ESTIMATING MARKET ACCESS EFFECTS WITH REGIONAL WAGES: AN APPLICATION OF THE GRAVITY EQUATION AND THE STRUCTURAL WAGE EQUATION IN A NON-LINEAR DYNAMIC SPECIFICATION

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ABSTRACT

This thesis analyzes the political-economic determinants of market access – an important theoretical indicator of spatial inequality - in the Asia-Pacific region. Political-economic controls such as dyadic hostility and sanction costs are specified in a gravity model of trade that is applied to 13 countries with respect to their neighboring trade partners. The effects that are yielded from the gravity model are used to construct a set of "market access" indices. The theoretical association between market access and wages is tested using a full information maximum likelihood estimation and is found to be nearly one to one across all but two countries under investigation. The inclusion of dyadic political-economic variables thus improves the explanatory power of market access in determining regional wages. The analytic framework presented thus offers practitioners a robust econometric and partial equilibrium method to measure the effects of bilateral economic policies on national income differentials.

BIOGRAPHICAL SKETCH

Johannes Plambeck received Bachelors of Arts degrees in Economics and International Relations with a minor in German from the University of California at Davis in 2010. His research in international and spatial economics stems from his interests in economic trade sanctions as a tool of statecraft. He began pursuing a Master's of Science in Regional Science at Cornell University in 2012 with specific research interests in applying the New Economic Geography model; however, his exposure to new discourse in the arenas of political-economy and economic geography inspired him to apply models that are central to the correct parameterizations of the New Economic Geography model. Upon graduation, he plans on applying the NEG model and models of spatial interaction for the investigation of sub-national economic agglomerative activity.

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Part One: General Synthesis

Introduction

According to the IMF, macro-growth economists are observing a persistent decreasing of economic inequality between countries (Derviş, 2012). The *causes* of lessening economic inequality are not well known however and continue to be a major point of debate - human capital formation, trade/transport costs and technological spatial spillovers have been identified as possible explanations to name a few (Ertur, et. al, 2007). Similarly, the choice of explanatory and endogenous variables for measuring economic inequality is indeed also befuddling; economists use a variety of measures for identifying economic inequality. The focus of this discussion centers on two such measures put forth by economic geographers. One is termed market potential, which is defined for a given region as the sum of all other regional GDPs in a world economy - where each other GDP is weighted by the inverse of its distance to the given region (Harris, 1954). The other is termed trade/transport cost, which is a composite index of factors that influence the flow of goods over economic space - where economic space consists of a set of regions. Throughout this paper I will define a region as a country that is part of a broader network of countries through which various types of interactions occur.

Market potential has been identified in both theory and empirics as a primary explanation of regional wage differentials (Combes, et. al, 2008). The relationship between these two variables is explored here empirically with an expression commonly known as the "wage equation". This equation is an element of the spatial general equilibrium of the Dixit-Stiglitz model of monopolistic competition (Fujita, et. al, 1999). Its application here is however rooted in the general equilibrium of the Dixit-Stiglitz Krugman model - hereafter referred to as the DSK model. The importance of the DSK model is its depiction of labor factors of production as internationally immobile (although intersectorally mobile) and exogenous. The DSK model - much like the more classic Heckscher-Ohlin model - states that if world trade is completely liberalized, countries with greater labor endowments relative to their trade partners can experience relatively increased wage remunerations via a "home market effect" (Leamer, 1995). This notion will be explored in a later section. So, while wages are theoretically modeled to allow for heterogeneity at equilibrium, the DSK model can also model wage convergence over regions. The key driver of the degree of convergence is trade/transport cost. By analyzing the components of trade costs, the economist can explore the underlying drivers of economic inequality.

This paper seeks to investigate the relationship between wages, trade/transport costs, and market potential in an open economy context. I ask: if inequality is indeed decreasing throughout the world, is market potential a possible driving factor? To answer this question, one must set-out to estimate market potential and then correlate it to wages across a set of countries. The literature shows that market potential calculations are principally derived with a measure of trade/transport costs. Political determinants of trade/transport costs, such as trade sanctions, are specifically under investigation. In theory, a market potential aggregate can be estimated indirectly using trade data. Since the structural expressions of these estimations are rooted in both a gravity equation and the DSK wage equation, spatial determinants of wages, such as trade/transport costs, are also considered alongside market potential. Therefore, trade/transport costs and market potential co-determine interregional wage levels. This point will be elaborated upon later. Economic geographers have found that regressions of wages on market potential produce coefficients on market potential that can range anywhere between 0.25 and 0.60 (Redding, Venables, 2004). The net effect of market potential on wages will however be offset by trade/transport costs, which have been found to stand at 170% of the average freight-on-board price (Combes, et. al, 2008).

A partial equilibrium framework that can be used to test the notions set-forth above is the "gravity" model of trade (Bergstrand, 1985). A Gravity relationship is utilized to obtain estimates of market potential and trade/transport costs. The most important in this application being the latter. Trade economists assert that among the primary driving forces of economic convergence are trade-cost-reducing trade liberalization policies instituted by national policy makers and supranational technocrats (Feenstra, 2007). These forces continue to persist: scholars in the neo-functionalist school of international relations identify the increasing of the number of cross-border financial ties and economic exchange at the forefront of the Global North's move towards global interdependence. Indeed, national and supranational policies are believed to instigate economic convergence via the mechanism of increasingly liberalized international trade. This paper quantifies these policies by controlling for trade/transport costs. Interestingly however, trade/transport costs can be shown to be composed of both policy effects and trade/transport costs, a notion that will be formalized later in this paper. A model framework utilizing a time-series panel data-structure is chosen that leads to unique parameter estimates across bilateral trade partners instead of generalized parameter estimates that normally fall out of regional-cross sectional data-structures.

In short, this thesis seeks to utilize trade/transport cost estimates to compute market access/market potential measures. These measures should theoretically be positively correlated to wages. A non-linear parameterization of the underlying functional form of market access makes it possible to analyze the effects of geographic and political-economic policies on market access and wages via their composition in the trade/transport cost estimate.

Motivation

Motivation for parsing the components of trade/transport costs are twofold. Firstly, a famous study by Anderson and Van Wincoop found that the distance elasticity of trade costs stands somewhere around 0.30 (Anderson, Wincoop, 2004). Although the authors attribute the remaining 0.70 to "multilateral resistance" - a form of price distortion that is a function of trade costs - little care has been taken to incorporate non-geographical variables (such as political economic variables) into gravity in order to explain the 0.70 missing effect. Tariff costs have been the focus of this literature although some practitioners have run estimations using dummy variables indicating membership to supranational trade entities or free trade agreements (Paillacar, 2009). The application I implement in this paper utilizes unconventional political economic variables, which I will discuss in subsequent sections.

Secondly, Thisse 2008 contends that approximating trade costs with many political and geographic variables cannot possibly be exhaustive (Combes, et. al, 2008). Instead, he argues internal trade costs should be included and considered as a numeraire to external trade costs. In such a model, trade/transport cost estimates become relabeled as "freeness of trade" estimates. Nonetheless, these measurements may still include political economic variables. It is precisely the inclusion of political economic factors alongside geographic ones in the analytic expression for transport/trade costs that motivates this application. In doing so, I ask how country-wide wage disparities might be explained by political economic factors. These factors will include measures of dyadic hostilities and trade sanction costs - both of which are expected to have negative influence. I hypothesize the following:

Hypothesis 1: Wages are positively correlated with market access.

Hypothesis 2: Political economic variables, in particular trade sanction costs and dyadic hostilities, have a statistically significant effect on trade levels. Trade sanction costs and dyadic hostilities should have a negative effect on trade levels.

I test these two hypotheses by utilizing a Gaussian FIML (full-information maximum likelihood) estimation strategy proposed by Wymer (Wymer, 2006). This method permits for the estimation of structural parameters in a non-linear dynamic framework, which generate heuristics for computing fixed costs of labor, α ,and gravity parameters for political-economic variables. I perform this estimation for 13 countries found in the Association of Southeast Asian Nations +3 (ASEAN+3) and greater Asia-Pacific region, including Taiwan (the ROC). Each country's model with respect to each of its 12 associated dyads can be considered as a unique model with separate sets of gravity parameter estimates, wage equation structural parameters, and production function technology parameters. In short, I find that political economic variables are indeed statistically significant and negative determinants of wage levels - in most cases. Moreover, the theoretical positive relationship between market access and wages holds for all dyads. Lastly, political economic variables, such as trade sanction costs, explain variations in bilateral exports. Since political economic effects are also a component of trade/transport costs, these effects also affect estimates of a given country's relative market access in the Asia-Pacific region.

Before beginning an overview of the underpinning theory of this application, I note that the takeaways of this paper need not be confined to the realm of international relations. Analytic trade/transport costs can and should be used in applications of the new economic geography (NEG). Further research in political economy should utilize trade costs in the spatial general equilibrium posed in NEG theory. In so doing, policy makers will be more accurate in predicting the effects of policy changes on interregional economic equality.

Part Two: Theory

The DSK Model

This gravity model is set in the DSK framework, which requires above all a mechanism for spatially asymmetric wage equilibria. This framework can also be described as a standard new trade theory model; albeit one with transport/trade costs and monopolistic competition.

We envisage a two-sector economy which requires two factor inputs for production - unskilled and skilled labor, denoted L_a and L respectively. As is the short-run case for the entire family of models presented above, labor is assumed to be immobile across any pair of regions *r* or *s* but mobile across sectors. Since my application considers space at the geographic level of the country, the assumption of immobile factors may be reasonable if net migration is negligible between all country pairs *r* and *s*.

The two sectors in this economy include firstly a formal sector that utilizes a combination of unskilled and skilled labor and secondly a residual sector that utilizes only unskilled labor. The inclusion of a residual sector is necessary from a mathematical standpoint. Unlike the formal sector, whose production is subject to transport costs, the residual sector is assumed to transport its production costlessly. Formally,

$$p_{c.i.f.} = p_{f.o.b.} * T_{rs}$$

$p_{c.i.f.}$ represents the "carriage, insurance, and freight" price - otherwise known as the "delivered" price that is charged at market. In other words, consumers bear all the costs of transportation/trade faced by a given firm in the exporting region. Some authors call this an "ad valorem tax". The $p_{f.o.b.}$ represents the "free on board" (or mill) price, essentially the cost of production. $T_{rs} = 1$ implies $costless\ trade$, s.t. $T_{rs} - 1$ measures the *proportion* of output lost in shipping from *r* to *s* (or *s* to *r* for that matter).

$$T_{rs} \geq 1$$

The residual sector thus sells output at spatially symmetric prices. Until beginning a discussion on the gravity model, I will present region *r* as the domestic region consuming exports from region *s* and domestic production from region *r*.

Moreover, it is assumed that the residual sector operates at perfect competition once at equilibrium. Bertrand competition occurring under perfect information and perfect competition at the sub-regional level ensures that the residual sector exhibits zero-profits such that firms can enjoy free entry and exit. Intuitively, a zero-profit condition can be said to hold in the long-run equilibrium, such that there is free-entry of firms whenever profits are positive (Feenstra, 2003). Markups due to consumer preference for variety are essentially null in the residual sector. Formally,

$$p_r = \frac{\beta w_{1,r}}{\rho} = \beta w_r * (\frac{\sigma}{\sigma - 1})$$

Where β represents a variable unskilled labor input cost (Ottaviano, et. al, 2003). $\frac{\sigma}{\sigma-1}$ represents the markup, whose derivation will be shown in a subsequent section of this paper. ρ indexes the markup and can be interpreted as the "representative consumer's" preference for product varieties. The residual sector is modeled as a constant returns sector, which implies that production in this sector faces a constant marginal cost. Formally, this means that the residual sector essentially assumes that β in the labor cost/production equation is equal to 1 such that $p_r = w_r$. This also implies that the marginal product of labor, the inverse of the marginal cost, is equal to one. Moreover, since consumption of output in the residual sector is not modeled as a CES aggregate index, the expression $\frac{\sigma}{\sigma-1}$ does not enter marginal revenues after the demand curve is obtained from utility maximization. This relationship $p_r = w_r$ is known as the "pricing rule" at perfect competition and is derived by setting constant marginal costs of production (in terms of labor and quantity produced) to marginal revenues (in terms of consumer demand). It is important to note that for the residual sector, wages are thus uniform over all regions and equal to one. In the formal sector, wages are *generally* given by the following *labor demand* expression:

$$w_r = \left(\frac{\mu}{1-\mu}\right)\frac{L_r}{L}$$

Here, L_r is simply the amount of skilled labor in region *r* (I will formalize this variable more shortly) and μ is the share of region *r*'s expenditures in the formal sector. The key takeaway here is that formal sector wages are generally heterogeneous, an important aspect that will be fully developed and synthesized into the DSK model.

