Journal of International Economics 92 (2014) 51–62

Contents lists available at ScienceDirect

Journal of International Economics

journal homepage: www.elsevier.com/locate/jie

Trade-in-goods and trade-in-tasks: An integrating framework

Richard Baldwin [a,c,e], Frédéric Robert-Nicoud [b,c,d,*]

[a] Graduate Institute, Geneva, Switzerland
[b] University of Geneva, Switzerland
[c] CEPR, United Kingdom
[d] SERC, United Kingdom
[e] NBER, United States

ARTICLE INFO

Article history:
Received 10 October 2011
Received in revised form 3 October 2013
Accepted 3 October 2013
Available online 24 October 2013

JEL classification:
F11
F16

Keywords:
Offshoring
Fragmentation
Task trade
Trade theorems

ABSTRACT

We introduce a simple but flexible analytical framework in which both trade in goods and trade in tasks arise. We use this framework to provide versions of the gains-from-trade and the famous four HO theorems (Heckscher–Ohlin, factor-price-equalisation, Stolper–Samuelson, and Rybczynski) that apply to this environment. We extend our framework to accommodate monopolistic competition and two-way offshoring and to integrate theoretical results of the early offshoring literature.

1. Introduction

A growing list of economists argues that the nature of international trade is changing in important ways.[1] Instead of simply creating more trade in goods, global integration is increasingly marked by trade of intermediate goods and services, also known as 'fragmentation', 'offshoring' or 'task trade'. The importance of this trade has been clarified with new data sets that remove the double counting in customs statistics that arises when intermediates cross borders on their own and then are embodied in further processed goods (Johnson and Noguera, 2012; Koopman et al., 2010). The new trade numbers are called 'value added' trade to distinguish them from the 'gross' trade flows that are traditionally measured.

In this paper, we introduce a simple but flexible analytical framework in which both trade in goods and trade in tasks arise endogenously in response to exogenous changes in the cost of moving goods and services. We then use this framework to provide versions of the traditional four theorems (Heckscher–Ohlin–Vanek, factor-price-equalisation, Stolper–Samuelson, and Rybczynski) that are valid when both trade in goods and trade in tasks occur. We also revisit the gains-from-trade theorem. Finally, we show how specific assumptions in the offshoring literature simplify the analysis and lead to specific and strong results in our framework.

Integrating task-trade into the trade-in-goods literature is important for at least three reasons. First, a substantial fraction of world output remains traded across international boundaries and trade in components and intermediate services represents a growing fraction of this trade (WTO, 2008). It is thus important to study these facts jointly.

Second, this trend has elicited a substantial number of theoretical contributions, reviewed in some detail below, that is marked by a wide range of cases where outcomes seemingly contradict standard trade theory results. We show that this arises because task trade and trade in goods display interesting similarities but task trade differs in that it typically involves some kind of technology transfer that is akin to *product-augmenting technical change* of the type identified by Dixit and Norman (1980, chapter 5).

Third, this technological transfer interacts with traditional sources of comparative advantage and these interactions require that the traditional four theorems be amended. Specifically, trade in tasks: i) becomes a source of comparative advantage in final goods which means that the Heckscher–Ohlin–Vanek and the factor-price-equalisation theorems break down in their standard formulation. ii) Has important wage effects beyond and above those predicted by the standard Stolper–Samuelson theorem, and iv) implies 'shadow migration' that exhibits Rybczynski-like effects on production and trade patterns for final goods.

* Corresponding author at: Department of Economics, University of Geneva, CH-1211 Genève 4, Switzerland.
E-mail address: frederic-robert-nicoud@unige.ch (F. Robert-Nicoud).

[1] Inter alia, Blinder (2006, 2009), Grossman and Rossi-Hansberg (2006, 2008, 2012), Hanson et al. (2005), Hummels et al. (2001), and Jones and Kierzkowski (1990). The 'task trade' terminology was introduced by Grossman and Rossi-Hansberg (2008).

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http://dx.doi.org/10.1016/j.jinteco.2013.10.002

Formally, we extend the traditional Heckscher–Ohlin–Vanek (henceforth HO) framework to allow for trade in tasks in the wake of Grossman and Rossi-Hansberg (2008), henceforth GRH. In our model, there are two countries, Home and Foreign, producing final goods by combining tasks, each of which involves primary factors of production. Importantly, Home has a Hicks-neutral technological superiority. Thus before task-trade becomes possible, Home wages are higher even though there is conditional factor price equalisation. This wage gap drives the offshoring when trade in some, but not all, tasks becomes feasible.

Task trade has five noteworthy consequences in this environment.

First, the reduction in Home firm production costs due to offshoring (i.e. task trade) is analogous to a technical change (the 'productivity effect' in GRH), so at least some – and possibly all – Home factor prices must rise. This analogy and this finding are central to the analysis of GRH.

Second, offshoring is akin to 'shadow migration' — i.e. it is as if foreign factors migrated to the offshoring nation and we show that the quantity effects on production and trade in final goods follow the logic of the Rybczynski theorem. This analogy, to the best of our knowledge, is novel.

Third, the combination of heterogeneous factor intensities at the task level implies heterogeneous task intensities at the final good level so that Home's effective technological superiority is no longer Hicks-neutral. Put differently, trade patterns in final goods are now governed by a combination of Ricardian and HO forces. The four traditional HO theorems break down in this environment. A key contribution of our paper is to transform the HO equations using shadow endowments instead of actual ones and to establish analogues to the traditional HO theorems in this modified version.

