
   (a) Firm Competitiveness, Markups, and Productivity [A6] [B6] [B9] [B10]
   (b) Firm Performance under Credit Constraints [A5] [A9] [B4]
   (c) Forward-Looking Firms and Import Responses to Exchange Rate Movements: Micro-foundation in Empirical International Macroeconomics [A7] [A4] [B7]
4. Other Papers on Chinese Economy [A8] [B5] [B8]

Below are synopses of my research papers organized along the themes specified above. To save space, I limit myself to my work and avoid detailed discussions on the relevant literature.

I will show the number of citations received by my papers based on information from two sources: Google Scholar (including patent citations, working papers and published papers) and Scopus (only including published papers for both cited and citing papers).[1] According to Google Scholar, I have received 3 citations from US patents (see Section 2 for details). In all the citations reported from published articles in refereed journals, to have a fair comparison, I only include internationally recognized economics journals in English and do not include citations from articles published in refereed economics journals in Chinese. All the citations of my papers summarized in this statement are up to September 1, 2017 and can be accessed at the following webpages:

- Google Scholar: http://scholar.google.com/citations?user=NchmVlcAAAAJ&hl=en

  [430 total citations; h-index=7; i10-index=5]

- Scopus: http://www.scopus.com/authid/detail.uri?authorId=37098775300

  [55 total citations by 50 documents; h-index=4]

- ORCiD: http://orcid.org/0000-0002-7768-2703

# 1 Endogenous Quality Choice of Exporting Firms [A1] [A2] [A5] [B2]

The quality of internationally traded products has become an important area of study in international trade (Feenstra and Romalis, 2014) because product quality is a key feature of international specialization (Schott, 2004). Export quality upgrading is particularly important for many developing countries who have embraced the promise of export-led growth because the production of high-quality goods is often viewed as a pre-condition for export success and for economic development (Amiti and Khandelwal, 2013). The early development in the quality upgrading literature includes seminal papers by Verhoogen (2008) and Khandelwal (2010).

- Robert C. Feenstra and John Romalis, 2014. "International Prices and Endogenous Quality," *The Quarterly Journal of Economics*, Oxford University Press, vol. 129(2), pages 477-527.

[1]Note that the number of citations from Google Scholar is larger than that from Scopus, because Google Scholar recognizes working papers and patents whereas Scopus only records citations made and received by published articles, i.e., Scopus requires both citing and cited articles have been published in journals.

- Peter K. Schott, 2004. "Across-Product Versus Within-Product Specialization in International Trade," *The Quarterly Journal of Economics*, Oxford University Press, vol. 119(2), pages 647-678.

- Mary Amiti and Amit K. Khandelwal, 2013. "Import Competition and Quality Upgrading," *The Review of Economics and Statistics*, MIT Press, vol. 95(2), pages 476-490.

- Eric A. Verhoogen, 2008. "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, Oxford University Press, vol. 123(2), pages 489-530.

- Amit Khandelwal, 2010. "The Long and Short (of) Quality Ladders," *Review of Economic Studies*, Oxford University Press, vol. 77(4), pages 1450-1476.

My research in this area has focused on using highly disaggregated Chinese firm level and firm-product level data to uncover new features of firms' exporting performance such as export pricing decision and how it is related to endogenous quality choice of the firm. I will discuss four papers under this theme.

## 1.1 Quality Upgrading, Export Prices and Trade Liberalization [A1] [A2] [B2]

How do lower tariffs on imported intermediates affect the competitiveness of a country's exporters? Do exporters respond by lowering the price of their existing portfolio of exported goods or do they respond by upgrading the quality of this portfolio even if this adjustment ultimately induces an increase in the price of their exported goods? Answering those questions has important implications to not only exporting firms in business world but also policy makers in developing countries.

### 1.1.1 Quality and Export Prices under Trade Liberalization [A1]

In the paper [A1], "**Trade Liberalization, Quality, and Export Prices**" (Fan, Li and Yeaple, 2015, *Review of Economics and Statistics*), we ask whether lower tariffs on imported intermediates induce firms to upgrade the quality of the goods that they export. To address this question, we present theory and evidence from highly disaggregated Chinese linked firm-level production data and customs data that tariff reductions induced Chinese exporters to upgrade the quality of the goods that they export, particularly in industries where the scope for quality variation is high. Chinese firms that enjoy the largest tariff reductions are observed to raise the prices of their exports to existing export markets and to shift their export

volumes geographically from countries where demand for high quality goods is relatively weak to markets where demand for high quality goods is strong.

We first document two stylized facts regarding the relationship between the arguably exogenous tariff reductions imposed on China by accession to the World Trade Organization (WTO) and the export prices for ordinary (non-processing) Chinese incumbent exporters. We show that in industries in which products are highly differentiated firms raise their export prices in response to a fall in the tariffs they pay on imported inputs. In industries featuring primarily homogeneous goods, the pattern is ambiguous or even reversed: a reduction in imported intermediate tariffs results in lower prices.

We explain these facts in the context of a tractable, heterogeneous-firm model with endogenous firm quality choice. The model generates linear equations that relates changes in the export prices charged by the firm and changes in the output quality produced by the firm to changes in the tariffs of the set of goods imported by the firm. Importantly, the magnitude (and potentially the sign) of the coefficient on import tariffs depends on the scope for quality heterogeneity within the industry.

We then estimate our model using panel data for Chinese firms over the period 2001-2006. By using long-differences within firm-destination-product categories, we eliminate many potential sources of spurious correlation. We also address the potential endogeneity of firm-level import behavior using instrumental variables. Our coefficient estimates confirm the main predictions of our model. Importantly, the result does not obtain in a placebo sample of export processing firms that were never subjected to tariffs. In addition, we present indirect evidence at the extensive margin of quality upgrading: firms experiencing large reductions in tariffs on their imported intermediates tend to enter new markets with relatively highly priced goods and exit markets where prices had tended to be low.

Our paper contributes to a vibrant literature that links improved access to imported intermediate inputs to superior firm performance, in particular, quality upgrading. Our focus is on the effect of tariff reductions on inputs. Our measures of the extent of trade liberalization take into account heterogeneity across firms in the magnitude of the shock and allow for the effects of trade liberalization to vary across industries that differ in their scope for quality upgrading. We also document how individual firms respond to improved access to imported intermediates by shifting their exports to markets where demand for high quality goods is strong.