The one-to-one mathematical relationship between a given region's wages and prices that emerges from perfect competition and costless transportation has one main benefit: the prices and wages of the formal sector can be expressed in terms of the residual sector - this is the notion of the residual sector's output being designated as the numeraire good. I now turn to modeling the formal sector and present the consumer optimization strategy.

Consumer Optimization

I now present the underlying utility structure of the DSK's general equilibrium framework. The formal sector is driven by a set of firms N. N is split between some number of regions: a domestic region and say an aggregated foreign region. As such we can write this as $N = N_r + N_s$, where *r* and *s* correspond to the domestic and foreign regions respectively and N is considered to be sufficiently large such that individual firms have a negligible effect on market price indices as a whole. Each firm in the set

N produces a variety of good i. Important to note is that these goods are not perfect substitutes but rather varieties of a differentiated good. It is assumed that firms are unique to their respective regions and do not produce the same varieties as other firms. In short, firms produce differentiated products.

For each region, firms produce their individual varieties under increasing returns, which leads to an equilibrium output that is non-region specific and dependent only on consumer preferences (ρ) and production technology (α, β) - the notation here will be presented soon below. Hence, firms will set their prices according to prevailing price indices, which allows for heterogenous wages across regions. However, prices and wages have no bearing on equilibrium output levels. There is a prevalence of multiple firms in one region, which stands contrary to the modeling approach taken in the New Economic Geography (NEG) in which factor inputs and firms are considered mobile in the long-run and operating under the pricing mechanisms of monopolistic competition. NEG would assume one firm and thus one variety per region for a finite continuum of varieties.

Given these sets of firms and their corresponding varieties, we can fashion an expression for region *r* consumption of variety *i*. In order to obtain this demand curve, we assume that the representative consumer consumes a composite good from the formal sector. This good alongside the goods consumed from the residual sector are assumed ex-post to maximize the representative consumer's utility. Utility is given as Cobb-Douglas with a CES sub-utility aggregate nested in place of consumption of the formal sector's output. Generally, the consumer's utility optimization problem is to maximize utility derived from consuming products of the formal and residual sector subject to an income constraint, i.e. :

$$\max U_r = M_r^{\mu} A_r^{1-\mu}$$

$$subject\ to: Y_r = P_r M_r + p^A A$$

Y_r represent's regional income. $M_r = \left[\int_0^n q(i)^\rho di\right]^{1/\rho}$ which is known as both the subutility function and the CES aggregator index for representative consumer's consumption of the formal sector's output. Utility preferences are assumed to be convex between choice alternatives, uniform across all possible good bundles, and then maximized at ex-ante consumption levels. Here, A represents the representative consumer's consumption of the residual sector's output everywhere; p^A is the price of residual output everywhere; μ is the representative consumer's expenditure share on formal sector output; and $\rho = [(\sigma - 1)/\sigma]$; and the aggregate price index takes the form:

$$P_r = \left[\int_0^n [p_r(i)]^{-(\sigma-1)} di + \int_0^n [T_{rs} p_s(i)]^{-(\sigma-1)} di\right]^{-1/(\sigma-1)}$$

Note that these expressions are given as integrals because it is assumed that all products are demanded in the same quantity and all prices are symmetrical at market equilibrium. P_r will decrease as the number of varieties taken in aggregate across regions rises; this dynamic captures the nature of competition between brand varieties. The expression here for P_r falls out of the expenditure minimization problem given a budget constraint on representative consumer income Y that confronts an individual variety of consumption choices from the formal sector (Fujita, et. al, 1999). It is defined as a continuous density function like the composite sub-utility consumption function so that the number of varieties is not treated as an integer. This assumption has important implications that are beyond the scope of this paper (Combes, et. al, 2008).

Note that for this utility optimization problem, consumers are paying delivered prices for the imported good being exported out of the foreign region s. σ is the elasticity of substitution between varieties and takes a value $\sigma > 1$ - as in Chamberlinian demand, this parameter remains constant in aggregate demand in keeping with the functional form of the CES aggregator, which yields benefits of constant elasticity of demand. These benefits allow demand to be solved for entirely in terms of the elasticity of substitution and technology parameters of the increasing returns to scale (IRS) production function (Feenstra, 2003). We can index σ with the expression $1/\rho = [\sigma/(1-\sigma)]$ to denote preference for variety, where $0 < \rho < 1$. An increase in σ means that products are becoming more homogenous. ρ close to 1 suggests that goods are nearly perfect substitutes for each other and as it decreases towards 0, the desire to consume a greater variety of manufactured goods increases. Krugman notes that the reciprocal of ρ is the *degree of economies of scale* when output is produced at equilibrium by all firms across all regions (Krugman, 1991). It can be derived by dividing the marginal product of labor at market equilibrium, by the average product of labor at *market equilibrium* (Krugman, 1991). This expression is derived from a general production cost function that exhibits increasing returns to scale.

The presence of transportation costs suggests that utility is maximized over a range of goods that may either have domestic or foreign origin. Moreover, the presence of CES preferences in both the composite consumption and price functions will lead to imperfect competition; and hence, "fragmented" (e.g. differentiated) spatial markets in the context of the open economy. This point is crucial since firms and production factors are assumed to be interregionally immobile in the short-run such that wages and prices equilibrate independently from firm concentration in the presence of international trade, which stands contrary to the long-run dynamics posed in NEG. This assumed immobility of factors arguably does hold in a short-run equilibrium, but is also convenient from a modeling perspective (Combes, et. al, 2008). This assumption is present in the HO model, New Trade Theory, and nearly every derivative of these families of models.

Maximization of the utility function with respect to the budget constraint less the value of aggregate consumption across the two sectors yields *total demand of formal sector production variety i* (Combes, et. al, 2008). This form falls out of the standard utility maximization framework presented in standard consumer optimization theory. Formally, constant elasticity of substitution (CES-type) demand is given as,

$$q_r(i) = \mu p_r(i)^{-\sigma}[P_r^{\sigma-1}Y_r + \phi_{rs}P_s^{\sigma-1}Y_s]$$

Notice that the CES aggregator imposed on formal sector product varieties $M_r = \left[\int_0^n q(i)^\rho di\right]^{1/\rho}$ is sufficient for yielding *constant* elasticity of demand for the consumer. To verify this, take the logs of both sides of the demand function in order to transform it into its empirical form: $-\sigma$ becomes the constant coefficient for $p_r(i)$ for all values $q_r(i)$, and $-\sigma$ is bearing the theoretical negative effect.

Turning back to the total demand function's components: $Y_r = \theta_\beta L_\beta + w_r\theta L$ and $Y_s = (1 - \theta_\beta)L_\beta + w_s(1-\theta)L$ in which L_β represents the total mass of unskilled labor across regions *r* and *s* and θ_β represents the share of unskilled workers in region *r* (Combes, et. al, 2008). The quantity $P_r^{\sigma-1}Y_r$ represents domestic markets and the quantity $\phi_{rs}P_s^{\sigma-1}Y_s$ represents foreign markets. The first term will nearly always be larger than the second if ϕ_{rs} is positive. ϕ_{rs} is termed the "spatial discount" factor or otherwise sometimes called the "freeness of trade" by trade economists. Freeness of trade is formally given as:

$$\phi_{rs} \equiv T^{-(\sigma-1)}$$

Clearly, freeness of trade is inversely related with trade costs - as it approaches 0, trade is at autarky. I now begin a quick overview of the DSK model's mechanics. DSK is a model of monopolistic competition which relies heavily on increasing returns to scale at the firm level and imperfect competition. These two elements are the mathematical ingredients necessary for formalizing agglomeration and ensuring that trade arises in equilibrium (Ottaviano, et. al, 2003).

In closing this subsection, it is worth remarking that other formulations of consumer preferences in the representative consumer's utility function have been proposed that lead to much richer demand functions. The quasi-linear utility function, which allows for mixed bundles of consumption, is one such example (Ottaviano, et. al, 2002). These demand structures allow for different elasticities of substitution between pairs of varieties.

Imperfect Competition

I now turn away from the consumer problem and approach the producer problem. The DSK model requires a formalization of imperfect competition for a number of reasons: imposing constant elasticity of substitution on the demand curve and allowing equilibrium regional wages to deviate from prices according to a markup; the latter reason here permitting monopolistic pricing. First and foremost, monopolistic competition is envisaged in a spatial economy in which each region *r* contains one monopolist who is charging a unique regional price that is a function of revenue and factor costs (e.g. wages). The modeler's goal here is to find a way to express prices in terms of their factor costs and markup at a profit-maximizing equilibrium - in other words equating marginal revenues to marginal costs. To begin with, one can take a more simplified view of the demand function presented above by ignoring the income effect of prices (e.g. compensated demand). Moreover, consider the case when we are modeling consumers to be facing f.o.b. prices under a mill-pricing strategy so that we can ignore transport/trade costs for goods out-of-region. Maximizing the representative consumer's utility with respect to demand for formal sector output yields the domestic demand component of the total demand function (Combes, et. al, 2008):

$$q_r(i) = \left[\frac{p_r(i)}{P_r}\right]^{-\sigma} M_r$$

Where $P_r = \int_0^n [p_r{}^{\rho/(\rho-1)}(i)]^{(\rho-1)/\rho} di$ results from an expenditure minimization problem (Fujita, et. al, 1999). Note also that the uncompensated consumer demand function for $M_r = \left[\int_0^n q(i)^\rho di\right]^{1/\rho}$ is equivalent to $M_r = \frac{\mu Y_r}{P_r}$ at utility maximized levels for the representative consumer (Donaghy, 2004). Rearranging the terms and solving for the price of variety *i*, one can obtain the inverse demand function for the variety *i*.

$$p_r(i) = \left[P_r M_r{}^{1/\sigma}\right] q_r(i)^{-1/\sigma}$$

Here, each firm is assumed to choose its price by taking the price indices as given.

This expression can be substituted into the firm's profit function:

$$\pi_r = p_r(i)q_r(i) - w_r(\alpha + \beta q_r(i))$$

The first term is gross revenue and the second term is production costs, when α is a fixed skilled labor cost (in terms of labor units). Differentiating the profit function with respect to quantity demanded of the formal sector output will yield an expression for marginal costs and marginal revenues (Fujita, et. al, 1999). Notice that π_r is generalized over all firms *i*. This occurs since profit maximization and market clearing yields optimal price and production levels that are common to all firms *in a given region*. Hence, producers are now assumed to <u>maximize their profits</u> under <u>nonstrategic behavior</u>, which means that they take their regional price index P_r as constant and exogenous in order to determine their production levels (Fujita, et. al, 1999). One typically proceeds by first deriving an expression for optimal price. Substituting the inverse demand curve expression into the expression for profit and taking $\frac{\partial \pi_r}{\partial p_r(i)}$ yields:

$$\frac{\partial \pi_r}{\partial p_r(i)} = p_r(i)\left[1 - \frac{1}{\sigma}\right] - w_r\beta = 0$$

Here it could be shown that σ also equals the price elasticity of demand (Combes, et. al, 2008). At the zero profit equilibrium, this implies:

$$p_r(i)\left[1-\frac{1}{\sigma}\right]=w_r\beta$$

The left hand side of this equation can be written in its more recognizable form: $p_r(i)\left(\frac{(\sigma-1)}{\sigma}\right)$. One then proceeds to derive expressions for marginal cost and marginal revenue. This expression allows one to derive the main component of imperfect competition: firms will produce $q_r(i)$ up to the point where their marginal costs are equal to their marginal revenues. Marginal revenue is given by $\frac{\partial[p_r(i)q_r(i)]}{\partial q_r(i)}=p_r(i)\left[1-\frac{1}{\sigma}\right]$ and marginal cost by $\frac{\partial[w_r(\alpha+\beta q_r(i))]}{\partial q_r(i)}=w_r\beta$. When MR = MC, $p_r(i)=w_r\beta$ and when prices are optimized, one can obtain once again the zero-profit equilibrium. Hence, imperfect competition exists at the level of the individual variety *i*, and each variety *i* is assumed to be produced by only one spatial monopolist. Firms will only strategically compete in the Bertrandian fashion within their own markets but not across markets. This quantity is less than what would otherwise exist under perfect competition, which implies that firms will face barriers to entry at the regional level. In other words, firms are endowed with a certain regional market and cannot simply produce everywhere as would be the case in perfect competition.

