

令和 5 年 6 月 5 日現在

機関番号：12601
研究種目：若手研究
研究期間：2020～2022
課題番号：20K13476
研究課題名（和文）International Trade and Inventory Management

研究課題名（英文）International Trade and Inventory Management

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交付決定額（研究期間全体）：（直接経費） 3,200,000円

研究成果の概要（和文）：私たちの研究目的は、企業データを使い、異質企業・国際貿易・在庫管理を統合した包括的モデルを開発・推定することでした。第一の目標を達成し、望ましい特徴を持つモデルを作成し、経済メカニズムの説明や文献との比較に役立つ数学的結果を提供しました。実証的な作業では、中国の税関データや土地価格・倉庫費用・貨物輸送証券と整合性を図り、デンマーク・ベトナム・インド・パラグアイ・チリ・パナマ・ペルー・コロンビア・メキシコの関税や関連データを分析しました。適切なデータセット・推定戦略・実証的演習リストを特定しました。

研究成果の学術的意義や社会的意義

Our research reveals how inventory management impacts international trade. Quantitative analysis of shipment and inventory costs informs businesses, policymakers, and economists. This understanding enhances trade policies, inventory management, and economic outcomes globally.

研究成果の概要（英文）：Our study aimed to develop a comprehensive model integrating heterogeneous firms, international trade, and inventory management, estimating it using firm-level data. We successfully achieved the first objective, creating a model with desired features and deriving key theoretical results. The model's tractability is a significant advantage, providing sharp mathematical outcomes to explain economic mechanisms and compare with existing literature. This tractability also simplifies estimation and numerical analysis. We devoted substantial time to empirical work, exploring various datasets to estimate parameters and validate economic mechanisms. We worked extensively with Chinese customs data, aligning it with land prices, warehouse costs, and bills of lading. We also analyzed customs and relevant data from Denmark, Vietnam, India, Paraguay, Chile, Panama, Peru, Colombia, and Mexico. We identified suitable datasets, an estimation strategy, and a list of empirical exercises.

研究分野：International Trade

キーワード：international trade inventory management trade costs heterogeneous firms

1 . 研究開始当初の背景

The magnitude of trade costs required to reconcile a typical trade model with international trade data is remarkably high. For instance, Eaton and Kortum (2002) reported that the estimated tariff equivalent of trade costs for 19 OECD countries in 1990 ranged from 123% to 174% of the trade value. These figures pose a perplexing challenge for international trade economists striving to explain this phenomenon (Anderson and van Wincoop, 2004). Understanding the scale of trade costs necessitates exploring their sources, which, in turn, have far-reaching implications for key inquiries in modern international trade literature: the nature of traded goods, the firms engaged in export activities, the magnitude of trade gains, and the formulation of optimal trade and industrial policies.

Previous explanations for the sources and magnitudes of trade costs have included aggregation bias (Coughlin and Novy, 2016), multi-stage production spanning international borders (Yi, 2010), economic and policy uncertainty (Carballo, Handley, and Limao, 2018), and information frictions (Allen, 2014). However, there is another potential explanation that has received comparatively less attention in theoretical trade literature: the costs associated with shipping goods and managing inventory. Empirical studies on trade have unearthed evidence of "lumpiness" in international trade, where fixed shipment costs prompt exporters to engage in infrequent yet substantial shipments (Alessandria et al., 2010; Horonok and Koren, 2015). Consequently, firms are compelled to undertake extensive inventory management, further adding to the costs of exporting.

Despite its relative neglect in international trade literature, inventory management has been extensively studied in other domains of economics. The optimal inventory problem, as highlighted by Ada and Cooper (2003), has been a subject of early research in dynamic optimization within economics, pioneered by Arrow et al. (1951). Inventories have also played a role in business cycle literature, with the study of inventory dynamics tracing back to Hawtry (1928) and more recent examinations by Kryvtsov and Midrigan (2013).

Given the acknowledged significance of inventory management in other economic contexts and its noteworthy impact on the structure of international trade (i.e., "lumpiness"), several fundamental questions arise: What proportion of trade costs can be attributed to the costs of shipment and inventory management? What are the welfare and policy implications when considering the challenges firms face in inventory management?

2 . 研究の目的

The study aimed to accomplish the following objectives:

- i. Develop a comprehensive model that integrates heterogeneous firms, international trade, and inventory management. A crucial aspect was to construct an analytically tractable model suitable for empirical and quantitative analysis.
- ii. Estimate the model using firm-level data. Overcoming endogeneity challenges required identifying suitable datasets and employing instrumental variables.
- iii. Empirically validate the key economic mechanisms of the model through a series of quantitative exercises. The challenge was to convincingly demonstrate that our model could capture important real-world features that other models failed to explain.