*Citations*: Our paper has been well received and cited in the field: 77 citations according to Google Scholar that includes working paper citations, and 8 citations according to Scopus, that only includes published articles (4 from *Journal of International Economics*, 1 from *European Economic Review*, 1 from *Canadian Journal of Economics*, 1 from *Review of Inter-*

*national Economics*, and 1 from *International Review of Economics and Finance*). Besides the above citations published in Scopus, Google Scholar also includes citations of the working paper version of this paper from other published articles (including 4 from *NBER* working papers that are non self-citations, 1 from *Economic Journal*, 2 from *Journal of Comparative Economics*, 1 from a book, and 6 from other refereed journals).

### 1.1.2 Quality and Productivity under Trade Liberalization [A2]

In the paper [A2], "**On the Relationship Between Quality and Productivity: Evidence from China's Accession to the WTO**" (Fan, Li and Yeaple, 2018, *Journal of International Economics*, *NBER* working paper No. 23690), we present an analysis of the effect of China's entry into the WTO on the quality choices of Chinese exporters in terms of their outputs and their inputs. We use highly disaggregated firm-product-level data and the shock of China's entry into the WTO to trace through in detail the mechanisms through which trade liberalization contributes to quality upgrading by Chinese firms. We find that the chief beneficiaries of liberalized intermediate input tariffs are not the initially most productive firms but are instead the less productive firms that are operating in industries in which the scope for quality variation is the most pronounced. It is these lower productivity firms that are most likely to upgrade the quality of their exports, increase the quality of their imported intermediates, and upgrade their workforces. In so doing, these firms are better able to break into markets with high demand for product quality and reduce the gap in their quality performance relative to initially more productive firms.

We develop a simple model of output and input quality choice to flesh out the mechanisms at work. In the model, firms differ in their productivity and maximize profits by choosing the quality of their output and inputs. As in many models of innovation, our model features scale effects whereby a larger market share induces more quality innovation and more productive firms charge higher export prices. Additionally, higher quality output requires higher quality (and more expensive) inputs. As a result, more productive firms pay higher prices for their inputs and sell at higher prices for their outputs. This mechanism induces firms to upgrade their quality in response to a reduction in import tariffs since productivity and low cost inputs are in a sense substitutable. More importantly, firm productivity is not Hicks' neutral and disproportionately affects the efficiency with which firms use intermediate inputs. As initially more productive firms are less affected by cost of inputs, the return to quality upgrading for high productivity firms is less sensitive to tariffs on imported inputs. Consequently, our model makes it possible to explain why more productive firms produce higher quality output using higher quality inputs, but gain less from tariff reductions than less productive firms. Our

framework shares much in common with Feenstra and Romalis (2014) who focus primarily on aggregate provision of quality across markets, but do not explore the differential impacts of quality across firms and the heterogeneous response within industry.

- Robert C. Feenstra and John Romalis, 2014. "International Prices and Endogenous Quality," *The Quarterly Journal of Economics*, Oxford University Press, vol. 129(2), pages 477-527.

Our model's predictions prove to be robust to a wide range of econometric specifications, to alternate methods of calculating tariff reductions enjoyed at the firm level or industry level, and to alternative measures of initial firm productivity. More importantly, we provide support to the interpretation of the data as quality upgrading through input prices of both labor input and imported intermediate inputs as well as through the share of imported inputs in total intermediate inputs. In addition, we present evidence at the extensive margin that the change in export price and destination markets' income is more pronounced for less productive firms who aggressively respond to input tariff reductions by shifting their exports from countries with relatively weak demand for high-quality goods to countries with strong demand for high-quality goods.

We show how firm heterogeneity in productivity maps into firm heterogeneity in quality and how shocks to the economic environment caused by trade liberalization alters this mapping. Our theoretical model shows and our empirical estimates confirm that the role of productivity is not as simple as the standard heterogeneous-firm models that have followed from the canonical Melitz framework. In particular, our results show that firms demonstrating high productivity in highly protected developing countries are relatively well adapted for an environment in which high quality intermediates are expensive to procure.

### 1.1.3 Quality, Variable Markups, and Welfare [B2]

International trade is the study of geographic barriers to economic interaction. Across international borders, these frictions appear to be large as volumes of economic interactions fall dramatically and prices for the same goods diverge. Modern trade models attribute the imperfect correlation of prices across locations to physical and man-made barriers to trade, the pricing-to-market behavior on heterogeneous producers, and systematic differences in the quality of output offered by firms across markets.

The analysis of international price dispersion, and the measurement of the gains from trade, has typically proceeded by considering only a subset of the individual mechanisms that are at its cause. In the paper [B2], "**Quality, Variable Markups, and Welfare: A Quantitative General Equilibrium Analysis of Export Prices**" (Fan, Li, Xu, and Yeaple,

*revise and resubmit at Journal of International Economics*), we present and analyze a simple quantitative general equilibrium model that incorporates endogenous entry by heterogeneous firms, endogenous quality choice in the presence of specific (and ad valorem) trade costs, and endogenous and variable markups.

Our framework is unique in its treatment of the "Washington Apples" effect in that the inclusion of endogenous quality choice in the presence of specific trade costs is highly tractable and allows us to infer indirectly the welfare effects of trade restrictions. In our model, quality upgrading allows firms to reduce the burden of specific costs of shipping goods and this mechanism is most valuable to the most productive firms. In the presence of variable markups and quality upgrading, there is a positive relationship between the price charged by a firm and the total quantity demanded by consumers in equilibrium. The size of this relationship allows us to infer the extent to which firms can avail themselves of this mechanism. Intuitively, the more difficult it is to upgrade quality, the lower are the gains from trade for any given level of trade costs.

We calibrate our model's key parameters to a mixture of macroeconomic data (gravity) and to firm-product-destination export price and sales data from Chinese customs. We show that the model can reasonably capture the positive relationship between sales and prices at the firm level and that any simpler setting without endogenous quality cannot. Moreover, the model does a good job matching key features of the variation in observed prices across destinations both at the firm level and in the aggregate and that any simpler framework with variable quality but without variable markup cannot.