Increasing Returns (Scale Economies)

Having derived the basis of imperfect competition by deriving an expression of firms' marginal revenues, I want to show how imperfect competition manifests itself in terms of the equilibrium price. Doing so requires expressing sales prices in terms of production costs. Production cost $C(q_r(i))$ - the cost function - is represented with the right-most term in the representative firm's profit function. It can be more formally expressed in a production function exhibiting increasing returns (stated here in terms of production value - i.e. cost of production):

$$w_r\big(\alpha + \beta q_r(i)\big) = L(i)_r w_r = C(q_r(i))$$

This function is also equal to $p_r(i)q_r(i)$ for some firm *i* when $\pi_r = 0$ (see the profit function for rationale). Worthy to note is the expression for labor which is denoted as $L(i)_r$, the labor used by firm *i* for producing variety *i*. Output of firm *i* is given by $q_r(i)$. Marginal costs are given by $\frac{\partial L(i)_r w_r}{\partial q_r(i)} = w_r\beta$. Notice that this function contains fixed skilled and variable unskilled labor costs, otherwise known as "technologies", α and β. If $\alpha \neq 0$ and is positive, then this function will exhibit increasing returns to scale. This can be readily seen by dividing the function by $q_r(i)$ to obtain the average cost of production.

Factor costs, and thus wages, are at equilibrium when profits are maximized by firms and when f.o.b. prices for formal sector goods are set at average costs for producing formal sector goods. Hence, a zero-profit condition in the context of imperfect competition implies that price equals average cost of production – a major implication that leads to the notion of increasing returns to scale in the production function. The former condition makes it feasible for firms to enter into this two-region economic system without immediately going bankrupt. The latter condition arises from increasing returns to scale in the formal sector and gives rise to conditions for imperfect competition within this sector.

Firms will exit if they cannot produce at or below average costs. Setting prices $p_r(i)$ equal to average costs $\frac{C(q_r(i))}{q_r(i)}$,

$$p_r(i) = \frac{w_r\alpha}{q_r(i)} + w_r\beta$$

Firm *i* will break even if they equate their marginal revenues equal to their marginal costs. Doing so, we obtain the "pricing rule" with markups:

$$p_r(i) = \left(\frac{\sigma}{(\sigma - 1)}\right) w_r \beta$$

Note that the markup breaks the pricing rule in perfect competition. This expression can be reformulated as a function of transport costs such that, $p_{rs}(i) = \left(\frac{\sigma}{(\sigma-1)}\right) T_{rs} w_r \beta$, where $T > 1$ (Combes, et. al, 2008).

Worth also noting here is the condition that equilibrium prices for products *i* are equivalent within regions (Donaghy, 2004). Proceeding with monopolistic pricing, the intersection of average costs and marginal costs forms the equilibrium condition for output. Indeed, $\left(\frac{\sigma}{(\sigma-1)}\right) w_r \beta = \frac{w_r \alpha}{q_r(i)} + w_r \beta$ and solving for $q_r(i)$ yields q^* for some *i*. Note that if technology parameters are regional specific, q^* will also be region specific. Formally,

$$q^* = \left(\frac{\alpha}{\beta}\right) * (\sigma - 1).$$

Hence, equilibrium optimal output will be uniform across regions (if technologies are regionally symmetric) such that profits are zero for all regions. This condition guarantees that free entry and exit persists across *regional* markets.

Necessary Conditions for Trade

Since economies are assumed to be open in the DSK framework, trade will feasibly lead to an equilibrium outcome across regional prices. The Heckscher-Ohlin model usually requires that the terms of trade $\frac{P_s}{P_r}$ be initially asymmetrical such that relative market sizes $\frac{Y_s}{Y_r}$ are as well. If they were not, there would be no reason for trade to ensue between the regions (Feenstra, 2003). Once free trade takes place, prices will reach a world price and wages rise for the factors employed in the greater net exporter of formal sector goods. For example, if $L_r > L_s$ such that $N_r > N_s$ then region *r* produces more varieties and exhibits $P_r < P_s$ for formal sector goods. Consequently, *r* will export more formal sector goods to *s* than vice versa; region *s* will demand relatively more ($q_s(i)$) in its demand function's foreign component ($\phi_{rs} P_r^{\sigma-1} Y_r$) compared to region *r*'s foreign component of demand. Moreover, since $w_r = \left(\frac{\mu}{1-\mu}\right)\frac{L_r}{L}$ wages for formal sector production will be higher in *r* than in *s* at the equilibrium world price.

Hence, the DSK models wages to converge and diverge according to factors such as transport/trade costs. In other words, wages may equilibrate differently across regions depending on regional transport/trade costs. Using this theoretical basis, I can now outline a gravity model of trade that assumes heterogeneous wages in a bilateral trade setting; a setting in which outputs are assumed to be uniformly and optimally produced by firms in a multiregional setting under imperfect competition and increasing returns to scale. Firms' "economic base" (e.g. exportable output) make up a portion of this equilibrium output and are assumed to face transport/trade costs. The coefficients estimated in this gravity model can then be used to construct ϕ_{rs}, "market access" and "supply access", all three of which are merely components of regional wages. This will be expounded upon shortly below.

The Gravity Model and Market Potential

The DSK model permits the economist to formulate a formalized notion of equilibrium wages and Venables shows that a theoretical component of the "wage equation" can be estimated in a gravity framework. To begin with, one need only consider first the "pricing rule" $p_r(i) = \left(\frac{\sigma}{(\sigma-1)}\right) w_r \beta$, which was shown earlier to fall out of equating marginal revenues of the firm to marginal costs of variety *i* production in the firm's profit function, and second the consumer's basic demand function for region *r* variety *i* output, $q_r(i) = \left[\frac{p_r(i)}{P_r}\right]^{-\sigma} \mu Y_r$. The new trade theory model, from which the DSK model achieves its empirical operationalized form, departs slightly from this form by considering demand expressed in terms of trade flows - specifically internal trade flows and imports from foreign regions. This is a slight departure because one is identifying consumption according to product origin. The basic demand function can be rewritten to encompass the demand for foreign imports and for internal trade flows given by a regional composite M_{rs}. Where region *r* is the exporter and region *s* is the importer. Hence, demand is given from the perspective of the importer, region *s* where $(r, s) \in N$. For the rest of this section, I am going to alter the logic of the origin-destination sub-scripts. Instead of the domestic-foreign interpretation, *rs* now denotes exporter first and importer second. Hence, this section presents notation that stands in contrast to previous sections in which *s* was considered an exporter in relation to our domestic region, region *r*.

Preferences are thus given for consumers in region *s* with the following utility function (Redding, Venables, 2004):

$$max\ U_s = \sum_{r}^{N} M_{rs}^{\mu} A_s^{1-\mu}\ \ such\ that\ Y_s = P_r M_{rs} + p^A A$$

Y_s is regional income of *s* and *A* is that region's consumption of agricultural output. $M_{rs} = \left[\int_0^n q_{rs}(i)^\rho di\right]^{1/\rho}$ and $P_r = \left[\int_0^n [T_{rs} p_r(i)]^{-(\sigma-1)} di\right]^{-1/(\sigma-1)}$. Here, N includes include region *s*, implying that internal (i.e. intraregional) trade is observable and proxies in-place of consumption of domestically produced goods.

Hence, this utility function is merely a function of trade flows. Note also the summation operator across regional composites, which implies that the foreign region *r* consists of a continuum of regions *r*'s. For the rest of this sections' discussion I will focus more on the foreign import component of trade flows by ignoring the role of internal flows. Following utility optimization, the demand function represents region *s*'s demand for region *r* exports and is hence the foreign demand component of total demand. Invoking Shephard's Lemma, the amount of the formal sector's good of variety *i* that is produced in *r* and demanded in *s* can be written as:

$$q_{rs}(i) = [p_{rs}(i)]^{-\sigma} P_s^{\sigma-1} \mu Y_s$$

They key to interpreting this expression is recognizing that the foreign and domestic components of consumer demand for region *s* have been combined into an expression for production originating from region *r*. Notice that this function is merely an expression for formal production of variety *i* in region *r* that will be imported by region *s*. Although we are talking about region *s* demand, it makes more sense to think about this equation from the exporter's perspective, region *r*. Region s's demand here is a function of its GDP, but it is useful to think of this expression as the demand that region *r*'s producers face from region *s* consumers. Where Y_s is aggregate income at location s and μY_s is the share of expenditures on formal sector output of variety *i* in region *s*. Hence, the consumer demand in *s* for region *r* production is a function of region *s* GDPs. Recall that the mill price at region *r* $p_{rs}(i) = p_r(i) T_{rs}$ and $\phi_{rs} \equiv {T_{rs}}^{-(\sigma-1)}$ where trade costs are spatially symmetrical (Fujita, et. al, 1999). In other words, *rs* denotes that which is charged in *s* for region *r* goods. Hence, mill pricing policies are in effect for all varieties produced in country *r* are sold at their c.i.f. price in country *s*.

Taking into account these transport costs yields an expression for effective demand of variety *i* in region *s*:

$$q_{rs}(i) = [p_r(i) T_{rs}]^{-\sigma} P_s^{\sigma-1} \mu Y_s$$

Here it is assumed that output occurs at full capacity so that production is at optimum levels. Again, region *s* is consuming imports at a c.i.f. price which is yielded by multiplying f.o.b. prices of foreign goods $p_r(i)$ by the cost of transporting those goods T_{rs}. The yielded expression is $p_{rs}(i)$, the c.i.f. price.

In this next step, I want to derive an expression of region *s* demand for all products across N at delivered-price consumption. Since transport costs are iceberg costs, such that $T_{rs} = T_{sr} > 1$, one expects the f.o.b. price of the exporter to be less than the c.i.f. price at the destination market such that $p_r(i) < p_{rs}(i)$ which implies that $q_r(i) > q_{rs}(i)$ as region *r* exports "melt-away" in transit to region *s*. However, this metaphor implies that if consumers in region *s* are in fact consuming the full quantity of region *r* production intended for region *s* markets, then T_{rs} times $q_r(i)$ exports must be delivered to region *s* so that no output is actually "melted along the way". Hence, under a delivered-price setting in which consumers bear the costs of shipping, the true quantity of exports from *s* to *r* is given by a premium borne to customers T_{rs} on top of production such that $T_{rs}q_r(i) = q_{rs}(i)$. Succinctly put, since effective demand for variety *i* at region *s* evaluated with trade costs leads to a quantity consumed ex-post the arrival of imports that is less then that demanded ex-ante, $p_r(i)$ needs to be multiplied by T_{rs}, given that $T_{rs} = T_{sr}$ such that trade costs are symmetrical. Hence,

$$T_{rs}q_{rs}(i) = [p_{rs}(i)]^{-\sigma}{T_{rs}}^{1-\sigma}P_s^{\sigma-1}\mu Y_s$$

Again, $p_{rs}(i)$ is an expression of the c.i.f. price of region *s* goods. And the same relationship between f.o.b. and c.i.f. prices can be applied to quantities; hence, $T_{rs}q_r(i) = q_{rs}(i)$. The left hand side can also be rewritten by rearranging the price terms so that:

$$q_{rs}(i)\left(p_{rs}(i)\right)^{\sigma} = [T_{rs}]^{1-\sigma}P_s^{\sigma-1}\mu Y_s$$

This form applies to a strictly two region case and is in fact the wage equation for region *r*. Hence, wages of the exporting region are a function of peripheral regions. Let me now simplify for a multiregional case. Consider the expression:

$$q_r(i)\left(p_r(i)\right)^{\sigma} = \sum_{s}^{N}[T_{rs}]^{1-\sigma}P_s^{\sigma-1}\mu Y_s$$

The subscript *rs* has been replaced with *r* for the purposes of expositional simplicity. Note however that I still allow $(r, s) \in N$.

