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### **A MULTI-MODE PARTIAL EQUILIBRIUM MODEL OF TRADE IN PROFESSIONAL SERVICES**

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## ABSTRACT

We develop a partial equilibrium analysis of trade in services based on the theoretical model with firm heterogeneity and multiple modes of supply in Helpman, Melitz, and Yeaple (2004). We calibrate the model to the U.S. markets for architectural and engineering services and legal services, and then we estimate the economic impact of reducing fixed costs of supplying U.S. markets for these two types of professional services through cross-border trade and affiliate transactions. For example, we estimate that 50 percent reductions in the fixed costs of trade in these professional services would have large effects on the value of cross-border imports into the U.S. market and on foreign affiliate purchases in the U.S. market but would have only small effects on the sales of domestic producers and on overall prices of the services in the U.S. market. The modeling framework can be easily reapplied to other national markets and other types of services (or goods) with multiple modes of supply if industry data are available.

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## 1. Introduction

Partial equilibrium modeling is a popular tool in trade policy analysis. Because of its relatively narrow focus on particular industries, partial equilibrium analysis is especially useful for quantifying the economic impact of industry-specific changes in trade policy.<sup>1</sup> Even so, partial equilibrium models are rarely used to analyze trade in services. To address this analytical gap, we develop a set of partial equilibrium models of trade in services.

Developing an economic model of trade in services is not simply a matter of reapplying the standard partial equilibrium framework to a new set of products, because there are distinctive characteristics of trade in services that need to be built into the model. First, the international provision of services occurs through several alternative modes of supply, captured in trade statistics such as cross-border trade and foreign affiliate transactions.<sup>2</sup> Second, there are often significant fixed costs of entering different national markets. Third, the services of each provider are usually highly differentiated products. And, finally, although there are no tariffs or freight charges on cross-border trade in services, there can be significant non-tariff barriers to trade.

The Helpman, Melitz, and Yeaple (HMY) model of cross-border trade and horizontal foreign direct investment is well-suited for analyzing trade liberalization in services industries.<sup>3</sup> The model includes heterogeneity in the productivity of service providers from each country, alternative modes for supplying foreign markets, and fixed costs that are barriers to each mode of supply. Helpman, Melitz, and Yeaple derive closed-form solutions for the values of cross-border exports

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<sup>1</sup> In contrast, it can be challenging to capture the fine details of trade policy changes using general equilibrium models that include the entire economy but rely on highly aggregated data.

<sup>2</sup> Cross-border trade roughly corresponds to mode 1 (cross-border supply), mode 2 (consumption abroad), and mode 4 (temporary movement of natural persons), while foreign affiliate transactions roughly correspond to mode 3 (commercial presence) in the General Agreement on Trade in Services (GATS) framework for services trade. Francois and Hoekman (2010) discuss the differences between the modes. Van der Marel and Shepherd (2013) provide evidence of inter-modal switching in trade in services.

<sup>3</sup> Helpman, Melitz, and Yeaple did not originally apply their model to services industries. Their empirical analysis only includes manufacturing industries. Riker (2015) applies the HMY framework to services industries, but his data are not disaggregated by category of service.

and foreign affiliate sales, based on specific functional forms that represent consumer preferences, trade costs, and the distribution of productivity levels across individual firms. There is a large literature that empirically tests – and generally supports – the predictions of the HMY model, including Girma, Kneller, and Pisu (2005) for U.K. firms, Tomiura (2007) for Japanese firms, Yeaple (2008) for U.S. firms, and Engel and Procher (2012) for French firms.

In this paper, we use a partial equilibrium version of the HMY model to simulate the impact of trade liberalization in two professional services industries that supply services in foreign markets through multiple modes of delivery: architectural and engineering services and legal services. In our specific applications, we estimate the effect of reducing fixed costs of exporting into the United States and the incremental fixed costs of foreign affiliate provision of two categories of professional services in the United States. We estimate that 50 percent reductions in the fixed costs of trade in these professional services would have large effects on the value of cross-border imports into the U.S. market and on foreign affiliate purchases in the U.S. market, but would have only small effects on the sales of domestic producers and on overall prices of the services in the U.S. market.<sup>4</sup> Holding the incremental fixed costs of foreign affiliate provision constant, a 50 percent reduction in the fixed costs of exporting into the U.S. market would increase cross-border imports by approximately 52 percent (architectural and engineering services) and 28 percent (legal services), and would reduce average prices prevailing in the respective industries by 0.19 and 0.04 percent. Holding the fixed costs of exporting into the United States constant, we estimate that a 50 percent reduction in the incremental fixed costs of foreign affiliate provision would increase foreign affiliate purchases in the U.S. by 26 percent (architectural and engineering services) and 28 percent (legal services), and would reduce average prices prevailing in the respective industries by 0.18 and .007 percent.

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<sup>4</sup> The hypothetical 50 percent reductions in the fixed costs of trade are meant to illustrate the potential effects of liberalization and are not associated with specific policy changes that have occurred or are proposed.

The contribution of this paper is that it demonstrates a practical way to quantify the impact of reducing barriers to trade in two professional services industries, using a partial equilibrium version of the HMY model. The estimation utilizes data on all of the different modes of service provision within an integrated modeling framework. The model's modest data requirements also accommodate the limitations in available data on services.

The rest of the paper is organized into six sections. Section 2 provides an overview of the international supply of the two types of professional services. Section 3 summarizes the HMY model. Section 4 discusses the data that we use to calibrate the parameters of the models to the U.S. market. Section 5 reports estimates of the impact of a 50 percent reduction in fixed costs associated with international trade in architectural and engineering services. Section 6 reports estimates of the impact of a 50 percent reduction in fixed costs associated with trade in legal services. Section 7 draws conclusions and recommends directions for future research.