We show that the properly calibrated model does indeed imply lower gains from trade than does the properly calibrated model that contains solely the variable markup but lacks the "Washington Apples" mechanism. Intuitively, since our model features a weaker relationship between productivity and the quality adjusted price, specific trade costs hit the most productive firms more heavily than the less productive. As a result, introducing "Washington Apples" effect is akin to making the firm productivity distribution more skewed towards the less productive firms and reducing the average productivity of foreign firms that are active in any given market. Thus, our model generates lower gains from trade.

We also consider the comparative static of reducing specific and iceberg type trade costs such that the two shocks are isomorphic in terms of their impact on trade volumes between countries and in their effect on aggregate welfare. The object of interest in our comparative static is the differential effect of these shocks on the pattern of prices across countries. Increases in specific trade costs induce firms to upgrade their quality which has the effect of raising export price at the intensive margin. Meanwhile, at the extensive margin firm productivity cutoff also increases. As a result, average prices across countries increase after raising

specific trade costs. On the other hand, increases in iceberg trade costs have the effect of reducing the quality of goods sold internationally such that export prices fall at the intensive margin, while shifting export market share to firms with higher productivity, leaving a small net impact on observed average export prices across country. This result has important implications for the analysis of the link between export price changes and the gains from trade. Specifically, to establish a link one needs to know what the nature of the shock was. Shocks to specific or to ad-valorem trade costs have very different effects on export prices even when they have identical effects on welfare and the volume of trade.

This paper contributes to two strands of the literature that seek to understand the causes and implications of international prices. First, our focus on endogenous quality puts our paper into a literature that includes the recent paper by Feenstra and Romalis (2014). Their analysis neglects variation in markups across countries by construction which allows them to allow for more complex mechanisms that give rise to quality dispersion. Finally, their paper is not concerned with measuring the gains from trade. Second, this paper also contributes to the literature featuring variable markups by considering vertically differentiated products, quality upgrading opportunities, and specific trade costs that give rise to the "Washington Apples"effect. Our framework, therefore, allows for much of the variation across countries and firms to be attributed not to variation in market power but to variation in quality of output. Allowing for quality upgrading helps to make the model with variable markups more consistent with the well-known pattern in the data that the most successful exporters tend to charge the highest prices (e.g. Manova and Zhang, 2012). Moreover, our framework highlights the differential effect of specific and ad valorem trade costs on the international distribution of prices.

- Robert C. Feenstra and John Romalis, 2014. "International Prices and Endogenous Quality," *The Quarterly Journal of Economics*, Oxford University Press, vol. 129(2), pages 477-527.

- Kalina Manova and Zhiwei Zhang, 2012. "Export Prices Across Firms and Destinations," *The Quarterly Journal of Economics*, Oxford University Press, vol. 127, pages 379-436.

## 1.2 Quality, Export Prices and Credit Constraints [A5]

In the paper [A5], "**Credit Constraints, Quality, and Export Prices: Theory and Evidence from China**" (Fan, Lai, and Li, 2015, *Journal of Comparative Economics*), we present theory and evidence from highly disaggregated Chinese data that tighter credit constrains force firms to produce lower quality. The paper modifies Melitz's (2003) model of trade with heterogeneous firms by introducing quality choice and credit constraints. The quality

sorting model predicts that tighter credit constraints faced by a firm reduce its optimal prices due to its choice of lower-quality products. However, when quality cannot be chosen by a firm in an efficiency sorting model, there is an opposite prediction that prices increase as firms face tighter credit constraints. An empirical analysis using Chinese bank loans data and a merged sample of large trading firms based on Chinese firm-level data from the National Bureau of Statistics of China (NBSC) and Chinese customs data strongly supports quality sorting and confirms the mechanism of quality adjustment: firms optimally choose to produce lower-quality products when facing tighter credit constraints. Moreover, the predictions of the efficiency sorting model are supported by using quality-adjusted prices in regression analysis and by using quality variation across firms within the same product.

*Citations*: This paper has received 48 citations according to Google Scholar and 7 citations according to Scopus (including 1 from *Journal of International Economics*, 1 from *Canadian Journal of Economics*, 1 from *Review of International Economics*, 1 from *Small Business Economics*, 1 from *China Economic Review*). Besides the citations published in Scopus, Google Scholar also includes citations received by the working paper version of this paper from published articles (including 1 from *ReStat*, 1 from *European Economic Review*, 1 from *Journal of Comparative Economics*, 6 from other refereed journals).

# 2 Knowledge Spillovers, Technology Diffusion, and Firm Innovation [A3] [B1] [B3] [B11] [B12]

My second branch of research is focusing on empirical studies of knowledge flows/knowledge spillovers, technology diffusion, and R&D related innovation activities.

International technology diffusion determines the pace at which the world's technology frontier may expand in the future (Keller, 2004). It has become increasingly important over the past twenty years. While precise measures of international technology diffusion are lacking, the available data reveal rapid growth. For example, the value of international trade in royalties and license fees has increased by a factor of eleven over the last two decades. Technology diffusion through various forms—including market transactions of royalties and license fees or spillover effects of R&D activities or trade in differentiated intermediate goods or multinational production—not only changes the productivity of goods produced for domestic markets, but also opens up the exporting scope for the benefiting countries (Keller, 2002a, 2002b). Therefore, the current pattern of world trade has been significantly shaped by international technology diffusion or knowledge spillovers. However, to what extent technological knowledge is global or local is still an open question and requests more study along the

line. In this area, Keller (2004) offers a comprehensive survey of the literature of international technology diffusion.

- Wolfgang Keller, 2002a. "Geographic Localization of International Technology Diffusion," *American Economic Review*, American Economic Association, vol. 92(1), pages 120-142.

- Wolfgang Keller, 2002b. "Trade and the Transmission of Technology," *Journal of Economic Growth*, Springer, vol. 7(1), pages 5-24.

- Wolfgang Keller, 2004. "International Technology Diffusion," *Journal of Economic Literature*, American Economic Association, vol. 42(3), pages 752-782.