At profit maximizing and market clearing levels, one simply substitutes the equilibrium expression for prices into the inverse demand function $p_r(i)$. Recall that the pricing rule states that equilibrium prices can be expressed as $p_r(i) = p_r = \left(\frac{\sigma}{(\sigma-1)}\right) \widetilde{w}_r \beta$ - the RHS is composed of the markup, composite costs, and the marginal unskilled labor input requirement respectively. I've rewritten w_r since Venables requires that $\widetilde{w}_r$ be decomposed into three factor costs: namely, an intermediate input cost G_r, wages of immobile factors (i.e. labor) w_r, and rents of mobile factors (i.e. capital) v_r. Without any loss of generality, each of these costs is aggregated under the assumption of linear homogenous Cobb-Douglas production technology with cost-input share parameters summing up to one. Formally,

$$\widetilde{w}_r = {G_r}^{\Phi} {w_r}^{\Psi} {v_r}^{\Theta} \text{ where } \Phi + \Psi + \Theta = 1.$$

Hence, total exports at profit maximizing levels can be manipulated to be expressed as wages at profit maximizing levels.

$$q_{rs}(i)\left(\beta\left(\frac{\sigma}{(\sigma-1)}\right) {G_r}^{\Phi} {w_r}^{\Psi} {v_r}^{\Theta}\right)^{\sigma} = {T_{rs}}^{1-\sigma} P_s^{\sigma-1} \mu Y_s$$

Where the *foreign* component of the CES price index P_s is calculated with a CES aggregator (Leamer, 1995):

$$P_s = \left[\int_0^n [T_{rs} p_r(i)]^{-(\sigma-1)} di\right]^{-1/(\sigma-1)}$$

As a side note, the wage equation presented above can be generalized more extensively for imputation into the general spatial equilibrium of an NEG model, though this is not the focus of this paper (Fujita, et. al, 1999). Doing so, however, is a mere matter of algebra. One need only substitute the equilibrium prices $p_r(i) = p_r = \left(\frac{\sigma}{(\sigma-1)}\right) w_r\beta$ into $q_r(i)(p_r)^{\sigma} = {T_{rs}}^{1-\sigma} P_s^{\sigma-1}\mu Y_s$ and substitute equilibrium production $q_r = q^* = \left(\frac{\alpha}{\beta}\right) * (\sigma - 1)$ in a likewise fashion. Rearranging the terms and aggregating over all possible trade partners R (Donaghy, 2004):

$$w_r = \left(\frac{(\sigma-1)}{\sigma}\right)\left[\frac{\mu}{q^*}\sum_{r}^{R} Y_s[T_{rs}]^{-\sigma} P_s^{\sigma-1}\right]^{1/\sigma}$$

One can also look at the producer's side of the problem to gain a better understanding of the cost and revenue components. Since at equilibrium $p_r(i) = p_r = \beta\left(\frac{\sigma}{(\sigma-1)}\right) {G_r}^{\Phi} {w_r}^{\Psi} {v_r}^{\Theta}$, it is also the case that $p_r\left(\frac{(\sigma-1)}{\sigma}\right) = \beta\widetilde{w}_r$. Substituting this equilibrium expression into the profit function π_r yields an expression of gross profits $\frac{p_r}{\sigma} q_r(i)$ less fixed costs $(\sigma - 1)\alpha$.

$$\pi_r = \frac{p_r}{\sigma}[q_r(i) - (\sigma - 1)\alpha] = 0$$

The expression for gross profits becomes useful in frequentist probabilistic models of location choice in which firm location decisions are a function of gross profits. This application is outside the scope of this paper; however, the regional profit expression here is useful for explaining the role that increasing returns will have in inducing agglomeration. The home-market effect, for instance, illustrates agglomeration by utilizing relative profits between regions as the driving mechanism that induces firms to locate in one region versus another. The cost component in equilibrium profits, $(\sigma - 1)\alpha$, contains a fixed cost barrier to entry. This expression for regional profits is also useful from a policy-maker's standpoint since $(\sigma - 1)\alpha$ is potentially a kind of subsidy that could be offered to start-up firms so that free entry and exit can be achieved, bolstering the competitive environment of the formal sector. Again, this application is not in the scope of this paper.

Consider now the wage equation in a multilateral setting. Since the expression for wages $q_r(i)(p_r)^{\sigma} = \sum_s^N [T_{rs}]^{1-\sigma} P_S^{\sigma-1} \mu Y_s$ applies only to a single variety *i*, one will want to aggregate this expression across the total number of varieties for region *r* to yield an aggregate level of bilateral exports from region *r* to region *s*. At profit maximizing and market clearing levels, all firms in region *r* can break-even if they produce $\bar{q}_r = (\sigma - 1)\alpha$. If one assumes that firms produce the same quantities at profit maximizing levels then $\bar{q}_r = \bar{q}_r(i)$. In other words, one can assume that all regional varieties are produced at the same levels $\frac{1}{N_r} \sum_i^{N_r} q_r(i) = \bar{q}_r = q^*$ (Redding, Venables, 2004). Hence, substituting this expression into the wage equation $q_r(i)(p_r)^{\sigma} = {T_{rs}}^{1-\sigma} P_S^{\sigma-1} \mu Y_s$ and multiplying each side by the number of firms in region *r* N_r and by $(p_r)^{1-\sigma}$ yields the *empirical* formulation, albeit non-operationalized form, of the wage equation. This equation is the gravity equation.

$$N_r \bar{q}_r p_r = N_r (p_r)^{1-\sigma} {T_{rs}}^{1-\sigma} P_S^{1-\sigma} \mu Y_s$$

Empirics of Gravity in terms of Market Potential

Increasing returns and imperfect competition were presented in the previous section of this paper to explain the existence of heterogeneous wages over space. The DSK model determines the equilibrium scale of production and markups of price over marginal cost independently of regional incomes. As such, wages can be shown to be endogenized in the DSK framework as was presented above. Yet, how might we test the theoretical relationship posed between wages, prices, regional incomes, and transport costs? One such method has been to identify grouped components of these variables through estimations of gravity.

The applied empirical component of this paper will estimate the parameters of the gravity equation. $N_r \bar{q}_r p_r$ is simply bilateral exports of region *r* to region *s* aggregated over the total number of firms in region *r* N_r. $\left[N_r (p_r)^{1-\sigma} {T_{rs}}^{1-\sigma} P_s^{1-\sigma} \mu Y_s\right]$ on the other hand is composed of three distinct elements which will be discussed here. The first of these elements is market potential.

One observes that economic activity appears to be greatest where we find the most exchange in goods and services. The mere proximity one finds oneself to large centers of exchange incentivizes one's participation therein. The scale of economic activity and the existence of space has in fact been formalized in the arena of economic geography. We call the measurement that combines these two pieces of information "market potential" (Harris, 1954). Motivation for such a measure arises when one observes that the potential demand for goods and services produced in any one location depends upon the distance-weighted incomes of all locations in a spatial economy. Market potential thus is an abstract index of the intensity of possible contact with markets and it can generally be described as a distance weighted GDP of neighboring regions in an economy. One such formulation of market potential might take the following form:

$$Market\ Potential_r = \sum_{s=1, s\neq r}^{R} Y_r / d_{rs}$$

d_{rs} denotes distance between centroids of a region. Subscripts *r* and s denote the spatial centroids of a set of markets defined by their geographic extent in terms of Cartesian coordinates. This formulation of market potential also has an empirical form:

$$Nominal\ Market\ Potential_r = \sum_{s=1, s\neq r}^{R} \mu Y_r\, {d_{rs}}^{\delta}$$

Here, the parameter δ is expected to take values greater than 1 after estimation. The empirical form of market potential is called nominal because it does not account for c.i.f. prices or regional price indices. However, one can see that it is in fact a component of the wage equation presented in the subsection above. Real market potential can thus be presented as:

$$Real\ Market\ Potential_r = \sum_{s=1,s\neq r}^{R} \mu Y_r\, \phi_{rs} P_s^{\sigma-1}$$

Where again for the sake of thoroughness $\phi_{rs} \equiv T_{rs}{}^{-(\sigma-1)}$ and $0 < \phi_{rs} < 1$ and is symmetric across "dyads" (e.g. trade pairs), and where $\phi_{rs} = 0$ denotes perfectly prohibitive trade. Real market potential is in theory a component of the wage equation.

Market Access and Freeness of Trade

Recall the multilateral trade flow equation:

$$N_r \bar{q}_r p_r = N_r (p_r)^{1-\sigma} T_{rs}{}^{1-\sigma} P_s^{1-\sigma} \mu Y_s$$

This equation is derived from the wage equation. Inspecting the multi region case of the wage equation, $q_r(p_r)^{\sigma} = \sum_s^N [T_{rs}]^{1-\sigma} P_s^{\sigma-1} \mu Y_s$, one discerns that real market potential *is* just another name for the wage equation. Note also that market potential is a negative linear function of transport costs, a positive function of foreign market size, and that market potential is negatively related to prices abroad, P_s. Venables decomposes the analytic expression here into three components for the purposes of easing econometric estimation (Redding, Venables, 2004). The first of these analytic expressions is "market access". He decomposes the expressions to illustrate some basic economic intuition. For one, market access describes the forward-linkages in an economy - these linkages might be described as the geographic or network linkages between a region of producers and every other regional market. In the case presented so far, And much like real market potential, market access is weighted by transport/trade costs. In fact, the wage equation stated above is precisely Venables' expression for market access (Redding, Venables, 2004). Market access can be further broken down into two basic components: "market capacity" and "freeness of trade".

$$q_r(p_r)^{\sigma} = Market\ Access_r = \phi_{rs}(Market\ Capacity_r)$$

Where $\phi_{rs} \equiv T_{rs}{}^{-(\sigma-1)}$ and $Market\ Capacity_r = \sum_s^N P_s^{\sigma-1} \mu Y_s$. Hence, market capacity is the price-weighted summation of all the buying-power across other regional markets *s* facing region *r*. Trade/transport costs are summarized with ϕ_{rs}, the spatial discount factor. This factor is more widely known as the "freeness of trade" parameter $0 < \phi_{rs} < 1$, where a value of 0 describes autarkic bilateral trade relations. In theory, this parameter typically arises in the theory when we choose not to empirically derive an expression for T_{rs}. T_{rs} is arguably difficult to observe since it is a function of several geographic, political, and cultural variables. I will return to this point shortly. In short, ϕ_{rs} is an indirect measure of trade costs whose estimation simply requires data on internal and external trade flows (Combes, et. al, 2008). Ideally we use intra and interregional exports to calculate:

$$\hat{\phi}_{rs} = \sqrt{\frac{q_{sr} q_{rs}}{q_{rr} q_{ss}}}$$

Where $q_{sr} + q_{rr} = q_r$ and $q_{rs} + q_{ss} = q_s$ in-line with the export-import subscripting logic.

My application deviates from this analytic form since internal trade costs are difficult to observe empirically. Many empirical applications of economic geography choose to estimate the internal cost component of $\hat{\phi}_{rs}$ but only by assuming that internal trade costs are a function of regional land mass (Redding, Venables, 2004). I argue that the inclusion of internal trade flows into the data-set leads to a parameter estimate for internal trade costs may not align well in my study: all of the ASEAN+3 countries in my data-set rely heavily on waterways and oceans for the movement of freight. In short, I assume that internal trade costs are negligible relative to external trade costs.

Hence, my application is in line with much of the applied literature by estimating trade costs directly. I continue to use ϕ_{rs} to represent trade costs for ease of exposition despite its traditional usage in empirical frameworks that attempt to measure internal trade costs.

Trade costs are theoretically composed of different underlying costs. These underlying costs are always costs faced by one region/country given its geographic or political-economic orientation with respect to another region/country.

$$ln(T) = A + \delta\, ln(d) + \lambda K_{rs}$$

Where A is a freight cost "shifter" that may have to be instrumented for and K_{rs} is a real valued vector of k variables, which might include political-economic or linguistic commonalities between *r* and *s*. Substituting this expression into a gravity models, estimating the parameters on distance and border effects, provides the necessary ingredients for solving for ϕ. The general form of predicted trade costs follows thusly:

$$\hat{\phi}_{rs} = e^{\hat{\delta}\ln(d_{rs}) + \sum_k^K \hat{\lambda}^k k_{rs}}$$

$\hat{\phi}_{rs}$ is therefore a function of natural-logged bilateral Euclidian distances between trade partners given by $\ln(d_{rs})$ and a series of dyadic political, geographic, and cultural variables $k_{rs} \in K$. Note that these dyadic variables are not naturally logged. Estimated directly in my application, $\hat{\phi}_{rs}$ can be constructed from parameter estimates of these aforementioned variables, which are obtained from structural estimation. The concern that most practitioners, including myself, have with this sort of approach to approximating trade/transport costs is twofold: (a) the problem of omitted variable bias and (b) bias due to excluding "multilateral resistance" indices (i.e. price indices) (Feenstra, 2003). I will quickly discuss these concerns here.