## **2. Trade in Architectural and Engineering Services and Legal Services**

The economic models in this paper focus on U.S. inbound trade in professional services.<sup>5</sup> The models are based on information from the *International Services* database of the U.S. Bureau of Economic Analysis (BEA) on U.S. foreign affiliate transactions and cross-border trade in 2012, by category of service and by partner country, and data from the 2012 *Economic Census* on total U.S. revenues of service providers in the United States, by category of service.<sup>6</sup> Table 1 summarizes these data for 2012.

In addition to this information on trade and foreign affiliate sales of architectural and engineering services and legal services, there is considerable evidence that there are barriers to the foreign

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<sup>5</sup> The modeling framework could be easily reapplied to other national markets and other types of services with multiple modes of supply if industry data are available.

<sup>6</sup> Grimm and Krishnan (2014) describe the BEA data.

provision of these services, in the U.S. market and abroad, as described below based on the OECD Services Trade Restrictiveness Index (STRI).<sup>7</sup> We expect that partial or complete elimination of these barriers will have economically significant effects on both modes of supply.

## **2.A. Architectural and Engineering Services**

Architects and engineers provide services related to the construction and design of buildings and other infrastructure, as well as the design of industrial procedures and production processes. In foreign markets, these services are supplied through multiple modes of delivery.<sup>8</sup> Due to technological advances, cross-border supply (or mode 1 supply), and specifically the digital delivery of services, for example, supplying architectural designs or engineering plans abroad via e-mail) is a growing area of trade, with U.S. cross-border exports and imports of architectural and engineering services experiencing 8.7 and 10 percent average yearly growth from 2006-2014, respectively.<sup>9</sup> Cross-border supply is often complemented by trade in the form of “movement of person” or mode 4 trade, when architects and engineers travel to provide services in foreign markets. For example, architectural designs provided through cross-border delivery might also warrant the architect visiting the project site to implement and manage the project. Finally, mode 3 trade, the supply of architectural and engineering services through the establishment of a commercial presence (e.g., a foreign affiliate), is an alternative and possibly complementary mode of supply, allowing companies to provide services throughout various phases of projects in host countries. Architectural and engineering services supplied by U.S.-owned foreign affiliates (foreign affiliate sales) grew by 14.7 percent between 2006 and 2012, while purchases from U.S. affiliates of

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<sup>7</sup> The OECD STRI reflects policies in place in 2013.

<sup>8</sup> Unless otherwise noted, this paragraph is based on Grosso et al., (2014), 10-12.

<sup>9</sup> BEA Interactive Data Table 2.1 (accessed September 15, 2016). These are all available years of data. BEA data on cross-border trade roughly corresponds to modes 1, 2 and 4 (cross-border supply, consumption abroad, and the presence of natural persons) while BEA data on foreign affiliate transactions roughly corresponds to mode 3 (commercial presence) in the GATS modes of supply framework for services trade. See Koncz et al., (2006), 39-40.

foreign firms (U.S. affiliate purchases) grew by 6.1 percent between 2006 and 2013.<sup>10</sup> In 2012, the year of the data used in the model calibration, foreign affiliate sales (\$35.8 billion) were more than double cross-border exports (\$13.4 billion) and U.S. affiliate purchases (\$12.9 billion) far exceeded cross-border imports (\$4.8 billion).<sup>11</sup>

Although policies related to the foreign provision of architectural and engineering services tend to be less restrictive than in other areas of professional services, countries maintain regulations related to the entry or operation of foreign or foreign-owned service providers that likely impede trade, including most notably discriminatory qualification and licensing requirements. The OECD STRI for architectural and engineering services categorizes trade restrictions into five groups: restrictions on foreign entry, restrictions to movement of people, barriers to competition, other discriminatory measures, and regulatory transparency.<sup>12</sup> In architectural and engineering services, the most prevalent are restrictions to movement of people (this category affects either all modes of trade or specifically mode 4 trade) and restrictions on foreign entry (this category affects mode 3 trade). In the former category, quotas and labor market tests – for example work permits that depend on proving that the vacancy could not be filled by a local employee or that the work by the foreign employee will benefit the local economy— are prevalent and restrict or limit foreign architects and engineers from traveling to host countries on a temporary basis. Also in this category, restrictions on recognition of foreign qualifications (for example, local practice or examination requirements) and licensing (residency and in a few cases, nationality requirements) are prevalent and affect all modes of trade.<sup>13</sup> Restrictions that affect the entry of foreign firms include specific requirements on the composition of boards of directors or the management of engineering and architecture firms (such as residency), restrictions on acquiring land (which

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<sup>10</sup> BEA Interactive Data Tables 3.1 and 4.1 (accessed September 15, 2016). These are all available years of data.

<sup>11</sup> BEA Interactive Data Tables 2.1, 3.1, and 4.1 (accessed September 15, 2016).

<sup>12</sup> The following paragraph is based on Grosso et al. (2014), 24-25.

<sup>13</sup> Temporary licensing systems are often available and some countries recognize foreign degrees with some additional local criteria.

affects construction services directly and the architectural and engineering services indirectly), and in some cases foreign equity restrictions for non-locally licensed architects. The remaining restrictions affect the use of professional titles (e.g., titles of “architect” or “engineer”), prices, and advertising architectural services.