## 2.1 Knowledge Spillovers and Technology Diffusion [A3] [B1] [B3]

Technology diffusion involves both market transactions and externalities which are captured by spillovers. In the paper [A3], "**Borders and Distance in Knowledge Spillovers: Dying over Time or Dying with Age? – Evidence from Patent Citation**" (Li, 2014, *European Economic Review*), I explore the spillover effect using patent citation data. I examine the effects of distance as well as subnational and national borders on international and intranational knowledge spillovers through patent citations across the 39 most patent-cited countries and 319 metropolitan statistical areas (MSAs) within the U.S. In contrast to previous findings that knowledge localization fades over time, border and distance effects increase over time for the same-age citations. This increasing effect of borders and distance is associated with strengthened knowledge agglomeration over time. Nevertheless, both border and distance effects decrease with the age of patents. Aggregate border effects are often overestimated due to various aggregation bias. Moreover, business travels and knowledge quality effectively attenuate the effect of subnational borders in knowledge flows.

*Citations:* This paper has impact in the field of innovation and technology related activities and policies. This paper has received 25 citations according to Google Scholar including 3 US patents (US7949581, "Method of determining an obsolescence rate of a technology," 2011; US7962511, "Method and system for rating patents and other intangible assets," 2011; also published as US9177349, 2015) and 4 citations from technology and innovation related journals according to Scopus. Besides the citations published in Scopus, Google Scholar also includes citations received by the working paper version of this paper from published articles (including 1 from *Canadian Journal of Economics*, 1 from *Journal of Regional Science*, and 6 from other refereed journals).

Since citations play the role of "paper trails" measuring information flows, I continue to work on knowledge spillovers based on citation data and try to identify factors that limit trans-

fers of knowledge between inventors. In the paper [B1], "**Geography, Ties, and Knowledge Flows: Evidence from Citations in Mathematics**" (Head, Li and Minondo, 2017, revise and resubmit at *Review of Economics and Statistics*), we study how geography and ties affect knowledge flows among scholars using data on academic citations, career and educational histories of mathematicians, and disaggregated distance data for the world's top 1000 math departments. The ties we consider are coauthorship, past colocation, advisor-mediated relationships, and *alma mater* relationships (holding a Ph.D. from the institution where another scholar is affiliated). Logit regressions using fixed effects that control for subject similarity, article quality, and temporal lags, show linkages are strongly associated with citation. Controlling for ties generally *halves* the negative impact of geographic barriers on citations. Ties matter more for less prominent and more recent papers and show no decline in importance in recent years. The impact of distance—controlling for ties—has fallen and is statistically insignificant after 2004.

In the revision for *Review of Economics and Statistics*, we successfully collect new data on conference participations and conference presentations by mathematics scholars and incorporate new tie variables that capture the relationship built during conference participations. We draw data from the American Mathematical Society Annual Meetings over the period 1990-2009. This conference gathers the largest number of mathematicians in America, and is considered the most important annual conference in mathematics. For each annual meeting, we extract the information contained in the full program web page. We merge the conference participation database with our baseline citations sample using the name of the scholars and the title of the papers as link. With these data, for each citing-cited paper pair, we build four new tie variables and incorporate those into our regression analysis: (i) number of times any citing and cited author participated in the same conference before citation; (ii) number of times any citing and cited author participated in the same conference and session before citation; (iii) number of times any citing and cited author participated in the same conference where the cited paper was presented before citation; (iv) number of times any citing and cited author participated in the same conference where the citing paper was presented before citation.

One of the novel aspects of our paper is the inclusion of asymmetric linkages. As knowledge flows are directional, it is useful to determine whether citations are stronger to the presumed sources of information. We find evidence that this is the case. The odds of citation are seven times higher if a paper is written by the advisor of the citing paper. The impact of the author being a former advisee is weaker, albeit still very large. Moving one step further apart in the advisor network, we find advisors of advisors have three times the normal odds of being cited, but there are no significant differences in their propensity to cite their advisees' advisees.

A major challenge faced by the literature investigating effects of geography, and especially ties, on citation is the difficulty of controlling adequately for the relevance of potentially cited papers. We contribute two methodological advances in tackling this difficult issue. First, we employ a novel set of fixed effects capturing the *triad* of cited paper, citing year and citing subject. This controls in a very general way for proximity in subject matter between citing and cited papers, as well as proximity in publication dates. Second, we show how different controls for subject similarity affect the estimates on the variables of interest. In particular we find that inadequate subject controls lead to large overestimates of linkage effects, but also that ties survive as significant forces in determining cites no matter how detailed we go in measuring topic similarity.

*Citations*: This paper has received 10 citations according to Google Scholar, among which 6 are published papers in refereed journals, including 1 from *Quarterly Journal of Economics* and 1 from *Management Science*.

In the paper [B3], "**International trade, technology diffusion, and the role of diffusion barriers**" (Li, 2017, revise and resubmit at *Canadian Journal of Economics*), I assess the welfare impact of trade and international technology diffusion as well as the change in the cross-country distribution of GDP due to removal of trade costs and diffusion barriers. I build a general equilibrium multi-country Ricardian trade model to include technology diffusion with diffusion barriers. The model is calibrated to match the world GDP distribution, the merchandise trade and technology diffusion shares of GDP, and real GDP per capita for a sample of 31 countries. Data on international trade in royalties, license fees, and information intensive services are used as proxies for international technology diffusion. The results suggest that currently the world has achieved more of the potential gains from reductions in trade barriers than the potential gains from reductions in the barriers to technology diffusion. This calls for more attention to be paid to the reduction of diffusion barriers.

## 2.2 Multinational Firm, R&D and Innovation [B11] [B12]

With growing importance of multinational firms in world production, employment and innovation, it is essential to understand the role of parent and affiliate R&D in their production decisions and international trade. The milestone paper by Aw, Roberts and Xu (2011) uses the model to quantify the linkages between the export decision, R&D investment, and endogenous productivity growth for ordinary manufacturing firms. The studies on innovation in developing countries are also related to knowledge spillovers and foreign direct investment (He and Maskus, 2012). My work will focus on R&D activities and their implications on trade associated with parent companies and affiliates of multinational firms under global FDI context

as well as the effect of place-based policy on innovation and entrepreneurship in China.

- Bee Yan Aw & Mark J. Roberts & Daniel Yi Xu, 2011. "R&D Investment, Exporting, and Productivity Dynamics," *American Economic Review*, American Economic Association, vol. 101(4), pages 1312-1344.

- Yin He & Keith E. Maskus, 2012. "Southern Innovation And Reverse Knowledge Spillovers: A Dynamic FDI Model," *International Economic Review*, Vol. 53(1), pages 279-302.