International economists typically use cross-panel gravity models at geographies smaller than the state level (Anderson, Wincoop, 2004). These data-sets contain intracountry alongside intercountry data; for instance, trade flows observed between states and provinces alongside trade flows observed between the countries containing those states and provinces. Practitioners have found a statistically significant effect on a parameter estimate for a dummy-variable that indicates whether a trade-flow corresponds to intercountry trade. Termed "the border effect", trade theory attributes strong border effects to the presence of "relative trade barriers" (Anderson, Wincoop, 2004). More explicitly stated, border effects are theoretically shown to exhibit *upward bias* during estimation if multilateral resistance is omitted from the operationalized model. This hypothesis has been verified empirically in numerous applications (Feenstra, 2003). The origins of this bias stem from the causality issues, or rather endogeneity that arises from the partial equilibrium of new trade theory. Consider the trade flows of variety *i* from *r* to *s* given from before:

$$X_{rs} = T_{rs} q_{rs}(i) = [p_{rs}(i)]^{-\sigma} {T_{rs}}^{1-\sigma} P_s^{\sigma-1} \mu Y_s$$

This equation can be solved for P_s, the inward multilateral resistance index, yielding:

$$P_s = \left[\frac{X_{rs}[p_{rs}(i)]^{-\sigma} {T_{rs}}^{1-\sigma}}{\mu Y_s}\right]^{1/\sigma-1}$$

Hence, if P_s is considered endogenous, which is in fact the case in a partial equilibrium framework, it is clear that $P_s = f(T_{rs})$ where $f(T_{rs})$ denotes a transformation. Even so we know that $P_s = \left[\int_0^n [T_{rs} p_r(i)]^{-(\sigma-1)} di\right]^{-1/(\sigma-1)}$, which implies that inward multilateral resistance, given by domestic price indices, is a function of trade/transport costs. A similar exercise can be performed for output prices p_{rs} for any *i*, which Van Wincoop designates as an outward multilateral resistance index.

Van Wincoop argues that if T_{rs} is determined solely with geographic variables such as bilateral distances and border dummies, it will be overestimated econometrically: it will contain the model-omitted effects of P_s due to its positive correlation with P_s. I argue however that this view can only be tested under an all too generalizing empirical framework. Trade economists observe that trade costs do not include merely physical logistic expenses but also information, monitoring, and policy costs associated with international transactions. Relevant country characteristics such as these are typically unobservable but can be captured with fixed-effects econometric methods, which proxy $N_r(p_r)^{1-\sigma} P_s^{\sigma-1} \mu Y_s$ from the expression for region *r* exports with fixed effect region dummies (Combes, et. al, 2008). These fixed-effect approaches to estimating "access" measures capture multilateral resistance but at the cost of discarding data on μY_s.

Moreover, applications are notorious for using estimated parameters from gravity to construct expressions of "access" and "freeness of trade" measures that are empirically correlated to per capita income instead of wages. Given the wide availability of wage data at even town-level geographies, this estimation strategy appears to be naive. Lastly, these fixed effect methods produce estimates of "access" and "freeness of trade" within a spatial panel, rather than a time panel dataset. In essence, this means that the estimated parameter effects of the variable components of trade/transport costs given by $\hat{\phi}_{rs} = \sum_{r \neq s}^{N} e^{\hat{\delta} \ln(d_{rs}) + \sum_k^K \hat{\lambda}^k k_{rs}}$ are <u>not</u> region-specific. This is troublesome, because some policy effects are not generalizable: is diplomatic coercion really generalizable across countries? I will discuss these points in the next section. Nevertheless, despite all these contentions, authors contend that the exclusion of P_s gives rise to the “gold medal mistake” that must be avoided in gravity model estimation to avoid biased estimates on trade costs (Baldwin, Taglioni, 2007). Is the common practitioner therefore a doomed Olympiad?

Some notable authors take the approach I offer in this paper, which is quite a motivating factor for my applications. Feestra argues that the empirical inclusion of P_s may not adequately capture other barriers of trade that are not just merely a function of trade/transport costs T_{rs} but are in fact political and cultural (Feenstra, 2003). Intriguingly, the theoretical relationship between gravity and agglomeration is useful from a political-economic practitioner's standpoint: ϕ_{rs} is theoretically correlated to a wide-range of variables ranging from the geographic and cultural to the political (Feenstra, 2003). The effects of these political-economic variables can be estimated, which is the primary exercise carried-out in this paper.

Hence, I elect to use political economic controls in the gravity model estimation because they resemble a component of trade costs that enter into the estimates for market access. Recall that Anderson and Van Wincoop attempt to parameterize trade barrier costs with respect to variables such as directly measured trade costs, distance, adjacency, trade-bloc membership, and other typical gravity model controls. Their theory that $\tilde{P}$, the "index of multilateral resistance", is a function of certain trade-costs such as those captured by distance and border effects, is analogues to the construction of the phi-ness of trade parameter (Anderson, Wincoop, 2004). NEG literature, like trade literature, emphasizes that although aggregate trade cost measurements can be estimated in a variety of ways, the inclusion of geographic and political-economic country-level observable characteristics will bias estimates unless a multilateral price index can be estimated with industry-level price indices and tariff data.

I assume that tariff costs and other trade costs are determined independently within the context of the gravity model. Since I do not use tariff data, I presume that tariff effects are captured by the absence of FTA or ASEAN and/or WTO membership for a given country. A country-pair that does not for example enforce an FTA is assumed to be faced with tariff-borne trade costs. The effects of these trade-costs can be captured with "inward and outward region-specific dummies" (Anderson, Wincoop, 2004). However, the application I propose will be limited to ASEAN, which encompasses the regions of East Asia, South East Asia, and Oceania. Hence, one estimation method which is used by Head and Mayer relies on a fixed effects estimation, wherein trade-cost effects are captured by country-specific dummies. The estimates on parameters using this method are unbiased (Anderson, Wincoop, 2004). This procedure was described in previous sections above (Head, Mayer, 2003).

However, this paper will not capture trade-costs with country-specific fixed effects because it is interested in capturing geographical and political-economic effects on trade flows. Anderson and Van Wincoop note that "[the gravity model] can only measure trade barriers relative to some benchmark" (Anderson, Wincoop, 2004). Their primary alternative to capturing multilateral resistance with country-specific fixed effects is a simple summary measure of trade costs for a particular region *j* with all of its trading partners including itself - where costs are broken down by importing and exporting costs (Anderson, Wincoop, 2004). Hence, some measure of internal trade costs is a necessary ingredient. I choose not to use their suggested aggregate measures because of aggregation bias that may lead to endogeneity with regional-trade bloc indicator dummies. Nevertheless, I do attempt to account for internal trade costs by using internal distance measures. The key differentiator in my data-set are countries who were in ASEAN versus countries that were not in ASEAN for some particular time period: ASEAN+3 status is in effect a control. This formulation makes it possible to identify how trade barriers in the absence of ASEAN partnership might affect bilateral trade.

Because I opt to shy away from using a country fixed-effects approach without the use of aggregate price data, I understand that my parameter estimates may be biased, especially if proxies for trade costs such as membership to currency unions and FTAs are endogenous with trade flows. Hence, there is a clear trade-off between the two gravity model functional forms presented above. Without price index or tariff data, the economist either may opt to capture "multilateral" resistance with country fixed-effects - at the cost of being unable to differentiate between different several sources of trade friction that may affect prices - or may opt to adopt the form presented above and consequently lose the ability to measure directly the cost of trade restrictive policies such as tariffs. Hence, although the fixed-effects methodology produces theoretically unbiased parameter estimates, it assumes that all trade-cost distorting policies can and must be summarized with a country-level fixed effect.

Supply Access

Economic geographical theory also concerns itself with the "backward linkages" in an economy. These linkages are specifically the physical and business-network connections between an exporting regions' firms and their input suppliers. These inputs typically refer to intermediate goods, which are a value-added component to final production. They do not refer to labor inputs. The expression for backward linkages is embedded in the wage equation. Recall its multilateral form:

$$q_r(p_r)^{\sigma} = \sum_s^N [T_{rs}]^{1-\sigma} P_s^{\sigma-1} \mu Y_s,$$

The backward linkages for region *r*, the exporting region, are given by region *r*'s "supply access". Supply access is not readily expressed in the wage equation. After homogenizing the composite good across regions and rearranging terms, recall the trade flows equation for exporter *r*:

$$X_{rs} = N_r \bar{q}_r p_r = N_r (p_r)^{1-\sigma} {T_{rs}}^{1-\sigma} P_s^{1-\sigma} \mu Y_s$$

The careful reader might observe that market access is contained on the right hand side. More relevant however is the presence of supply access which is made up of two components: "freeness of trade" and supply capacity.

$$N_r \bar{q}_r p_r = (Supply\ Access_r)(Market\ Capacity_r) = (Supply\ Capacity_r)\phi_{rs}(Market\ Capacity_r)$$

Where $\phi_{rs} \equiv {T_{rs}}^{-(\sigma-1)}$ and $Supply\ Capacity_r = N_r(p_r)^{1-\sigma}$. Supply capacity is the product of the number of firms in region *r* and their price competitiveness; hence, a doubling of supply capacity doubles the value of sales (Redding, Venables, 2004). Note that market access is a negative function of domestic input prices and a positive function of the number of domestic firms.

Taken together, market access and supply access theoretically both have a positive effect on wages in region *r* and exports to region *s*. Moreover, as these access measures increase for region *r*, one would expect long-run agglomeration to occur across such regions. Because of this, one may wish to investigate how trade/transport costs affect "access" scores via their opposing effects against "capacity" effects. Once it is determined how different political, geographic, economic, and cultural factors weigh-into the determination of these "access" scores, one will gain an understanding of the driving forces of agglomeration. With these general motivations in mind, I will discuss the variables considered in my model. Following an overview of the data, I will lay-out the operationalized forms of the empirical model components presented above.

Part Three: Empirics

Variables and Data

Practitioners in economic geography are first and foremost concerned with identifying geographic, political, economic, and demographic factors that give rise to agglomerative forces. Where firms locate and why is perhaps the most important question faced by the private sector on a day-by-day basis. Policy makers may ask similar questions but may focus on country-level variables that are more policy oriented. Where foreign direct investment is targeted and why may just be a policy maker's analogue to the question posed by the CEO's of major corporations. The primary policy tool I will focus on in this application is the "economic trade sanction".

This tool is often studied in the field of international relations and its effectiveness has only received limited study in that body of literature. No comprehensive study has in fact investigated the effect of economic trade sanctions on the "target" and "sender" economies of a sanction; both the basic theoretical causal mechanisms and empirical results of these studies are often heavily debated and dismissed (Kirschner, 2002). I believe that the major issue with these studies often lies with the question being asked. Nearly all studies on economic trade sanctions ask "whether sanctions meet their objectives" and probe what gives rise to "effective sanctions"; they do not ask how sanctions affect regional economies. Dependent variables are often a binary indicator of "success" correlated to arbitrary valuations of sanction potency. Estimations are carried out in a regional-panel dataset under a logit framework with gravity variables as controls (Hufbauer, et. al, 2009).

Moreover, the studies conducted on sanctions implement regressions in a spatial non-time-series panel setting, just like their new trade theory counterparts, which explains away spatial-variation. Hence, their parameter estimates over-generalize space and cannot be used to inform the foreign policy of a country, especially in light of the rich historical, cultural, geographic, social, demographic, economic and political dissimilarities that exist across nations. I will briefly discuss the work that has been done on economic trade sanctions before turning to other political-economic variables included in my application.

Variables: Sanction Costs, Economic Variables, and Political Economic Controls

I. Sanction Costs

The use of comprehensive trade sanctions as a tool of coercion has increased dramatically since the beginning of the Post-Cold War Era. Comprehensive sanctions - or targeted trade sanctions as they are more commonly called – are viewed as a critical component of the successful application of power in the 21st century and measuring their success in this regard has become the object of much discourse in the arena of political-economy and peace studies over this last decade (Drezner, 2011). Much research that studies the effect of sanctions considers the measurement of bilateral trade flows as a “concrete yardstick” by which the direct impact of comprehensive unilateral sanctions can be analyzed. The inclusion of an indicator for trade sanctions in a gravity model is hence arguably important if a strong correlation can be established between trade flows and the presence of trade sanctions.