Table 2 summarizes the most restrictive measures that apply to select countries with above average architectural and engineering services STRI scores, as well as the United States. For example, Poland restricts allowable legal forms for architecture and engineering firms, conditions employment and residency permits on either proving positive local impacts or that the vacancy could not be filled locally, and maintains that providers of architectural and engineering services must be members of national associations that, in turn, require EU citizenship. The STRI scores for the United States are much lower than their counterparts in the other countries, and this suggests fewer or less intense restrictions on trade in these services.<sup>14</sup>

## **2.B. Legal Services**

International trade in legal services typically involve foreign lawyers providing legal services in their home country law, international law, or third country law. Host country law is normally subject to local requalification or restricted from trade. However, with the growing significance of foreign affiliates of law firms established abroad and supplying multi-jurisdictional advice to their local clients’ international business dealings, providing host country law is an increasingly important area of international trade.<sup>15</sup> It is reported that supplying services via the establishment of a commercial presence (mode 3) and via the movement of people (mode 4) are the preferred modes of delivery in foreign markets.<sup>16</sup> In 2012, U.S. cross-border exports (\$8.3 billion) exceeded foreign affiliate sales (\$5.1 billion) of legal services and cross-border imports (\$2 billion) exceeded U.S. affiliate purchases (\$0.13 billion) of legal services. Cross-border imports have also grown at a

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<sup>14</sup> For architectural, engineering, and legal services, the OECD STRI scores for the United States are based on policies in effect in the state of New York and may not reflect policies of other states.

<sup>15</sup> Grosso et al. (2014), 7-8.

<sup>16</sup> As indicated above, part of mode 4 is captured in the data on cross-border trade.

faster average annual rate than U.S. affiliate purchases (7.7 percent from 2006 to 2014 versus 1.8 percent from 2006 to 2013). However, foreign affiliate sales have grown at a faster average annual rate than cross-border exports of legal services in recent years (11.9 percent from 2006 to 2013 versus 7.4 percent from 2006 to 2014).<sup>17</sup>

Policies related to the foreign provision of legal services tend to be the most restrictive among professional services.<sup>18</sup> The STRI for legal services is categorized into the same five groups as architectural and engineering services. Also like architectural and engineering services, the most prevalent are restrictions to movement of people and restrictions on foreign entry. Notably, in the former category, nationality and/or residency requirements to practice law, along with lack of recognition of foreign qualifications, are significant impediments and affect all modes of trade.<sup>19</sup> In this same category, quotas and labor market tests are also prevalent and restrict or limit foreign attorneys from traveling to host countries on a temporary basis. When applicable, the category of restrictions affecting foreign entry differentiates between firms practicing international versus domestic law. For example, countries commonly restrict ownership of law firms to locally-qualified lawyers only in domestic law practice. Other prevalent restrictions in this category include local qualifications for a majority of the board of directors/equity partners/managers and limits on commercial association between locally and non-locally licensed attorneys.<sup>20</sup> Restrictions in other categories relate to fee-setting and advertising.

Table 3 presents the most restrictive measures that apply to select countries with above average legal services STRI scores, as well as the United States. In the two cases where trade is completely

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<sup>17</sup> BEA Interactive Data Tables 2.1, 3.1, and 4.1 (accessed September 15 and 22, 2016). These are all available years of data.

<sup>18</sup> The following paragraph is based on Grosso et al. (2014), 9-10 and OECD (2016), 2.

<sup>19</sup> Some countries have implemented limited-licensing schemes which circumvent the necessity to be licensed in the host country and allow foreign attorneys to practice in their qualified areas of law (typically known as foreign legal consultants). Temporary practice rules adopted by some jurisdictions are considered an additional avenue for foreign attorneys to be able to practice law.

<sup>20</sup> Restrictions on commercial association can impede the ability of foreign firms to partner with or employ local lawyers as an avenue to provide host country law to their clients, without the need to requalify in local markets.

restricted, nationality or residency restrictions apply to either or both domestic and international law practice and a temporary licensing system is not in place. In India, which has one of the most restrictive scores, legal services can only be provided by Indian citizens. Foreign law firms are not permitted to establish businesses and non-locally licensed attorneys cannot invest in law firms in India. Additionally, Indian law firms cannot commercially associate or partner with non-locally licensed attorneys and foreign law firms cannot hire local attorneys for the purpose of providing host country legal advice. Again, the STRI score for the United States is much lower than for counterparts in the other countries, and this suggests fewer or less intense restrictions on trade in these services.<sup>21</sup>

### 3. HMY Framework

In this section, we derive an economic model of foreign affiliate sales and cross-border exports of services, based on a partial equilibrium version of the HMY framework.<sup>22</sup> Then we derive formulas for calculating the impact of reducing the fixed costs of trade in these services.

Each of the partial equilibrium models is narrowly focused on a single category of services. Labor is the only factor of production and, following Helpman, Melitz, and Yeaple (2004), we assume that the wages in each country are equalized by international trade in other sectors of the economy, and to simplify the notation, we set these wages equal to one in all countries.<sup>23</sup> Providers of the services vary in their productivity. There are  $n_j$  firms headquartered in each country  $j$ , and the unit labor requirement of each firm,  $a$ , is drawn from a distribution with cumulative distribution function  $G(a)$ . The firms provide services that are differentiated from the services provided by other firms

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<sup>21</sup> See above footnote 14.

<sup>22</sup> For the purposes of the model, cross-border exports refer to all trade that does not involve setting up a foreign affiliate.

<sup>23</sup> It is straightforward to relax this simplifying assumption about wages while still treating wages as exogenous variables in the partial equilibrium model, though this complicates the notation and increases the data requirements of the model.

within their category, and they engage in monopolistic competition. The parameter  $\varepsilon$  is the constant elasticity of substitution between different varieties of services within the category.