In the paper [B11], "**Multinational R&D, Import Intensity, and Price**" (Fung, Li and Liu, *in progress*), we empirically investigate the connection between parent/affiliate R&D, their import intensity, import variety and price. We also address the role of trade regimes (processing, ordinary and hybrid exports) in these relations. We develop a unique data created by linking Taiwanese parent firms that are listed on Taiwan Stock Exchange to detailed firm-level data and customs transactions of their affiliates in China from 2000 to 2006. Our findings suggest that the share of imported intermediate inputs in affiliate total inputs is larger for processing and hybrid exporters as compared to ordinary exporters. We also empirically assess the influence of affiliate and parent R&D on the relation between tariff and import intensity at the firm and product level. Our empirical results suggest that tariff concessions increase import intensity and this effect is augmented by affiliate R&D intensity while mitigated by parent R&D intensity. These results imply a complementary relation between affiliate R&D and imported inputs and a substitutive relation between parent R&D and imported inputs. As imported inputs may contain foreign technology that is difficult to be transmitted to affiliates and affiliate R&D can be a channel of direct technology transfer, our results indicate that parent and affiliate R&D may have different functions that will affect the relation with imported inputs. In addition, we find that the impact of parent R&D is mainly on ordinary imports while the influence of affiliate R&D is on both ordinary and processing imports.

In the paper [B12], "**Place-based Policies, Innovation and Entrepreneurship: Evidence from China's Economic Zones**" (Li and Wang, *in progress*), we compile and analyze data to examine the micro-impact of a prominent place-based program in China—the Economic Zones: implementing special policies in an area within a jurisdiction, the goals of the zones are to increase foreign direct investment (FDI), domestic investment, international trade, technological cooperation and innovation, and employment. We exploit a natural experiment in the establishment of China's economic zones and goes to village level as administrative unit (9-digit administrative code level) to collect data for our empirical analysis. We have successfully compiled our database that captures encouraged and discouraged industries

in each economic zone so we are able to compare encouraged vs. discouraged industries and firms located inside vs. outside zone. Our database allows us to trace back the history of each economic zone and to identify firms' performance change before and after the implementation of the zone policy. Using firms as the unit of analyses, we aim to answer two questions. First, does the zone program boost firms' investment, employment, innovation and productivity? Second, what characteristics of targeted localities and programs are effective in promoting local entrepreneurship and technology progress? The findings of the project shed light on how place-based policies help nurture innovation and entrepreneurship in developing countries. This ongoing project greatly complements the existing literature, which has primarily focused on the impact of such place-based policies in the United States and in Europe.

# 3 Micro Evidence on Heterogeneous Firms' Responses to Various Macroeconomic Shocks

The heterogeneous firm model has been the workhorse model in international trade. Redding (2011) reviews the recent theoretical literature on heterogeneous firms and trade and discusses the empirical challenges. Melitz and Redding (2014) further reviews the new approach to international trade based on firm heterogeneity in differentiated product markets which highlights the usage of disaggregated trade data. Hottman, Redding, and Weinstein (2014) quantify four components of firm heterogeneity: costs, quality, markups, and product scope. Their results suggest that variation in quality and product scope explains at least four fifths of the variation in firm sales.

- Stephen J. Redding, 2011. "Theories of Heterogeneous Firms and Trade," *Annual Review of Economics*, vol. 3(1), pages 77-105.

- Marc J. Melitz & Stephen J. Redding, 2014. "Heterogeneous Firms and Trade," *Handbook of International Economics*, Elsevier.

- Colin J. Hottman & Stephen J. Redding & David E. Weinstein, 2016. "Quantifying the Sources of Firm Heterogeneity," *The Quarterly Journal of Economics*, Oxford University Press, vol. 131(3), pages 1291-1364.

My work in this area has been devoted to investigate highly disaggregated Chinese firm-level and firm-product level data and to explore the micro evidence on heterogeneous firms' responses to various shocks including trade liberalization, credit constraints, and exchange rate shocks etc. As I have extensively discussed my work on firms' quality choice and its

implications (see Section 1), in this section I will focus on my papers of other sources of firm heterogeneity such as markup and productivity.

## 3.1 Firm Competitiveness, Markups, and Productivity [A6] [B6] [B9] [B10]

In the paper [A6], "**Trade Liberalization and Markups: Micro Evidence from China**" (Fan, Gao, Li and Luong, 2017, *Journal of Comparative Economics, In Press*), we present evidence from highly disaggregated Chinese firm-product data that, given productivity, input tariff reductions induce an incumbent importer/exporter to increase product markups. We further investigate empirically the mechanisms underlying this trade liberalization effect, and find that input tariff reductions decrease marginal costs, and their effects on markup adjustments are more profound among firms with higher import dependence. Moreover, we exploit unique features of Chinese data by comparing results for two trade regimes: ordinary trade (wherein firms pay import tariffs to import) and processing trade (wherein firms are not subject to import tariffs). While the aforementioned trade liberalization effects and mechanisms only apply to ordinary trade, processing trade samples are used in a placebo test. The paper also shows that more productive firms charge higher markups for products. All these findings are robust to alternative markup measures including one estimate using physical-quantity output data, different production function specifications, a subsample consisting only of pure exporters, and estimations based on our theoretical derivations.

This paper contributes to the literature by examining whether lower tariffs on imported intermediates can cause firms to adjust firm-product markups for exported goods, and by determining the direction and size of such adjustments. In robustness checks, we also study the responses of firm-level markups, which measure firm competitiveness in both domestic and foreign markets. Nevertheless, our focus in this paper is on firm-product markup since highly disaggregate data on the firm-product level allows us to clearly distinguish between two different trade regimes. This paper has received 3 citations according to Google Scholar (including 1 from refereed journal).