Generally, sanctions may be defined as temporary abrogation of normal state-to-state relations to pressure target states into changing specified policies or modifying behavior in suggested directions (Abunimah, et. al, 2002). The most notable piece in the trade sanctions literature has measured the severity of trade sanctions on a sanctioned country’s bilateral trade with Gravity Models of trade (Hufbauer, et. al, 2009). These models argue that one of the primary intentions of trade sanctions is to isolate a country's economy from the rest of the world. These models utilize the traditional controls in a gravity model, but also use several binary indicators that classify the type of trade sanction being imposed. Hufbauer, the leading scholar in this body of literature, has found that U.S. voluntary, mandatory, and multilateral trade sanctions in particular do not reduce the target country’s trade with its *other* trade partners; rather, trade sanctions of *broader scope* are correlated with larger predicted total trade flows. In estimating gravity parameters, Hufbauer uses logit to investigate factors that are correlated to increased sanction success (Hufbauer, et. al, 2009). He finds that the likelihood of sanction "success" is often tied to the "cost" of a sanction. To summarize, his study finds that sanctions only seem to affect bilateral trade flows and may only have multilateral implications if they are backed by real costs to the target.

Prevailing literature on the effectiveness of past trade sanctions has studied regional food prices during the 90s in Iraq (Abunimah, et. al, 2002). These studies analyzed correlations between Iraqi domestic policy, food markets, and "sanction costs". Food markets were measured with CPI's for the Iraqi food industry and policy measured with Polity index scores. These studies presented inconclusive evidence but made important strides in terms of initiating data-collection. The Polity Index for example has undergone four revisions since its inception (Marshall, 2014). Sanction costs have similarly undergone similar scrutiny: Morgan's fourth version of the Threat and Imposition of Economic Sanctions (TIES) database exists alongside the Hufbauer-Schott-Elliott (HSE) sanctions database for measuring sanction costs (Morgan, et. al, 2013). The TIES database in particular sets-out to measure various aspects of sanction costs such as the credible threat, the anticipated cost to sender, anticipated cost to target, and associate nominal and "final" costs. "Costs" are arguably *arbitrarily* construed in that they are primarily based on qualitative political-economic factors and not merely economic characteristics. Consequently, costs are given with an ordinal ranking often ranging from 0 to 3. I therefore assign sanction costs from the perspective of the senders of sanctions. Despite these short-comings, the strength in the TIES database really lies in its classification of sanction types, which are broken down into economic embargos, export restrictions, and import restrictions.

More recently, literature on comprehensive sanctions have investigated the affect of trade sanctions on regime change and the types of political issues that economic sanctions are most effective in addressing. Bepat and Morgan find for example in using OLS that multilateral sanctions are indeed correlated with statistically significant rates of regime change if one controls for the kind of multilateral and institutional backing behind the sanction (Bepat and Morgan, 2009). Letskian and Souva attempt to answer whether the choice of sanction targets is consistent with the theory of democratic peace. Using a simple logit framework, they find that democracies are significant less likely to use comprehensive sanctions against another democracy and that as trade interdependence between two states increases, coercion through sanctions is less likely to occur. These authors also ask whether the "saliency" of an issue (i.e. the severity of demands imposed by the sender) are correlated at all to successful sanctions. They find that costly sanctions should be less likely to succeed against nondemocratic targets, and that the greater the salience of the demands by the sender, the lesser the likelihood of sanction success (Lektzian, Souva, 2007).

In short, sanctions research focuses on measuring the factors that affect the "likelihood of sanction success" and the types of trade sanctions that actually have their intended effect on multilateral trade. The studies outlined above primarily investigate the appropriate "controls" that should be included in causal regression frameworks. The leading authors find that institutional backing, multilateral settings, issue saliency (e.g. costs), and political regime type are correlated to sanction success in both positive and negative ways. Nearly all studies find that regime type (i.e. polity) is correlated to sanction occurrence: more than 78% of sanctions in the past three decades were imposed on nondemocratic target states (Allen, 2008). Lastly, sanctions seem to affect bilateral trade and appear to meet their policy objectives when the costs to the target are high.

The primary take-aways from this literature are utilized in my study. I focus on bilateral trade between dyads and investigate a causal relationship between sanction costs and bilateral trade. I specifically focus on the nominal sanction costs to the target of a sanction. I however do not wish to merely study the effect of sanction costs on bilateral trade. Instead, I mean to investigate the transmitted effect of trade sanctions on exporter wage levels. However, in order to more neatly accomplish this, I utilize the controls that have been found to be statistically significant in the sanctions literature. These controls include polity and membership to multilateral institutions such as the WTO and ASEAN+3. Data structure is also of utmost importance: to more accurately capture the effects of institution membership and sanction costs at specific national contexts, I choose in each of my models to use time-series panel data for one specific country and its dyads instead of using a dataset containing all possible dyads combinations. Bilateral trade data and economic data can be easily obtained for a time-panel, which I will now briefly discuss.

II. Economic and Geographic Variables

Time-series trade-flow data, GDP data, and wage data are the three key observations employed in the empirical application of this paper. Trade-flow data are collected from the International Monetary Fund's Direction of Trade Statistics database using quarterly time series from 1988-2013 for the following countries: Australia, China, Indonesia, India, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand, Taiwan and Vietnam. Taiwanese trade data are not present in the IMF data-set because of international agreements with the People's Republic of China (PRC) which forbid the recognition of Taiwan as a country. Hence, Taiwanese bilateral trade data are collected from the Taiwanese National Statistics website - the DGBAS. I choose the time-span of 1988-2013 for mostly practical reasons: bilateral trade-data are not reliable for many countries in my data-set prior to 1988. Even so, some bilateral pairs' trade flow data had to be backward and forward predicted by regressing flows on GDP. Moreover, the chosen time-span aligns well with the political-economic data employed in this study: the TIES, Polity IV, and Correlates of War databases contain data for the time period 1988-2013. Since the time-series data may be serially correlated, the data are corrected for seasonal trends around the means.

The time-series data here are joined to incomes data - more specifically, annual average real wage index data (2005=100) acquired from the Economist Intelligence Unit. These data are collected annually but are transformed via interpolation to exhibit quarterly seasonal trends. Geographic data are obtained from the CEPII gravity model, which contains data on bilateral distances and borders.

After joining all of these data, each country-pair contains 99 time-series observations. The combined data-set of all country-pair observations contains 99 times 12 times 13 entries. I will now quickly discuss the political-economic controls used in this study.

III. Political Economic Controls

I hypothesize that a myriad of political economic controls may have a statistically significant relationship with trade flows in gravity. The multilateral indicator controls will consist first of a set of dummy variables for membership to ASEAN, the GATT/WTO, and dyadic FTA policies. If a country in the dataset belongs to ASEAN or the GATT/WTO, their corresponding ASEAN and/or GATT/WTO cell is coded with a corresponding 1 respectively. The data for these indicators are drawn from the ARIC database, the WTO website, and the Asian World Bank website.

The second set of controls includes discrete rank-ordinal variables, which are Polity, Dyad Hostility, and Social Unrest. Polity scores are taken from the Polity IV database. Dyad hostility and social unrest are taken from the Correlates of War database. Polity scores range from -10 to +10, with -10 indicating nearly a completely totalitarian state and +10 indicating nearly a completely democratic state. Dyad Hostility ranges from 0 to 4: higher scores indicating greater hostility between a dyad. Sanction costs borne to the exporting country of a dyad are drawn from the TIES database. Values range from 1 to 3 - the higher number denoting more severe costs to the sender. Lastly, Social Unrest also spans 0 to 4: higher scores indicating higher social unrest in the exporting country.

The inclusion of political-economic controls such as these presented here is important from a causal perspective because we are fairly certain from empirical evidence that sanction effectiveness is correlated to our controls - independent of disturbances. Sanction effectiveness is of course absent from the gravity model of trade as it is the dependent variable of interest in the logit models used to study the likelihood of sanction success conditional on covariates. If political-economic controls $\mathrm{B_r^m}$ and $\mathrm{E_s^q}$ are indeed conditionally independent from the unobservables in the logit model, then in theory we should use them as controls alongside sanction-costs within the gravity model. Formally, we know that:

$$Ln(Sanction\ Effectiveness_{rs}) = \mathrm{A} + \sum_{m}^{M} \Phi(\mathrm{B_r^m}) + \sum_{q}^{Q} \Psi(\mathrm{E_s^q}) + \sum_{m}^{M} \sum_{\mathrm{q}}^{\mathrm{Q}} \Omega(\mathrm{B_r^m E_s^q}) + \varepsilon_{rs}$$

$$E\left(\mathrm{B_r^m}, \mathrm{E_s^q} \middle| \varepsilon_{rs}\right) = 0$$

Hence, we assume no endogeneity and assume spherical error terms. Here *r* and *s* are regions in a given dyad *rs* and *m* and *q* are conditionally independent regressors generated i.i.d. Hence, if $f(Sanction\ Effectiveness_{rs})$ denotes a transformation of sanction-related political-economic data into some kind of sanction-cost indicator, and $Cov\left(g(\mathrm{B_r^m}, \mathrm{E_s^q}) \middle| f(Sanction\ Effectiveness_{rs})\right) \neq 0$, then the exclusion of $g(\mathrm{B_r^m}, \mathrm{E_s^q})$ from the gravity model may bias the parameter estimate on $f(Sanction\ Effectiveness_{rs})$ in part due to omitted variable bias. To formalize this notion, I now introduce the operationalized form of the gravity model of trade.

Gravity Operationalization

Recall the theoretical gravity model:

$$X_{rs} = N_r(p_r)^{1-\sigma} {T_{rs}}^{1-\sigma} P_s^{1-\sigma} \mu Y_s$$

Venables uses this model to account for relative regional GDPs and gravity-controls so that we can identify explanatory economic and geographic variables that affect wages (Redding, Venables, 2004). The inclusion of additional political-economic policy variables such as membership to a regional trade agreement is necessitated - as argued above - and differentiates economic and geographic effects from political-economic effects. After taking natural logs on GDP and bilateral distance, the more generalized version of the gravity equation is thus:

$$Ln(X_{rs}) = \theta + o_{rs}Ln(Y_r) + \xi_{rs}Ln(Y_s) + \delta_{rs,2}Ln(d_{rs}) + \delta_{rs,1}(border_{rs}) + \sum_{k}^{K} \lambda^k{}_{rs}k_{rs} + \sum_{l}^{L} \iota_{rs}l_r + \varepsilon_{rs}$$

This model is the generalized empirical gravity model employed in my study. It is general because its specification is flexible across different country pairs: political-economic variables may be completely irrelevant in some dyad specifications. This flexibility is accommodated by the FIML estimation procedure (Wymer, 2006). Here l_r corresponds to the set of gravity control variables specific to the exporting country only (i.e. unilateral variables), which includes *WTO membership*, *ASEAN membership*, *degree of social unrest*, and *polity*. k_{rs} corresponds to a set of bilateral gravity control variables which include *common language*, *signed free trade agreement*, *sanction costs to the sender*, and *dyad hostility*. Redding and Venables employ international political-economic openness measures for the exporter and importer in a given dyad, which they consider to be an effective approach at quantifying components of country specific characteristic effects; these measures are essentially composite indices of tariff barriers, non-tariff barriers, black market exchange premiums, state monopoly presence on exports, and the existence of a socialist economic system (Redding, Venables, 2004). I will not myself utilize an international openness measure - and indeed many different indices such as the human freedom or index of economic freedom do exist for this purpose. Rather, I will attempt to utilize membership to regional trade agreements among other more specific political-economic robustness controls for openness.