Fourth, we show that task-trade creates intraindustry trade in a Walrasian economy.

Finally, starting from an equilibrium with trade in goods but no task trade, allowing for offshoring has ambiguous welfare effects because it affects the terms-of-trade. In this respect, increasing access to trade at the extensive margin is similar to increasing it at the intensive margin; more trade unambiguously raises the welfare of a country only starting from autarky.[2]

Our framework departs from the offshoring literature of the 1990s and early 2000s (which we review below) by making two specific assumptions — arbitrage opportunities arising from Hicks-neutral technology differences (an assumption we maintain throughout) and Leontief technologies (an assumption we sometimes relax). This enables us to obtain strong analytical results and precise conditions to sign the factor price, output, and trade effects of offshoring, another key novelty of our paper. Several of these effects are comparable to results uncovered by this early literature and we also show under which conditions they also arise in our setting. In this sense, our framework enables us to integrate this literature within the standard HO toolkit.

We conclude the paper with an extension that departs further from the early offshoring literature by assuming that task trade implies technology diffusion. In this environment, offshoring has novel price and quantity effects on the host country, Foreign. Finally, we extend the basic framework to accommodate monopolistic competition and two-way offshoring/task-trade.

1.1. Existing literature

Our paper integrates and extends a large body of theoretical literature in trade theory. The early HO theory incorporates trade in intermediate goods (Batra and Casas, 1973; Woodland, 1977; Dixit and Grossman, 1982; Helpman, 1984) and the 1990s saw a number of informal analyses of fragmentation as well as some formal modelling (Deardorff, 1998a,b; Venables, 1999). Task-trade issues, however, were more recently crystallised by Kohler (2004a), Markusen (2006), Antràs et al. (2006), and Grossman and Rossi-Hansberg (2006, 2008).

The most commonly cited reference in the early offshoring/fragmentation literature is the diagrammatic analysis of Jones and Kierzkowski (1990), which seems to be the first to leverage the insight that fragmentation acts as technological progress and should therefore be expected to have complex wage effects. The ensuing line of modelling typically works with small open economies where fragmentation occurs in one sector and in one direction.[3] The focus of the analysis is firmly on wage effects. Jones and Kierzkowski (1990), for instance, argue that workers whose jobs are 'lost' to offshoring may, somewhat paradoxically, see their wages rise in some special cases.

Among the mathematical formalisations of fragmentation, Deardorff (1998a,b) studies fragmentation in a multi-cone HO model where cost-saving offshoring is driven by non-factor price equalisation. The focus is on factor prices and showing that task-trade need not foster wage convergence. Venables (1999) works with a $2\times2\times2$ HO model where offshoring is cost saving due to non-factor price equalisation arising from a factor-intensity reversal. Fragmentation occurs in one industry and in one direction. He uses numerical simulations and Lerner–Pearce diagrammatic analysis to study examples where task-trade produces wage convergence and divergence. Kohler (2004a) works with a small-open-economy specific-factor model where fragmentation occurs in one sector. The focus is on the reward to the specific capital that moves offshore when fragmentation occurs and on the overall welfare effects on the home nation. Markusen (2006) works with a multi-cone HO model that he simulates numerically assuming that fragmentation occurs in the skill-intensive sector and the fragment is of middle skill-intensity. He typically finds that skilled workers gain. Kohler (2004b) works with a small open economy where fragmentation/offshoring can only happen in one sector, using the Dixit and Grossman (1982) model with a continuum of intermediate goods; he shows that cheaper offshoring raises or lowers factor prices according to the relative factor intensity of the two sectors and the fragments offshored. We add production and trade effects to this literature. By imposing additional structure on the model, we are also able to repeat some of its simulation findings by analytic means.

More recently, Grossman and Rossi-Hansberg (2006, 2008) present a perfect competition model where two final-goods are produced using two continuums of tasks, each employing only one type of labour. Offshoring arises endogenously and the range of tasks offshored varies continuously with the cost of offshoring. The paper formalises the analogy between offshoring and technological change (the 'productivity effect') showing that task-trade, unlike trade-in-goods, can generate gains for all factors in the offshoring nation. The paper establishes necessary and sufficient conditions for wage-changes in the small open economy case with two factors and two goods. It also explores the novel labour supply effect that influences wages when there are more factors than goods.

There also exists a string of recent offshoring papers that are not encapsulated by our integrating approach. Rodriguez-Clare (2010) embodies the GRH approach in a Ricardian model à la Eaton and Kortum (2002). He studies the impact of task-trade on the gains from trade for the home and host nations. Global welfare rises due to offshoring's productivity effect, but terms-of-trade effect can mean that the home nation loses despite this. Antràs et al. (2006, 2008) propose a model in which all tasks are potentially offshorable. The focus is on the formation, composition and size of (cross-border) teams when workers have different abilities (skills), and countries have different skill endowments. Among other results, they show that improved communication technology yields larger teams and larger wage inequalities. Their model also provides a trade-induced explanation for the rise in returns to skills. Fujita and Thisse (2006) and Robert-Nicoud (2008) study how offshoring interacts with

[2] The gains-from-trade results in our paper were simultaneously and independently developed by Markusen (2013). Both papers use the methodology introduced by Dixit (1985). Markusen then applies the analysis to the positive models developed by Markusen and Venables (2007) and GRH.

[3] See Jones and Marjit (1992), Arndt (1997, 1999), Findlay and Jones (2000, 2001), Jones and Kierzkowski (2000, 2001), Jones et al. (2002), and Francois (1990a,b,c).