Firms' competitiveness may be well affected by industrial policies that encourage agglomeration. Industrial clusters are promoted by policy and generally viewed as good for growth and development, but both clusters and policies may also enable non-competitive behavior. In the paper [B6], "**Growth Policy, Agglomeration, and (the Lack of) Competition**" (Brooks, Kaboski, and Li, January 2018, under review at *Review of Economic Studies*, earlier version available as *NBER* working paper No. 22947, also highlighted in *NBER Digest* March 2017), we study the presence of non-competitive pricing in geographic industrial clusters. We

develop, validate, and apply a novel screen for collusive behavior. We derive the screen from the solution to a partial cartel of perfectly colluding firms in an industry. Outside of a cartel, a firm's markup depends on its market share, but in the cartel, markups across firms converge and depend instead on the total market share of the cartel. Empirically, we validate the screen using plants with common owners, and then screen for collusion using data from Chinese manufacturing firms (1999-2009). We find strong evidence for non-competitive pricing within a subset of industrial clusters, and we find the level of non-competitive pricing is about four times higher in Chinese special economic zones than outside those zones.

Citations: This paper has received 1 citation from *Journal of the European Economic Association* (by F Zilibotti) and 1 from *Journal of Economic Growth*.

One of the most robust stylized facts that has emerged from more than 20 years of empirical research on firm heterogeneity in international trade is that exporters appear to be more productive than firms operating only on the domestic market. Surprisingly, one country where this pattern has not been found is China. Various explanations have been provided for this result, varying for the presence of export subsidies or easy access to financing or the fact that many Chinese manufacturers engage in processing trade. Given the fact that China has become the biggest exporter in the world, this striking result has attracted quite a lot of attention.

In the paper [B9], "**Physical Productivity and Exceptional Exporter Performance: Evidence from a Chinese Production Survey**" (Li, Smeets and Warzynski, 2017, under preparation for submission to *The Rand Journal of Economics*), we want to re-examine this apparent puzzle by looking at the question from another angle. In particular we investigate the role of pricing differences between firms.

We use a detailed dataset providing physical quantities produced by Chinese firms over the period 2000-2006. We combine this production survey with standard accounting data and with customs data in order to estimate production functions using both deflated revenue and physical quantity as a measure of output. As a consequence, we obtain two different estimates of total factor productivity: the standard revenue based productivity (TFPR) and the physical productivity (TFPQ). We then relate our two measures of productivity to export behavior of firms. We find that Chinese exporters for largely export oriented products like leather shoes or shirts appear to be less efficient than firms only involved on the domestic market based on the standard revenue productivity measure. However, we show strong positive export premium when we instead consider physical productivity. The simple and intuitive explanation of our results is that exporters charge on average lower prices. We focus more particularly on the role of processing trade and find that price differences are especially (and probably not surprisingly) large for firms involved in this type of contractual arrangements. We also discuss

how we could adapt our analysis to other products for which the domestic market plays a more important role. We contribute to a growing literature investigating the role of pricing heterogeneity bias on the measurement of productivity.

In the paper [B10], "**Trade Liberalization, Demand, and Markups of Multi-Product Firms**" (Fan, Li and Warzynski, revised in February 2018, under preparation for submission to *Journal of International Economics*), we study how multi-product firms reallocate resources across product and destination market via adjusting markups during trade liberalization and how this resource reallocation depends on product demand. We first document the stylized facts that products facing higher demand in general present larger markups, and trade liberalization induces ordinary trade firms (that pay import tariffs to import) to increase product markup more for its products facing higher demand, while this markup adjustment pattern is not significant or even ambiguous for processing trade firms (that are not subject to import tariffs). We incorporate the demand heterogeneity at product-destination level and the changes in firm's importing behavior under trade liberalization into a heterogeneous firm trade model. The model predicts that a higher demand attribute induces an incumbent exporter to set a higher markup of the exported product, and input tariff reductions lead to an increase in markup of the exported product. The tariff reduction effect on markup increase is more profound for products facing higher demand attribute. We estimate firm-product-country specific markup by modifying the methodology as in De Loecker, Goldberg, Khandelwal, and Pavcnik (2016), and measure the product-country specific demand by total export revenue of that product to a specific destination by all countries excluding China. The empirical results using Chinese disaggregate firm-product-country data confirm the model predictions and are robust to various econometric specifications. The results also show that the aforementioned effect of input tariff reduction only applies to ordinary trade through the adjustment of marginal costs, while the similar pattern does not obtain for processing trade observations.

- Jan De Loecker & Pinelopi K. Goldberg & Amit K. Khandelwal & Nina Pavcnik, 2016. "Prices, Markups, and Trade Reform," *Econometrica*, Econometric Society, vol. 84 (3), pages 445-510.

## 3.2 Firm Performance under Credit Constraints [A5] [A9] [B4]

There is a growing body of literature on the effects of credit constraints on international trade, especially after the financial crisis of 2008. Understanding firm performance under credit constraints is particularly important to developing countries such as China where financial market is usually immature. Feenstra, Li, and Yu (2014) examines why credit constraints for domestic and exporting firms arise in a setting where banks do not observe firms' productivities. They

find that the credit constraint is more stringent as a firm's export share grows. Thus, credit constraints play an important role in shaping firms' export performance. On this regard, I have three papers addressing firm performance under credit constraints.

- Robert C. Feenstra & Zhiyuan Li & Miaojie Yu, 2014. "Exports and Credit Constraints under Incomplete Information: Theory and Evidence from China," *The Review of Economics and Statistics*, MIT Press, vol. 96(4), pages 729-744.

The first paper is [A5], "**Credit Constraints, Quality, and Export Prices: Theory and Evidence from China**" (Fan, Lai, and Li, 2015, *Journal of Comparative Economics*), which has been discussed under the theme of export quality in Section 1.2 "Quality, Export Prices and Credit Constraints".

In the paper [A9], "**Credit Constraints and Firm Productivity: Microeconomic Evidence from China**" (Li, Liao and Zhao, 2017, *Research in International Business and Finance*), we use a panel of over 600,000 Chinese firms (1998–2009) to investigate the effects of credit constraints on firm productivity. We find that both internal finance through a firms own cash flow and external credit supply significantly promote firm productivity and productivity growth rates. Specially, there is a substitution effect between internal finance and external credit supply: the marginal effect of internal finance on firm productivity is weaker when firms have sufficient external credit. Also, internal finance is more important for firms in those financially vulnerable industries. Finally, we observe that marginal effect of both external credit supply and internal finance on firm's productivity is weaker for SOEs than non-SOEs.