The HMY model includes three costs of serving a foreign market. The first is a variable cost of cross-border exports from country  $i$  to country  $j$ ,  $\tau_{ij}$ , that has an iceberg form. This is an ad valorem trade cost that increases the marginal cost of supplying market  $j$  across the border by

$(\tau_{ij} - 1) \times 100$  percent. The second is a fixed cost of exporting from country  $i$  to country  $j$ , equal to  $f_{x_{ij}}$  units of labor. The third is a fixed cost incurred when a firm from country  $i$  establishes a foreign affiliate in country  $j$ . Following Helpman, Melitz, and Yeaple (2004), we represent this third cost in terms of the *incremental* fixed cost of foreign affiliate sales relative to cross-border exports.<sup>24</sup> This incremental fixed cost is equal to  $f_{P_{ij}}$  units of labor. The model also includes fixed costs of producing in country  $j$  to supply the domestic market, equal to  $f_{Dj}$  units of labor.

Equation (1) represents the profits of a firm with unit labor requirement  $a$  in country  $j$  from serving its domestic market.

$$\pi_{Dj}(a) = \frac{1}{\varepsilon} \beta E^j (P^j)^{\varepsilon-1} \left[ \left( \frac{\varepsilon}{\varepsilon-1} \right) a \right]^{1-\varepsilon} - f_{Dj} \quad (1)$$

Following the notation in Helpman, Melitz, and Yeaple (2004),  $E^j$  represents the aggregate expenditure level in country  $j$ ,  $\beta$  is the constant expenditure share of the services category, and  $P^j$  is a CES price index for the services category in country  $j$ .<sup>25</sup>

Equation (2) is the profits of a firm in country  $i$  from exporting its service to country  $j$ .

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<sup>24</sup> This is the cost of establishing foreign affiliate production, in excess of the cost of gaining market access.

<sup>25</sup> The HMY framework assumes that there are constant expenditure shares, corresponding to Cobb-Douglas preferences across categories of services.

$$\pi_{xij}(a) = \frac{1}{\varepsilon} \beta E^j(P^j)^{\varepsilon-1} \left[ \left( \frac{\varepsilon}{\varepsilon-1} \right) a \right]^{1-\varepsilon} \left( \tau_{ij} \right)^{1-\varepsilon} - f_{xij} \quad (2)$$

Equation (3) is the incremental profits of a country  $i$  firm that serves the market in country  $j$  through foreign affiliate sales rather than cross-border exports.

$$\pi_{ij}(a) - \pi_{xij}(a) = \frac{1}{\varepsilon} \beta E^j(P^j)^{\varepsilon-1} \left[ \left( \frac{\varepsilon}{\varepsilon-1} \right) a \right]^{1-\varepsilon} \left( 1 - \left( \tau_{ij} \right)^{1-\varepsilon} \right) - f_{Pij} \quad (3)$$

A firm's most profitable mode of supply depends on the firm's unit labor requirement. All firms in country  $j$  with unit labor requirements below  $a_D^j$  sell in their domestic market. The cutoff level for domestic sales is implicitly defined in equation (4).

$$\pi_{Dj}(a_D^j) = 0 \quad (4)$$

In addition, firms in country  $i$  with unit labor requirements below a cutoff level  $a_X^{ij}$  also supply the foreign market, either through cross-border exports or through foreign affiliate sales. Firms from country  $i$  with unit labor requirements below the cutoff  $a_I^{ij}$  serve country  $j$  by establishing a foreign affiliate in the country. Firms in country  $i$  with unit labor requirements below a cutoff level  $a_X^{ij}$  but above  $a_I^{ij}$  serve country  $j$  through cross-border exports. In the HMY model, firms do not engage in both exporting and foreign affiliate sales in the same market, and all firms that participate in foreign markets also produce for their domestic market.

These cutoff levels are implicitly defined by the condition for zero profits in cross-border exports (in equation (5)) and for zero incremental profits for foreign affiliate sales relative to cross-border exports (in equation (6)).

$$\pi_{xij}(a_X^{ij}) = 0 \quad (5)$$

$$\pi_{Iij}(a_I^{ij}) - \pi_{Xij}(a_I^{ij}) = 0 \quad (6)$$

According to Helpman, Melitz, and Yeaple (2004),  $a_D^i > a_X^{ij} > a_I^{ij}$ . The most productive firms establish foreign affiliates, while the least productive firms only serve their domestic market.

Equations (1) through (6) imply that the relative cutoff levels are determined by all four types of costs.

$$\frac{a_X^{ij}}{a_D^j} = \left( \frac{f_{Xij}}{f_{Dij}} \right)^{\frac{1}{1-\varepsilon}} \left( \frac{1}{\tau_{ij}} \right) \quad (7)$$

$$\frac{a_I^{ij}}{a_D^j} = \left( \frac{f_{Pij}}{f_{Dij}} \right)^{\frac{1}{1-\varepsilon}} \left( 1 - (\tau_{ij})^{1-\varepsilon} \right)^{\frac{1}{\varepsilon-1}} \quad (8)$$

We assume that the magnitudes of the different types of fixed costs ensure that  $a_I^{ij} < a_X^{ij} < a_D^i$ .