The estimation strategy for the system above is conducted across *s* pairs $s \neq r$. Hence, upon the completion of estimation there will be for region *r* a vector of rank *s* predictions of $\widehat{X}_{rs}$. Each gravity model utilizes 99 time-series observations. This is an important distinction from previous reduced-form estimations of the gravity model in the NEG setting, which attempt to estimate model parameters in a linear fixed-effects framework (Combes, et. al, 2008). In other words, my estimation requires that different region-pairings are not bundled together into the same data-set for estimation. Authors have typically approached estimation with fixed-effect panel methods for a variety of reasons: this strategy permits the economist to present effects in a more generalized way and it is less cumbersome from a data-collection standpoint. Nevertheless, there are inherent weaknesses to this approach: one assumes that unobserved regional characteristics are the same across all region-pairs and that economic policies have a general effect on all countries. I deviate from this framework by assuming that the characteristics of region-pairs and the effects of economic policies have been constant over time for specific pairings. I perform a non-linear structural estimation that controls for time variations prior to estimation. This structural estimation minimizes the negative of the log of the determinant of the residual variance-covariance matrix. Hence, I estimate the gravity model above 12 times for any 1 country in my data-set of 13 countries. Parameter estimates from each gravity model are collected to eventually construct a single market access and supply access score for the given country. I employ a full-information maximum likelihood estimation algorithm for identifying each set of gravity model parameters (Wymer, 2006). This algorithm permits the practitioner of the NEG to identify the wage equation parameters in a structural setting - in my application, I utilize the reduced structural form proposed by Venables (Redding, Venables, 2004). The algorithm allows one to place constraints on parameter bounds while maximizing a likelihood function vis-a-vis a quasi Gauss-Newton procedure.

Wage Equation Operationalization

I utilize Venables' method of parameterizing the reduced-form wage equation. Recall the structural form of the wage equation for a region-pair:

$$q_r(i)(p_r)^{\sigma} = {T_{rs}}^{1-\sigma} P_s^{\sigma-1} \mu Y_s$$

The gravity model makes it possible to test the wage equation by correlating wages to reduced-form expressions of the RHS, also known as market access and supply access:

$$X_{rs} = N_r \bar{q}_r p_r = [N_r (p_r)^{1-\sigma}] {T_{rs}}^{1-\sigma} [P_s^{1-\sigma} \mu Y_s]$$

Notice again that $N_r(p_r)^{1-\sigma} = Supply\ Capacity_r$, that $P_s^{1-\sigma}\mu Y_s = Market\ Capacity_r$, and that ${T_{rs}}^{1-\sigma} = \phi_{rs}$.

Parameter estimates obtained from the gravity model are used to construct supply access and market access:

$[N_r(p_r)^{1-\sigma}]{T_{rs}}^{1-\sigma} = Supply\ Access_r$ and ${T_{rs}}^{1-\sigma}[P_s^{1-\sigma}\mu Y_s] = Market\ Access_r$. Since the gravity model is estimated by first taking the natural logs of Y_s, Y_r and d_{rs}, the construction of market and supply access scores must first rescale Y_s, Y_r and d_{rs} by taking their exponents. Market access for region *r* is thus constructed using the parameter estimates from 12 gravity models in the following manner:

$$Market\ Access_r = e^{ln\,(Y_r)} \tau_{rr} (t_{rr})^{1-\sigma} + \sum_{r \neq s}^{R} e^{\xi_{rs} Ln(Y_s) + \delta_{rs,2} Ln(d_{rs}) + \delta_{rs,1}(border_{rs}) + \sum_k^K \lambda^k{}_{rs} k_{rs} + \sum_l^L \iota_{rs} l_r}$$

Where ${t_{rr}}^{1-\sigma} = 1$ by assumption of cross-regional homogenous internal transport distances, which is a typical assumption in the literature (Anderson, Wincoop, 2004). The first collection of terms in the additive expression is a simplified form of Venables' "domestic market access" measure; the second collection of terms is an enhanced form of Venables' "foreign market access" measure. Notice also that foreign price indices P_s are absent from the RHS of this formulation, which in essence summarizes the forward-linkages in a regional economic system. Notable authors in Economic Geography have traditionally circumvented this problem by employing a fixed-effects panel estimation strategy (Combes, et. al, 2008). A less indirect approach to obtaining the inclusivity of prices in this particular structural framework might utilize industry-aggregate CPI measures. The absence of domestic price indices leads to the problem of multilateral resistance bias as outlined by Anderson and Vin Wincoop, and proceeding thusly essentially yields a measurement of "nominal" market potential.

If one accepts nominal market potential as a suitable correlative to regional aggregate wages, then nominal supply potential is calculated in a similar fashion.

Similar to the market access measure (e.g. identified as nominal market potential), supply access here is missing the theoretically important component of domestic intermediate industry-aggregate input prices. A logical proxy for intermediate industry-aggregate input prices might be an aggregate producer price index. This component essentially summarizes the backward-linkages in a regional economic system. Recall the importance that this variable plays in determining the degree to which firms are competing with one another in a given region. Notice also the absence of a variable that summarizes the number of firms operating in region *r*. The absence of these two crucial variables essentially yields a halfway-house expression for supply access. Its usage in the structural estimation presented here is hence simply relegated to that of a theoretical place-holder.

Lastly, it is useful although not necessary to quickly examine the analytic expression for trade/transport costs, ϕ_{rs}. The literature of regional science offers a handful of different ways for calculating this expression (Bosker, Garretsen, 2007). Theoretically, Samuelsonian iceberg transportation costs have been arguably the most straightforward approach to yielding ϕ_{rs}. This method requires data on cost, insurance, and freight prices alongside free-on-board prices for various commodity baskets. Of course, it is often inappropriate to use such a measure since transport costs in terms of purely freight rates because these rates may be interregionally homogenous for some industries. In other words, one needs to be mindful of industry-specific costs to transport. Moreover, in some countries, transport bears a very small proportion of total GDP. Hence, in many country-specific settings, the economist should carefully examine how non-labor inputs to production are moved in order to quantify this important parameter. One can also take a very general approach to modeling transport/trade costs by simply interacting exponential distance-decay with meta-data on aggregate iceberg transport costs.

The approach I take for quantifying transport costs in my application is very nominal since the econometric estimate of the parameter $\delta_{rs,2}$ (see below) is absent in the model specification used in estimation. Analytic transport costs are formulated with:

$$\phi_{rs} = e^{\delta_{rs,2} Ln(d_{rs}) + \ \delta_{rs,1}(border_{rs}) + \sum_k^K \lambda^k{}_{rs} k_{rs}}$$

Notice that this expression is already found in the analytic formulation of market and supply access for a given trade-pair. In practice, the calculation of predicted trade/transport costs is conducted within the context of the gravity model, as noted in previous sections of this paper. Practitioners have estimated trade/transport costs in a variety of gravity model types, some of which utilize information on commute patterns or even migration patterns in-place of the bilateral trade flows that we typically associate as the model dependent variable (Wang, 2011).

Once market access and supply access terms are computed using the analytic expressions above, their predicted analytic expressions are imputed into a second-stage regression within the FIML framework. This second stage regression utilizes a reduced-form expression of Venables' wage equation (Knapp, 2006). I recall the Venables' wage equation and its input cost-share parameters on G_r, w_r, and v_r:

$$q_{rs}(i)\left(\beta\left(\frac{\sigma}{(\sigma-1)}\right)G_r{}^{\Phi}w_r{}^{\Psi}v_r{}^{\Theta}\right)^{\sigma} = T_{rs}{}^{1-\sigma}P_s^{\sigma-1}\mu Y_s$$

Venables solves this equation in-terms of its composite cost component, $\left(G_r{}^{\Phi}w_r{}^{\Psi}v_r{}^{\Theta}\right)^{\sigma}$, and proxies this value with per capita GDP. His reduced-form expression is thus:

$$\left(G_r{}^{\Phi}w_r{}^{\Psi}v_r{}^{\Theta}\right)^{\sigma} = A\left[\sum_{r,r\neq s}^{R} N_r(p_r)^{1-\sigma}T_{rs}{}^{1-\sigma}\right]^{\frac{\alpha\sigma}{\sigma-1}}\left[\sum_{r,r\neq s}^{R} T_{rs}{}^{1-\sigma}P_s^{1-\sigma}\mu Y_s\right]$$

Where A contains the remaining structural variables and parameters left-out of the expressions for supply and market access.

My application does not break-down factors costs into smaller components; rather, I assume only one factor of production, labor, and estimate its cost share to sit somewhere around 0.9. This more simplified view is also adopted by Knapp to some extent. Head and Mayer also rearrange the terms in the wage equation expression to yield a more simplified estimable form (Head, Mayer, 2003).

Taking natural logs on both sides of the structural wage equation and denoting Venables' $A = \zeta_{rs}$ yields the following structural wage equation:

$$ln(w_r) = \frac{\zeta_{rs}}{\Psi\sigma} + \frac{1-\Psi}{\Psi-\alpha\sigma}ln\left[\sum_{r,r\neq s}^{R} N_r(p_r)^{1-\sigma}T_{rs}{}^{1-\sigma}\right] + \frac{1}{\Psi\sigma}ln\left[\sum_{r,r\neq s}^{R} T_{rs}{}^{1-\sigma}P_s^{1-\sigma}\mu Y_s\right]$$

In reduced operationalized form, the structural wage equation is expressed as:

$$ln(w_r) = \frac{\zeta_{rs}}{\Psi\sigma} + \frac{1-\Psi}{\Psi-\Psi\sigma}ln\left[\widehat{Supply\,Access}_r\right] + \frac{1}{\Psi\sigma}ln\left[\widehat{Market\,Access}_r\right]$$

Note that each collection of 12 gravity equation for region *r* is estimated alongside 1 wage equation. The empirical wage equation faces three important theoretical constraints. These parametric restrictions are imposed during FIML estimation. Firstly, I require that σ, the elasticity of substitution, to be nearly 1. In other words, I impose a requirement that a regional economy's goods be perfect substitutes for one another. Most authors recognize that the elasticity of substitution takes on values between 5 and 8 (Combes, et. al, 2008). I deviate however from these meta-values since σ near 1 yields model convergence in many of the 13 models implemented in this application.

The second theoretical constraint requires that the input share on labor Ψ is less than 1. $\Psi < 1$. This requirement is necessary since it is assumed that input-costs enter a production function in a linearly homogenous and symmetric fashion such that they add up collectively to 1.

Thirdly, I constrain distance parameters to initially negative values such that distance has an overall negative effect on bilateral trade.

Using these requirements and setting other parameters to feasible initial values, I implement Wymer's (2006) procedure for Gaussian FIML estimation of a non-linear continuous-time model. Wymer's procedure essentially uses a nonlinear maximum likelihood algorithm to estimate a nonlinear continuous time model with stocks and flows. This procedure utilizes a 1st-order exponential log functional form of both dyadic trade flows and wages given by a set of differential equations:

$$l\,n\big(\Delta X_{rs}(t)\big) = \gamma_{rs}\left(\ln\left[\frac{\hat{X}_{rs}}{X_{rs}}\right]\right)dt + \zeta_{rs}(dt)$$

$$l\,n\big(\Delta w_r(t)\big) = \eta_r\left(\ln\left[\frac{\hat{w}_r}{w_r}\right]\right)dt + \zeta_r(dt)$$

The Wymer algorithm minimizes the log of the determinant of the residual matrix $\zeta_r(dt)$, which is the same as maximizing the likelihood function. The estimated endogenous variables here are known as the partial equilibrium variables. The parameters η_r and γ_{rs} are estimated alongside other key structural parameters in this procedure. These parameters are also known as the partial equilibrium adjustment parameters. If one divides one by these parameters, one can interpret the adjust parameters as an indicator of how long it takes (typically in financial quarters) for a system to adjust to partial equilibrium levels. Literature often identifies this convergence time to be 5.85 quarters. The FIML algorithm terminates when the norm of the gradient reaches approximately 0.001 the parameter estimates are changing across iterations by no more than 0.001.

Part Four: Results and Conclusion

Results

This study investigates the following two hypotheses:

Hypothesis 1: Wages are positively correlated with market access.

Hypothesis 2: Political economic variables, in particular trade sanction costs and dyadic hostilities, have a statistically significant effect on trade levels. Trade sanction costs and dyadic hostilities should have a negative effect on trade levels.

Nominal market access is found to be positively correlated with wages across all countries in the ASEAN+3 region. With the exception of Vietnam, whose log-likelihood is low for the model-fit, Australia, Taiwan and Thailand exhibit the highest market access effects of all countries in this study - 1.6, 1.1 and 1.9 respectively. Any rise in market access for these countries leads to larger increases in wages relative to other countries in the ASEAN+3 region. Contrastingly, with the exception of New Zealand, whose distance from the geometric center of the ASEAN+3 region is farthest, the Philippines, Indonesia, and Malaysia exhibit the lowest market access effects of all countries - at 0.9, 1.0 and 1.0 respectively.