In the paper [B4], "**Credit Distribution and Export: Microeconomic Evidence from China,**" (Li, Park and Zhao, revise and resubmit at *Journal of Comparative Economics*), we explore how the distribution of credit supply among firms within an industry affects that industry's export intensity (the export-to-sales ratio) and export propensity (the ratio of the number of exporters to the total number of firms). Based on a heterogeneous firm trade model, we derive two opposing hypotheses: for industries with relatively low foreign market penetration costs, a more dispersed credit distribution decreases the industry's export intensity and the number of exporters; conversely, for industries with relatively high foreign market penetration costs, the dispersion of credit increases the export intensity and the number of exporters. We test these two hypotheses using Chinese firm-level data and Chinese bank loan data. The empirical results support both hypotheses and confirm the significant heterogeneous impacts of the credit distribution on exports across industries.

## 3.3 Forward-Looking Firms and Import Responses to Exchange Rate Movements: Micro-foundation in Empirical International Macroeconomics [A4] [A7] [B7]

Price responses to exchange rate movements are one of the central topics in international economics. Many studies have endeavored to provide potential explanations for the low exchange rate pass-through coefficients. Various macroeconomic variables have been found to affect the aggregate price response to exchange rate changes. Yet, the micro-level evidence for determinants of exchange rate pass-through remains understudied, though the recent development of the literature has witnessed emerging studies that examine micro-level, especially firm-level, responses to *current* exchange rate fluctuations based on disaggregated trade data. More importantly, the role of *expected* future exchange rate movements has been largely overlooked. Do firms also react to future exchange rate when making import/export decisions? Do they respond differently along the intensive and extensive margins when facing contemporaneous and future exchange rate movements? The existing studies remain silent on these questions. To answer those questions, I work on the following three papers to study forward-looking behavior of firms and their responses to future expected exchange rate shocks. The first two papers are co-authored with former HKUST PhD students.

In the paper [A4], "**Margins of Imports, Forward-Looking Firms, and Exchange Rate Movements**" (Fan, Li and Zhao, 2018, *Journal of International Money and Finance*), we present theory and evidence on firms' import responses to *current* and *future* exchange rates along both intensive and extensive margins. In the paper we first build a dynamic heterogeneous-firm model to study how firms adjust their import decision by taking into account of both current and future exchange rates. In the model, individual firms pay a fixed sunk cost and face a probability of failure when searching for foreign intermediate suppliers. The impact of future exchange rate on import is different from that of current exchange rate: spot exchange rate appreciation would increase both the intensive margin (import value of individual firm) and the extensive margin (the number of importing firms), while future exchange rate appreciation increases the extensive margin rather than the intensive margin of imports. The model predictions are strongly supported by an empirical analysis using disaggregated data on China's imports from the United States and forward rates between US Dollar (USD) and Chinese Yuan (CNY) on the non-deliverable exchange market.

In the paper [A7], "**Price Adjustment to Exchange Rates and Forward-looking Exporters: Evidence from U.S.-China Trade**" (Li and Zhao, 2016, *Review of International Economics*), we fill a gap in the literature by exploring firms' forward-looking behavior in the presence of sticky prices to provide micro-level evidence that shows how firms adjust

trade prices in response to not only *current* but also future *expected* exchange rate movements. We show that the pricing behavior of exporting firms exhibits a "forward-looking" nature with sticky prices. As a result, the expectations of *future* exchange rates affect *current* prices at both the product level and firm level. We find evidence by employing both highly disaggregated HS-10 product-level import data of the United States and firm-product level customs data on China's exports to the United States. These findings provide evidence for a previously unexplored micro-level forward-looking nature of trade price adjustment as response to future exchange rates, and suggest a potentially important factor in helping explain incomplete exchange rate pass-through.

Given the increased RMB exchange rate fluctuations and the larger spillover effect of Chinese economy to other economies through trade channels, it is essential to understand the effect of exchange rate changes on China's import demand. In the paper [B7], "**Import response to exchange rate fluctuations: A micro-level investigation**" (Li, Xu and Zhao, 2017, under revision for submission to *Journal of International Money and Finance*), we present micro-level evidence on firms' import responses to exchange rate fluctuations along different margins using highly disaggregated data of Chinese imports. We first develop a simple heterogeneous-firm trade model, making predictions on firms' import responses at both extensive and intensive margins. We then investigate if these predictions are consistent with the empirical evidence. We find that, for all sectors as a whole, when domestic currency appreciates, more firms start importing and more products are added into the imported inputs bundle (extensive margin effect), and the import value by each firm also increases (intensive margin effect). However, there exists observed import response heterogeneity when detailed sector-by-sector analysis is conducted. Finally, as supported by the model, we also find that these firm-level import responses are more profound for ordinary trade firms than for processing trade firms.

# 4 Other Papers on Chinese Economy [A8] [B5] [B8]

I am strongly interested in studying Chinese economy related research questions, and my other papers are all clustered under this theme.

In the paper [A8], "**The Higher Educational Transformation of China and Its Global Implications**" (Li, Whalley, Zhang, and Zhao, 2011, *The World Economy*), we discuss the major transformation of higher education that has been underway in China since 1999 and evaluates its potential global implications. Reflecting China's commitment to continued high growth, this transformation focuses on major new resource commitments to tertiary

education and significant changes in organizational form. All of these changes have already had large impacts on China's higher educational system and are beginning to be felt by the global educational structure. This focus on tertiary education differentiates the Chinese case from other countries who earlier at similar stages of development instead stressed primary and secondary education.

*Citations*: This paper has been well cited by studies on Chinese economy. It receives 147 citations according to Google Scholar, and 21 citations according to Scopus.

In the paper [B5], "**Coagglomeration of MNEs in Service and Manufacturing Industries: Evidence from China**" (Li and Zhang, revise and resubmit at *Journal of Economic Geography*), we test different agglomerative forces in the coagglomeration patterns of service multinational enterprises (MNEs) and investigate how they compare with and relate to the coagglomeration of manufacturing MNEs using Chinese firm-level data. We find that the coagglomeration of service MNEs is largely driven by output similarity (shared customers), followed by knowledge spillovers. In contrast, labor market pooling is the most important driving force for the coagglomeration of manufacturing MNEs, followed by input similarity (shared suppliers). Meanwhile, knowledge spillovers facilitate coagglomeration between MNEs in two industries within the same sector, but not across sectors.