Equations (9), (10), and (11) represent the equilibrium value of foreign affiliate sales ( $A_{ij}$ ), cross-border exports ( $X_{ij}$ ), and domestic shipments ( $S_j$ ) that are associated with the cutoff unit labor requirements defined by equations (4), (5) and (6).

$$A_{ij} = n_i \beta E^j (P^j)^{\varepsilon-1} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \int_0^{a_I^{ij}} a^{1-\varepsilon} dG(a) \quad (9)$$

$$X_{ij} = n_i \beta E^j (P^j)^{\varepsilon-1} (\tau_{ij})^{1-\varepsilon} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \int_{a_I^{ij}}^{a_X^{ij}} a^{1-\varepsilon} dG(a) \quad (10)$$

$$S_j = n_j \beta E^j (P^j)^{\varepsilon-1} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \int_0^{a_D^j} a^{1-\varepsilon} dG(a) \quad (11)$$

Equation (12) is the country  $j$  CES price index for the category of services.

$$P^j = \frac{\varepsilon}{\varepsilon-1} \left( \sum_{h \neq j} n_h \int_0^{a_l^{hj}} a^{1-\varepsilon} dG(a) + \sum_{h \neq j} n_h (\tau_{hj})^{1-\varepsilon} \int_0^{a_X^{hj}} a^{1-\varepsilon} dG(a) + n_j \int_0^{a_D^j} a^{1-\varepsilon} dG(a) \right)^{\frac{1}{1-\varepsilon}} \quad (12)$$

The variable  $h$  in equation (12) is an index of all countries other than  $j$ .

If the productivity of individual firms has a Pareto distribution with shape parameter  $k > \varepsilon - 1 > 0$ ,

$$\text{as in Helpman, Melitz, and Yeaple (2004), then } \int_{c_1}^{c_2} a^{1-\varepsilon} dG(a) = \frac{k}{k - (\varepsilon - 1)} \left( (c_2)^{k-(\varepsilon-1)} - (c_1)^{k-(\varepsilon-1)} \right)$$

for a lower boundary  $c_1$  and an upper boundary  $c_2$ . In this case, we can rewrite equations (9)

through (12) in terms of the cutoff levels  $a_D^j$ ,  $a_X^{ij}$ , and  $a_I^{ij}$ .

$$A_{ij} = n_i \beta E^j (P^j)^{\varepsilon-1} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \left( \frac{k}{k - (\varepsilon - 1)} \right) (a_I^{ij})^{k-(\varepsilon-1)} \quad (13)$$

$$X_{ij} = n_i \beta E^j (P^j)^{\varepsilon-1} (\tau_{ij})^{1-\varepsilon} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \left( \frac{k}{k - (\varepsilon - 1)} \right) \left( (a_X^{ij})^{k-(\varepsilon-1)} - (a_I^{ij})^{k-(\varepsilon-1)} \right) \quad (14)$$

$$S_j = n_j \beta E^j (P^j)^{\varepsilon-1} \left( \frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon} \left( \frac{k}{k - (\varepsilon - 1)} \right) (a_D^j)^{k-(\varepsilon-1)} \quad (15)$$

$$P^j = \left( \frac{\varepsilon}{\varepsilon-1} \right) \left( \frac{k}{k - (\varepsilon - 1)} \right)^{\frac{1}{1-\varepsilon}} \left( \sum_{h \neq j} n_h (a_l^{hj})^{k-(\varepsilon-1)} + \sum_{h \neq j} n_h (\tau_{hj})^{1-\varepsilon} \left( (a_X^{hj})^{k-(\varepsilon-1)} - (a_I^{hj})^{k-(\varepsilon-1)} \right) + n_j (a_D^j)^{k-(\varepsilon-1)} \right)^{\frac{1}{1-\varepsilon}} \quad (16)$$

We can further rewrite equations (13) through (16) in terms of the relative cutoff levels  $\frac{a_I^{ij}}{a_D^j}$  and

$$\frac{a_X^{ij}}{a_D^j}.$$

$$A_{ij} = n_i Z^j \left( \frac{a_I^{ij}}{a_D^j} \right)^{k-(\varepsilon-1)} \quad (17)$$

$$X_{ij} = n_i Z^j \left( \tau_{ij} \right)^{1-\varepsilon} \left( \left( \frac{a_X^{ij}}{a_D^j} \right)^{k-(\varepsilon-1)} - \left( \frac{a_I^{ij}}{a_D^j} \right)^{k-(\varepsilon-1)} \right) \quad (18)$$

$$S_j = n_j Z^j \quad (19)$$

To simplify the notation in equations (17) through (19), we defined the common term

$$Z^j = \beta E^j \left( \sum_{h \neq j} n_h \left( \frac{a_I^{hj}}{a_D^j} \right)^{k-(\varepsilon-1)} + \sum_{h \neq j} n_h \left( \tau_{hj} \right)^{1-\varepsilon} \left( \left( \frac{a_X^{hj}}{a_D^j} \right)^{k-(\varepsilon-1)} - \left( \frac{a_I^{hj}}{a_D^j} \right)^{k-(\varepsilon-1)} \right) + n_j \right)^{-1} \quad (20)$$

Finally, we can substitute equations (7) through (8) into equations (17), (18), and (20).<sup>26</sup>

$$A_{ij} = n_i Z^j \left( \frac{f_{Pij}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( 1 - \left( \tau_{ij} \right)^{1-\varepsilon} \right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} \quad (21)$$

$$X_{ij} = n_i Z^j \left( \tau_{ij} \right)^{1-\varepsilon} \left( \left( \frac{f_{Xij}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( \frac{1}{\tau_{ij}} \right)^{k-(\varepsilon-1)} - \left( \frac{f_{Pij}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( 1 - \left( \tau_{ij} \right)^{1-\varepsilon} \right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} \right) \quad (22)$$

$$Z^j = \beta E^j \left( \sum_{h \neq j} n_h \left( \frac{f_{Pij}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( 1 - \left( \tau_{hj} \right)^{1-\varepsilon} \right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} + \sum_{h \neq j} n_h \left( \tau_{hj} \right)^{1-\varepsilon} \left( \left( \frac{f_{Xhj}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( \frac{1}{\tau_{hj}} \right)^{k-(\varepsilon-1)} - \left( \frac{f_{Phj}}{f_{Dj}} \right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left( 1 - \left( \tau_{hj} \right)^{1-\varepsilon} \right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} \right) + n_j \right)^{-1} \quad (23)$$

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<sup>26</sup> Equation (19) still applies.