3 . 研究の方法

During the development of our theoretical model, significant effort was dedicated to ensuring its tractability by formulating realistic yet sufficiently simple assumptions. Multiple iterations were carried out to refine these assumptions and derive the model's properties. Subsequently, substantial time was invested in explaining the economic intuition behind our results and establishing connections with existing literature. To gather feedback and enhance our theory, we presented our theoretical findings at various workshops and seminars.

After completing the theoretical aspect, our focus shifted to the empirical part of the project. We extensively explored numerous datasets to identify the most suitable data for estimating key parameters of our model and validating its main economic mechanisms. Overcoming

endogeneity challenges in parameter estimation and providing insightful applications of our model were crucial. Chinese customs data, which we had access to from previous projects, played a central role. We aimed to align it with Chinese data on land prices, warehouse costs, and bills of lading. Additionally, we analyzed customs and other pertinent data from several countries, including Denmark, Vietnam, India, Paraguay, Chile, Panama, Peru, Colombia, and Mexico.

We continued to present our work at various conferences, seeking feedback from experts in the international trade literature, such as Prof. Taiji Furusawa of the University of Tokyo, Prof. Andres Rodriguez-Clare of the University of California at Berkeley, and Prof. Stephen Yeaple of the Pennsylvania State University. We also met with specialists in the transportation industry (e.g., Prof. Takuma Matsuda of the Takushoku University) to get more insights into practical aspects of international transportation of goods. Based on the feedback received and the outcomes of working with diverse datasets, we identified the appropriate set of data, devised an estimation strategy, and outlined a series of empirical exercises that we intend to undertake using our model.

4 . 研究成果

We have successfully accomplished the first objective of our study. Specifically, we have developed a model that exhibits the desired characteristics and derived its key theoretical outcomes. One noteworthy feature of our model is its tractability, as it produces sharp mathematical results. This feature proves invaluable in elucidating the economic intuition underlying the main mechanisms of our model and facilitating comparisons with other existing models in the literature. Moreover, the tractability of our model significantly simplifies its estimation and numerical analysis.

The second and third objectives required a considerable amount of time. While we had a series of intermediate results (that are described in a current draft of our paper), it is only recently, toward the end of the formal research project period, that we have devised appropriate estimation strategies and discovered intriguing economic applications of our model. At present, we possess all the necessary data and computational resources to pursue the second and third objectives in the upcoming year. Once the model estimation and quantitative analysis are complete, we will prepare a draft of our paper for submission to a top-tier economics journal.

5. 主な発表論文等

〔雑誌論文〕 計3件（うち査読付論文 3件／うち国際共著 3件／うちオープンアクセス 1件）

1. 著者名 Ivan Deseatnicov, Konstantin Kucheryavyy, and Kyoji Fukao	4. 巻 28
2. 論文標題 Exports, trade costs and FDI entry: evidence from Japanese firms	5. 発行年 2021年
3. 雑誌名 Transnational Corporations	6. 最初と最後の頁 1-34
掲載論文のDOI（デジタルオブジェクト識別子） 10.18356/2076099x-28-3-1	査読の有無 有
オープンアクセス オープンアクセスとしている（また、その予定である）	国際共著 該当する

1. 著者名 Kucheryavyy Konstantin, Lyn Gary, Rodriguez-Clare Andres	4. 巻 15
2. 論文標題 Grounded by Gravity: A Well-Behaved Trade Model with Industry-Level Economies of Scale	5. 発行年 2023年
3. 雑誌名 American Economic Journal: Macroeconomics	6. 最初と最後の頁 372-412
掲載論文のDOI（デジタルオブジェクト識別子） 10.1257/mac.20190156	査読の有無 有
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1. 著者名 Bhattarai Saroj and Kucheryavyy Konstantin	4. 巻 forthcoming
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3. 雑誌名 Journal of the European Economic Association	6. 最初と最後の頁 forthcoming
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〔学会発表〕 計17件（うち招待講演 8件／うち国際学会 2件）

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1. 発表者名 Konstantin Kucheryavyy
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4. 発表年 2021年

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2. 発表標題 A Tractable Model of Trade with Flexible Cost Structure
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4. 発表年 2021年

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2. 発表標題 A Tractable Model of Trade with Flexible Cost Structure
3. 学会等名 European Trade Study Group
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4. 発表年 2021年

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3. 学会等名 University of Tokyo, Tokyo, Japan
4. 発表年 2020年

〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

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7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関
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