It is well known that international trade theory emphasizes comparative advantage in explaining the distribution of industries across countries or regions, and comparative advantages are usually determined by technology, endowments, or scale economies. However, unfortunately, compared with other traditional determinants of comparative advantages, we know much less about *how* the revealed comparative advantage (RCA) is affected by relatedness between industries. In other words, little has been explored about how the linkages between an industry and the existing industrial structure of a region determine the evolution of the RCA of that industry in that region.

In the paper [B8], "**Sources of Relatedness between Industries and Revealed Comparative Advantage: Evidence from China**" (Li and Zhu, 2017, under preparation for submission to *Journal of International Economics*), we present empirical evidence from disaggregated Chinese industrial data (1998-2009) to uncover how the RCA of an industry in a region is affected by the relatedness between industries. We quantify relatedness and employ a density measure built upon proximities between industries. We further decompose the sources of relatedness into four mechanisms: input linkage, output linkage, labor market pooling, and knowledge spillovers. To address the identification issue, we employ the interaction between nationwide industry-level FDI policy and regional industrial structure in China to further test the mechanisms of industry relatedness and their impacts on RCA.

There are three main findings. First, all four sources of relatedness significantly increase

the future probability of an industry to have RCA in that region, and the future RCA of an industry is mostly driven by its relatedness with other local industries regarding labor pooling and knowledge spillovers. Second, industries with higher capital or skill intensity benefit more from being located in the same region with other industries using similar labor, while benefit less from knowledge spillover from other local industries. In other words, the effect of knowledge spillover for capital or skill intensive industry is much smaller than that for labor intensive industries. Third, the aforementioned findings are further confirmed by the tests using FDI policies in China: FDI encouragement policies tend to be more successful in regions with higher labor pooling density, but less successful in regions with higher knowledge spillover density. Our results are robust to alternative measures of labor pooling density, different aggregation level of regions, and controlling for endowment driven comparative advantage.

# References

### Publications in Refereed Journals


[A1] "**Trade Liberalization, Quality, and Export Prices,**" with Haichao Fan and Stephen Yeaple, *Review of Economics and Statistics*, December 2015, Volume 97 (5), pp. 1033-1051.

[A2] "**On the Relationship Between Quality and Productivity: Evidence from China's Accession to the WTO,**" with Haichao Fan and Stephen Yeaple, *Journal of International Economics*, forthcoming. Earlier version available as NBER working paper No. 23690, August 2017.

[A3] "**Borders and Distance in Knowledge Spillovers: Dying over Time or Dying with Age? — Evidence from Patent Citation,**" *European Economic Review*, October 2014, Volume 71, pp. 152-172.

[A4] "**Margins of Imports, Forward-Looking Firms, and Exchange Rate Movements,**" with Haichao Fan and Chen Carol Zhao, *Journal of International Money and Finance*, forthcoming.

[A5] "**Credit Constraints, Quality, and Export Prices: Theory and Evidence from China,**" with Haichao Fan and Edwin Lai, *Journal of Comparative Economics*, May 2015, Volume 43 (2), pp. 390-416.

[A6] "**Trade Liberalization and Markups: Micro Evidence from China,**" with Haichao Fan, Xiang Gao, and Tuan Anh Luong, *Journal of Comparative Economics*, 2017 (In Press).

[A7] "**Price Adjustment to Exchange Rates and Forward-looking Exporters: Evidence from U.S.-China Trade,**" with Chen Carol Zhao, *Review of International Economics,*, November 2016, Volume 24 (5), pp. 1023–1049.

[A8] "**The Higher Educational Transformation of China and Its Global Implications,**" with John Whalley, Shunming Zhang, and Xiliang Zhao, *The World Economy*, April 2011, Volume 34(4), pp. 516-545.

[A9] "**Credit Constraints and Firm Productivity: Microeconomic Evidence from China,**" with Wei Liao and Chen Carol Zhao, *Research in International Business and Finance*, 2017 (In Press).

**Working Papers**

[B1] "**Geography, Ties, and Knowledge Flows: Evidence from Citations in Mathematics,**" with Keith Head and Asier Minondo, revise and resubmit at *Review of Economics and Statistics*.

[B2] "**Quality, Variable Markups, and Welfare: A Quantitative General Equilibrium Analysis of Export Prices,**" with Haichao Fan, Sichuang Xu, and Stephen Yeaple, 2017, revise and resubmit, *Journal of International Economics*.

[B3] "**International trade, technology diffusion, and the role of diffusion barriers,**" revise and resubmit at *Canadian Journal of Economics*.

[B4] "**Credit Distribution and Export: Microeconomic Evidence from China,**" with Albert Park and Chen Carol Zhao, revise and resubmit at *Journal of Comparative Economics*.

[B5] "**Coagglomeration of MNEs in Service and Manufacturing Industries: Evidence from China,**" with Jin Zhang, revise and resubmit at *Journal of Economic Geography*.

[B6] "**Growth Policy, Agglomeration, and (the Lack of) Competition,**" with Wyatt Brooks and Joseph Kaboski, January 2018, under review at *Review of Economic Studies*. Earlier version available as NBER working paper No. 22947, December 2016. Highlighted in NBER Report: *The NBER Digest*, March 2017.

[B7] "**Import response to exchange rate fluctuations: A micro-level investigation,**" with Jenny Xu and Chen Carol Zhao, November 2017. Under preparation for submission to *Journal of International Money and Finance*.

[B8] "**Sources of Relatedness between Industries and Revealed Comparative Advantage: Evidence from China,**" with Linke Zhu, December 2017. Under preparation for submission to *Journal of International Economics*.

[B9] "**Physical Productivity and Exceptional Exporter Performance: Evidence from a Chinese Production Survey,**" with Valerie Smeets and Frederic Warzynski, December 2017. Under preparation for submission to *The Rand Journal of Economics*.

**Papers in Progress**

[B10] "**Trade Liberalization, Demand, and Markups of Multi-Product Firms,**" with Haichao Fan and Frederic Warzynski, previous version: May 2017, revised in February 2018. Under preparation for submission to *Journal of International Economics*.

[B11] "**Multinational R&D, Import Intensity, and Price,**" with Loretta Fung and Jin-Tan Liu.

[B12] "**Place-based Policies, Innovation and Entrepreneurship: Evidence from China's Economic Zones,**" with Jin Wang.