Finally, we calculate the impact of reducing the two types of fixed costs of trade on foreign affiliate sales, cross-border exports, domestic sales, and prices in country  $j$  by totally differentiating the equations of the model.<sup>27</sup> The notation  $\hat{V}$  represents the proportional change in variable  $V$ .

$$\hat{A} = (\varepsilon - 1) \hat{P} + (k - (\varepsilon - 1)) \hat{a}_I \quad (24)$$

$$\hat{X} = (\varepsilon - 1) \hat{P} + (k - (\varepsilon - 1)) \left( \begin{array}{l} \left( \frac{1}{1 - \left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}} \right) \hat{a}_X - \left( \frac{\left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}}{1 - \left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}} \right) \hat{a}_I \\ \end{array} \right) \quad (25)$$

$$\hat{S} = (\varepsilon - 1) \hat{P} + (k - (\varepsilon - 1)) \hat{a}_D \quad (26)$$

$$\hat{P} = \left( \frac{k - (\varepsilon - 1)}{1 - \varepsilon} \right) \left( m_A \hat{a}_I + m_X \left( \frac{1}{1 - \left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}} \right) \hat{a}_X - m_X \left( \frac{\left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}}{1 - \left( \frac{a_I}{a_X} \right)^{k-(\varepsilon-1)}} \right) \hat{a}_I + (1 - m_A - m_X) \hat{a}_D \right) \quad (27)$$

In equation (27),  $m_X$  and  $m_A$  are the market shares for cross-border imports and foreign affiliates purchases in the market. Assuming that  $\hat{f}_D = 0$ ,

$$\hat{a}_I = \left( \frac{1}{1 - \varepsilon} \right) \hat{f}_P + \hat{P} \quad (28)$$

$$\hat{a}_X = \left( \frac{1}{1 - \varepsilon} \right) \hat{f}_X + \hat{P} \quad (29)$$

$$\hat{a}_D = \hat{P} \quad (30)$$

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<sup>27</sup> Because these calculations focus on a single market (the United States) and aggregate all other countries, we omit the  $ij$  subscripts to simplify the notation in equations (24) through (30). In this case,  $A$  is U.S. purchases from U.S. affiliates of foreign firms, and  $X$  is cross-border imports into the U.S. market.

Equations (28) through (30) indicate that the reductions in the two types of fixed costs affect market outcome through adjustments on extensive margins. There is no adjustment on the intensive margins, because wages and variable trade costs remain constant in the partial equilibrium framework. The participation of domestic firms, domestic affiliates of foreign firms, and exports of foreign firms on the market adjusts to reductions in fixed costs, including induced adjustments in the price index for the market.<sup>28</sup> When either of the types of fixed costs decline, there is an increase in the number of foreign firms participating in the market and a reduction in the number of domestic firms. Since the new entrants are more productive than the firms that exit, the price index for the market declines.

These equations provide estimates of the effects of reductions in  $f_I$  and  $f_X$  on foreign affiliate purchases, cross-border imports, domestic sales, and prices in the U.S. market. The equations utilize data on the market shares of imports to the U.S. market and foreign affiliate purchases in the U.S. market, as well as the shape parameter of the distribution of productivities, the elasticity of substitution among varieties, the relative magnitude of the two types of fixed costs, and the magnitude of the variable trade costs.

#### **4. Calibration of the Parameters of the PE Model**

Table 4 reports the market shares for cross-border imports and foreign affiliate purchases in the U.S. market,  $m_X$  and  $m_A$ . The denominator for these share calculations, total consumption of services in the U.S. market, is calculated as the sum of total revenue of service providers in the

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<sup>28</sup> This can be illustrated as shifts in the cutoff productivity levels in Figure 1 in Helpman, Melitz, and Yeaple (2004).

United States, from the 2012 *Economic Census*, minus cross-border exports from the United States plus cross-border imports into the United States, from the BEA data in Table 1.<sup>29</sup>

Zhai (2008) estimates that  $\varepsilon$  (the elasticity of substitution) for all services is equal to 4.3, based on evidence that mark-up ratios in these industries are approximately 30 percent. Di Giovanni,

Levchenko, and Rancière (2011) estimate that  $\frac{k}{\varepsilon-1}$  is equal 1.155 in professional services

industries, based on a large sample of non-exporting French firms. Together, these estimates from the literature imply the  $k$  (the shape parameter in the Pareto distribution of productivities) is equal to  $5.1315 = 1.155 * (4.3-1)$ .

Next, we calibrate  $\frac{f_p}{f_x}$  for the U.S. market using the equations of the model. Equation (31) is

implied by equations (21) and (22).

$$\frac{m_A}{m_X} = \frac{\left(\frac{f_p}{f_x}\right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left(1 - (\tau)^{1-\varepsilon}\right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} (\tau)^{\varepsilon-1}}{\left(\frac{1}{\tau}\right)^{k-(\varepsilon-1)} - \left(\frac{f_p}{f_x}\right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}} \left(1 - (\tau)^{1-\varepsilon}\right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}}} \quad (31)$$

Inverting equation (31),

$$\frac{f_p}{f_x} = \left(\frac{m_A}{m_X}\right)^{\frac{1-\varepsilon}{k-(\varepsilon-1)}} \left(\frac{1}{\tau}\right)^{1-\varepsilon} \left( \left(1 - (\tau)^{1-\varepsilon}\right)^{\frac{k-(\varepsilon-1)}{\varepsilon-1}} \left( (\tau)^{\varepsilon-1} + \left(\frac{m_A}{m_X}\right) \right) \right)^{\frac{\varepsilon-1}{k-(\varepsilon-1)}} \quad (32)$$

Finally, we estimate the effects of the reductions in fixed costs for several different values of variable trade costs parameter,  $\tau$ , ranging from 1.1 to 1.3.

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<sup>29</sup> Domestic sales of foreign-owned affiliates in the United States (or foreign affiliate purchases) are included in the Census revenue statistics.

## **5. Estimated Impact on Trade in Architectural and Engineering Services**

First, we estimate the effects of reducing fixed costs of exporting to the United States (a reduction in  $f_X$ ) and the incremental fixed costs of foreign affiliate provision in the United States (a reduction in  $f_P$ ) on international trade in architectural and engineering services. Table 5 reports that a 50 percent reduction in  $f_X$  (holding  $f_P$  fixed) would increase cross-border imports into the United States by approximately 52 percent. It would reduce the price index for the services category by approximately 0.19 percent. This would benefit consumers in the United States but would also reduce the demand for services supplied through the other modes of supply. Domestic sales and foreign affiliates purchases in the United States would both decline by approximately 1 percent.

Separately, Table 5 reports that a 50 percent reduction in  $f_P$  (holding  $f_X$  fixed) would increase foreign affiliate purchases of the services in the United States by 26 percent. It would reduce the price index for the services category by approximately 0.18 percent. This would benefit consumers in the United States but would also reduce the demand for services supplied through the other modes. Domestic sales in the United States would decline by approximately 1 percent, and cross-border imports would decline by approximately 26 percent.

The effects of simultaneously reducing both types of fixed costs is simply the sum (or net) of the effects in the two columns for each row in Table 5, because the estimated impacts are based on linear equations (24) through (30). In this case, there would be a net increase in foreign affiliate purchases and cross-border imports and a net decrease in domestic sales and the price index for the range of values of  $\tau$  that we considered.

## **6. Estimated Impact on Trade in Legal Services**

Finally, we estimate the effects of reducing fixed costs of exporting to the United States (a reduction in  $f_X$ ) and the incremental fixed costs of foreign affiliate provision in the United States (a reduction in  $f_P$ ) on international trade in legal services. Table 6 reports that a 50 percent reduction in  $f_X$  (holding  $f_P$  fixed) would increase cross-border imports into the United States by approximately 28 percent. It would reduce the price index for the services category by approximately 0.04 percent. This would benefit consumers in the United States but would also reduce the demand for services supplied through the other modes. Domestic sales and foreign affiliate purchases in the United States would both decline by 0.23 percent.

Separately, Table 6 reports that a 50 percent reduction in  $f_P$  (holding  $f_X$  fixed) would increase foreign affiliate purchases of the services in the United States by approximately 28 percent. It will reduce the price index for the services category by approximately 0.001 percent.<sup>30</sup> This would benefit consumers in the United States but would also reduce the demand for services supplied through the other modes. Domestic sales in the United States would decline by approximately 0.007 percent, and cross-border imports would decline by approximately 0.8 percent. The smaller effects in table 6 reflect the very small share of foreign affiliate purchases and cross-border imports into the U.S. market for legal services, as reported in table 4. In fact, all of the differences in the estimates in table 6, relative to table 5, are due to the differences in these market shares.

## **7. Conclusions**

This paper extends conventional partial equilibrium models used in trade policy analysis to address trade in services, rather than trade in goods, and to incorporate alternative modes of supplying

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<sup>30</sup> This small effect reflects the very small share of foreign affiliate sales in the U.S. market for legal services, as reported in table 4.

services to foreign markets. The HMY model provides an excellent framework for this analysis, with its tractable equations and reasonable data requirements.

In our specific applications we estimate the effect of reducing fixed costs of exporting into the United States (a reduction in  $f_x$ ) and the incremental fixed costs of foreign affiliate provision (a reduction in  $f_p$ ) to two categories of professional services in the United States. Holding  $f_p$  fixed, a 50 percent reduction in  $f_x$  would increase cross-border imports by approximately 52 percent (architectural and engineering services) and 28 percent (legal services) and would reduce prices in the respective industries by 0.19 and 0.04 percent. We estimate that a 50 percent reduction in  $f_p$ , holding  $f_x$  fixed, would increase foreign affiliate purchases in the U.S. by 26 percent (architectural and engineering services) and 28 percent (legal services) and would reduce prices in the respective industries by 0.18 and .007 percent.

These models quantify the economic impact of hypothetical reductions in the fixed costs of trade, but the models do not provide a method for estimating the *magnitude of cost reductions* associated with specific policy changes. To provide an illustration of how the model works, we have assumed 50 percent reductions in one or both of the types of fixed costs. The relevant magnitudes of these "shocks" to the models are critical inputs into an analysis of actual policy changes and are therefore a very important area for future research.

Finally, our review of OECD STRIs in tables 2 and 3 suggest that there may be even larger potential gains from liberalizing markets for services in other countries, though the challenge for future research will be collecting reliable data on markets shares  $m_A$  and  $m_X$  in these markets.

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**Table 1: U.S. Trade in Certain Professional Services in 2012 (in billions of US dollars)**

Category of Services	Cross-Border Exports	Cross-Border Imports	Outbound FAS	Inbound FAS
Architectural and Engineering Services	13.411	4.807	35.780	12.874
Legal Services	8.280	2.033	5.125	0.134

Source: BEA International Services Database.

**Table 2: Architectural and Engineering Services Restrictions for Selected Countries**

Country and Score	Restrictions on Foreign Entry	Restrictions on Movement of People	Other
<b>India</b> Architecture: 0.626, Engineering: 0.273	Equity restrictions applying to non-locally licensed individuals or firms (architecture); legal form; residency (engineering) and nationality/licensing (architecture) for board of directors; acquisition and use of land and real estate by foreigners; repatriation of capital; mergers and acquisitions	Labor market tests; limitations on stay; employment visa related requirements (engineering); nationality or citizenship required for license to practice (architecture)	Fee setting (architecture); advertising (architecture); minimum capital requirements
<b>Poland</b> Architecture: 0.435, Engineering: 0.427	Legal form; acquisition and use of land and real estate by foreigners	Labor market tests; limitations on stay; nationality or citizenship requirements for license to practice	Fee setting (architecture); minimum capital requirements
<b>Slovak Republic</b> Architecture: 0.471, Engineering: 0.484	Equity restrictions applying to non-locally licensed individuals or firms; licensing for board of directors; residency for management	Labor market tests; limitations on stay; nationality or citizenship requirements for license to practice	Fee setting (engineering); minimum capital requirements; advertising
<b>United States</b> Architecture: 0.15, Engineering: 0.18	Foreign investment screening	Quotas (contractual/independent service suppliers); local exam and practice requirements; permanent residency/domicile required for practice (engineering)	

Source: OECD Services Trade Restrictiveness Index Simulator (accessed September 21, 2016).

<http://sim.oecd.org/default.ashx>.

Note: Most restrictive policies in the "Foreign Entry" and "Movement of People" categories are listed (i.e. excluding those which may be scored greater than 0 but are subsumed by a binding restriction). Select restrictions in the remaining categories are listed. The average STRI score in architecture is 0.23 and in engineering is 0.20.

**Table 3: Legal Services Restrictions for Selected Countries**

Country and Score	Restrictions on Foreign Entry	Restrictions on Movement of People	Other
<b>India</b> Legal: 0.946	No foreign equity in law firms and restrictions on ownership by non-locally licensed attorneys (both domestic and international); prohibitions on commercial association and hiring local lawyers	Labor market tests; limitations on stay; Citizenship required for practice (both domestic and international law)	Advertising prohibited (non-discriminatory)
<b>Korea</b> Legal: 0.475	Restrictions on ownership by lawyers (Korean law firms, domestic law); certain commercial association restrictions; board of directors and managers must be lawyers in Korean law firms (domestic law); local office for foreign legal consultants; repatriation of profits	Limitation on stay; residency for foreign legal consultants; domicile requirement for domestic and international law; education and practice requirements for domestic law; lack of temporary licensing	
<b>Poland</b> Legal: 1.000	Restrictions on ownership by non-locally licensed attorneys (both domestic and international); legal form; certain restrictions on commercial association; board of directors and managers must be licensed lawyers; establishment requirements for host country law	Labor markets tests; limitations on stay; domicile requirements for host country law; recognition of foreign qualifications based on reciprocity (international law) and/or education/practice in Poland (domestic law); lack of temporary licensing	Advertising restrictions; minimum capital requirements
<b>United States</b> Legal: 0.16	Licensing requirements for board of directors and managers (domestic law); foreign investment screening; local office requirements for nonresident attorneys	Quotas (contractual/independent service suppliers); local exam requirements (domestic law); lack of temporary licensing	

Source: OECD Services Trade Restrictiveness Index Simulator (accessed September 21, 2016).  
<http://sim.oecd.org/default.ashx>.

Note: Most restrictive policies in the "Foreign Entry" and "Movement of People" categories are listed (i.e. excluding those which may be scored greater than 0 but are subsumed by a binding restriction); in the case of India, many scored measures are not listed as they are not applicable since foreign law firms are not permitted to establish in India. Select restrictions in the remaining categories are listed. The average STRI score in legal services is 0.36.

**Table 4: Market Shares in the U.S. Market in 2012 (percent)**

<b>Category of Services</b>	<b>Share of Cross-Border Imports</b>	<b>Share of Inbound FAS</b>
Architectural and Engineering Services	1.87	5.00
Legal Services	0.80	0.05

Source: BEA International Services Database.

**Table 5: Estimated Impact on Trade in Architectural and Engineering Services**

<b>Economic Outcome (in percent changes)</b>	<b>Variable Trade Cost <math>\tau</math></b>	<b>50 Percent Reduction in <math>f_x</math></b>	<b>50 Percent Reduction in <math>f_p</math></b>
Foreign Affiliate Sales in the United States	1.1	-0.9951	26.8387
	1.2	-1.0145	26.8581
	1.3	-0.9656	26.8092
Cross-Border Imports into the United States	1.1	52.2175	-26.3739
	1.2	53.2382	-27.3946
	1.3	50.6730	-24.8294
Domestic Sales in the U.S. Market	1.1	-0.9951	-0.9113
	1.2	-1.0145	-0.8919
	1.3	-0.9656	-0.9408
Price Index in the U.S. Market	1.1	-0.1939	-0.1776
	1.2	-0.1977	-0.1738
	1.3	-0.1882	-0.1833

**Table 6: Estimated Impact on Trade in Legal Services**

Economic Outcome (in percent changes)	Variable Trade Cost $\tau$	50 Percent Reduction in $f_X$	50 Percent Reduction in $f_P$
Foreign Affiliate Sales in the United States	1.1	-0.2292	27.7434
	1.2	-0.2282	27.7423
	1.3	-0.2271	27.7412
Cross-Border Imports into the United States	1.1	28.4257	-0.9116
	1.2	28.2981	-0.7840
	1.3	28.1584	-0.6443
Domestic Sales in the U.S. Market	1.1	-0.2292	-0.0066
	1.2	-0.2282	-0.0077
	1.3	-0.2271	-0.0088
Price Index in the U.S. Market	1.1	-0.0447	-0.0013
	1.2	-0.0445	-0.0015
	1.3	-0.0443	-0.0017