A major component of empirical market access is freeness of trade. When interacted alongside with Venables' market capacity expression, one yields predicted market access. Recall the form of freeness of trade:

$$\phi_{rs} = e^{\delta_{rs,2} Ln(d_{rs}) + \delta_{rs,1}(border_{rs}) + \sum_k^K \lambda^k{}_{rs} k_{rs}}$$

Note that the parameter estimates $\lambda^k$and especially $\delta_{rs,1}$ have been found to be biased if the gravity model is estimated in the absence of data on multilateral resistance (Anderson, Wincoop, 2004). Theory and empirics have both shown that the border effect will be biased upwards due to the absence of multilateral resistance indices in the empirical specification of the gravity model above. Border effects are found to be highly correlated with unobservable trade barriers. The reduced form exporter/importer fixed effects gravity model specification is Venables' work-around for this kind of bias.

The estimated form of trade/transport costs follows the formula below (Head, Mayer, 2003). Note that the second collection of expandable terms in the exponential are political-economic bilateral effects.

$$\hat{\phi}_{rs} = d_{rs}{}^{\hat{\delta}_{rs,2}} \left(e^{\hat{\delta}_{rs,1} + \sum_k^K \hat{\lambda}^k{}_{rs}} \right)$$

$$\hat{\lambda}^k{}_{rs}: language\ effect, border\ effect, FTA\ effect, sanction\ cost\ effect, dyad\ hostility\ effect$$

I calculate predicted transport costs for each bilateral trade relationship in the data-set. I adjust the scores by transforming them into the form $\phi_{rs}{}^{1-\sigma} \cong T_{rs}{}^{1-\sigma}$. This form assumes that phi is a proxy for *T* is necessary if results were to be imputed into an NEG model. In the case where $\hat{\phi}_{rs}$ is found to be near 1, this model predicts that bilateral trade faces nearly no barriers to trade; values near 0 are however indicative of autarkic trade relations. Indeed, the model presented here reports both extremes for a relatively small fraction of all possible bilateral trade relationships. For instance, where the coefficients on distance are found to be near zero or even slightly positive, freeness of trade will take on a value very close to one. Trade cost estimates should be carefully interpreted for these reasons.

As a consequence of the above, predicted bilateral trade/transport costs that take on fairly intermediate values between 0 and 1 are of primary interest in this study. Many of the flows can be confirmed by anecdotal knowledge. Australia for instance instigates relatively freer trade with Korea, New Zealand, and Taiwan compared with its other trading partners in the ASEAN+3 area. China ensures freer trade with Indonesia, Japan, and Thailand in comparison to its other trade relationships. Indonesia is found to be relatively autarkic in many of its trade relations; India relatively free. Japan's enacts few barriers to trade with Korea and New Zealand; Korea aggressively reduces frictions with the Philippines, Australia, and Taiwan. Malaysia is found to have significantly freer trade relations with Vietnam, the Philippines, and Indonesia relative to its other relations; likewise, New Zealand has freer trade with Korea, Singapore, and Taiwan relative to other ASEAN+3 nations. The Philippines appear to have friendlier trade relations with Singapore relative to others; however, parameter estimates on distance call other inferences into some doubt. Singapore's estimates however are consistent across the board and indicate very close trade relations with Taiwan, Thailand, and Malaysia. Thailand's trade is most free with Vietnam, the Philippines, and China; Taiwan exhibits strong ties with Indonesia. Last but not least, Vietnam exhibits strong ties with Singapore.

What I have not listed qualitatively above are the trade relationships that are found to be nearly totally unimpeded. Again however, parameter estimates on distance make inference utilizing trade cost estimates difficult given their near positive magnitudes.

The tabulated trade/transport costs in the appendix illustrate how returns to labor (e.g. wages) may be affected by political-economic and geographic variables. Taken in aggregate, trade/transport costs affect each countries' market access. Countries such as the Philippines, Indonesia, and Malaysia have penalized their returns to labor relative to other countries given their political-economy. Indeed, after controlling for distance, political system, and language, political-economic variables might possibly do much to dampen market potential effects in these countries relative to others. Contrastingly, Australia, Taiwan and Thailand have done the opposite by pursuing international relations in a more accommodating fashion with respect to their labor economy. An examination of these political-economic effects is given in the appendix. I will investigate (a) polity effects, (b) dyad hostility effects, (c) sanction cost effects, and (d) free-trade agreement effects for all countries in the ASEAN+3 region, including New Zealand and Australia but excluding Vietnam.

Australia's polity is among the highest ranked in the Polity IV database - standing at +10 (e.g. highly democratic). This polity score is found to be positively correlated with Australian trade flows. Nevertheless, this observation does not hold generally across all countries' polity scores: a separate cross-country regression would have to be performed to obtain a pooled-dyad effect of polity on trade flows.

Contrary to what one might expect, the coefficient on Australia's dyad hostility effects does not bear a negative sign. Estimated coefficients are significant and positive for relations with Indonesia and Japan, but not for China. Hostilities with Indonesia occurred for 1 quarter in 1999 and were initiated by Australia with regards to Timor; this dispute is however found to have negligible consequences on the Australian exports to Indonesia, possibly due to the de-escalation of the dispute on the part of Indonesia. Disputes with Japan also occurred only for 1 quarter in 1998 but hostilities were reciprocated by the Japanese. This dispute had its roots in the violation of bluefish tuna sanctuaries in the Southern Ocean and never escalated beyond a litigation phase. Lastly, a dispute between China and Australia in

2001 over air-space above the Spratly Islands in the South China Sea seems to have had a negligible effect on relations.

Moreover, coefficients on Australia's sanction costs are found to bear positive signs as well. Indonesia's 1997 import restriction on Australian exports appears to exhibit some positive correlation between the cost borne to Indonesia for sending the sanction and Australian exports to Indonesia. One could judge from empirical evidence then that the conflict in East Timor had a limited impact on Austral-Indonesian trade relations. Similarly, a multilateral export restriction imposed on India in 1998, in which Australia was a plaintiff, is found to have had the reverse intended effect: a positive one.

Australian FTAs with Singapore and Thailand are found to have positively enhanced trade. The FTA with Singapore covers goods and services has been in effect since 2003; the FTA with Thailand also covers goods and services and has been in effect since 2005. Australia's FTA with Malaysia covers goods and services and has been in effect since 2013. The estimated coefficient on the FTA is found to be negative; although, given that the FTA has not been in effect for more than a year since the inception of this study, this effect should be interpreted with caution.

China's polity of -7 (e.g. highly authoritarian) is found to have complemented its export base, which is unsurprising if we consider its fixed exchange rate regime. Significant Chinese dyad hostility effects vary in direction however. Sino-Japanese trade relations are found to be positively correlated with dispute-onsets. Between 1995 and 1999, 3 disputes broke out between these two countries, all of which were initiated by China. Nevertheless, evidence suggests a limited effect of these disputes on Chinese exports to Japan. The same dynamic can be found between Korean-Chinese trade relations: a dispute in 1994 between China and Korea over fishing rights in the South China Sea is found to be positively correlated with Chinese exports to Korea. Lastly, two Chinese-Vietnamese disputes occurring between 1993-1994, both of which were initiated by China with regards to territorial sea water claims in the South China Sea, have had no effect on Chinese exports to Vietnam. These three cases may all demonstrate the reluctance of China's South and East Asian neighbors to limit the import of Chinese goods into their respective countries.

Dyad hostility effects begin to bear their expected negative signs in the cases of Chinese-Philippine and PRC-ROC relations. The former is a string of complicated affairs, with hostilities being initiated by both parties across different years in the 1990s. These disputes occurred at Mischief Reef, Ayungin - the former resulting in an illegal forced Chinese occupation and the latter involving a premeditated breach of sovereignty. To date, Chinese-Philippine relations are heavily strained by disputes over the Spratlys, and the effects can be seen in the trade data: Chinese exports to the Philippines have suffered as a consequence. Lastly, PRC-ROC relations - that is relations between the People's Republic of China and Taiwan (the Republic of China) - have also suffered due to repeated military escalations. Taiwan, is an unofficially recognized country by the United States and has since the mid 20th century lost its standing as a UN member. Its disputes with the PRC resonate back to the Chinese Civil War that raged between 1946 to 1950. Although data from this period are not considered in this study, data covering the period between 1993-2001 are. The most violent of these occurring in 1995-1996 during the 3rd Taiwan Strait Crisis, in which the PRC violated Taiwanese airspace with cruise-missile tests. The affair instigated the largest U.S. naval incursion against the PRC since the Vietnam War. Since the mid-90s, disputes between these two countries have centered around territorial sea claims in the South China Sea. Taken in aggregate, these hostilities have had a negative impact on Chinese exports to Taiwan.

Sanction costs to China are found to have a statistically significant negative effect on Chinese exports to Korea and Vietnam, but a statistically significant positive effect on exports to Japan. The cost of import restrictions against Japanese exports in 1988 and 2001 and the cost borne to Japan following

Japanese import restrictions on Chinese exports in 1992 are taken in aggregate to have no negative effects on bilateral trade flows. Contrastingly, Chinese import restrictions on Korean goods have been outstanding since 1997 and are owed to import substitution policies across the two countries. These policies have damaged Sino-Korean trade flows. Lastly, China's sanctions on Vietnam in 1992 are also found to have had a negative impact on Chinese exports to Vietnam.

Chinese FTAs also tell a mixed story. And FTA with New Zealand which has been in force since 2008 has been found to enhance Chinese exports. Nevertheless, an FTA of similar scope with Singapore that has been in force since 2009 is associated with negative effects to Chinese exports.

Taken together, these political-economic effects have not negatively affected China's market access in the ASEAN+3 region relative to other countries.

Political-economic effects across all Indonesian bilateral relations are found to be significant with positive effects on exports. Indonesian polity is quite dynamic however, which makes it unclear as to whether certain regimes have been more effectual in promoting trade or not.

The effects of Indonesia's hostilities with Australia, China, and New Zealand have all had statistically significant negative effects on Indonesian exports to these countries. In the case of Australia and New Zealand, this effect may be due to the enactment of barriers to trade by the Australians and New Zealanders just short of economic sanctions. Indonesian exports to these countries are also found to have been negatively affected by hostilities with China over islands in the South China Sea.

As is the case with Australia and China, Indonesian sanction costs have had mixed effects on its bilateral relations. An import restriction imposed on Australia in 1997 is found to be positively correlated with Indonesian exports to Australia; anti-dumping related import restrictions imposed on China, Singapore and Korea in 2000 are also positively correlated. These anti-dumping cases were limited however in scope to industries like steel, and have evidently been shown to have net negative aggregate effect on exports to these countries. On the contrary, import restrictions on Japanese exports in a similar trade dispute in 2000 are found to have had a net negative effect on Indonesian exports to Japan. To what extent this effect may be based on reciprocal action on the part of the Japanese requires additional investigation.

Lastly, an Indonesian FTA with Japan which has been in force since 2008 is found to be positively correlated to Indonesian exports to Japan. Looking at these effects in aggregate, one might conclude that Indonesia's relatively poor market access in the ASEAN+3 region may be due to its hostilities with its neighbors, especially China.

India is one of two models in this paper whose polity is actually negatively correlated with aggregate exports. India's polity has hovered somewhere between +8 and +9 since the latter half of the 20th century. India has not engaged in any outright hostilities with its neighbors within the scope of the data used in this study; however, it has experienced sanction costs. An import restriction imposed on China in 1998 is positively correlated with exports to China, which suggests a case of no reciprocation by China. An export restriction imposed on India by Australia between 1998-2001 is also found to have had a net positive effect on Indian exports to Australia; that is to say that the costs of sending a sanction against India on Australia's part is correlated to greater exports flowing to Australia and originating from India. These sanctions were imposed in reaction to India's testing of nuclear weapons in 1998.

Nevertheless, sanction costs bear their expected negative sign when considering 1993 Indian import restrictions on South Korean exports. These restrictions were met by similar South Korean restrictions, which have indeed negatively affected Indian exports to South Korea. Japan's export restrictions against India with regards to the nuclear non-proliferation test-bans were also met with some retaliation on the Indian side. The net effect of these sanctions are negative for India's exports to Japan.

Taken in aggregate, India's political-economy has kept India export economy competitive in the ASEAN+3 region. Despite being geographically located in the peripheries of the ASEAN+3 region, its market access to this region exceeds that of Japan, China, and Korea.

The Japanese gravity formulation is the most non-linear model in this paper. Nevertheless, FIML estimation finds all political-economic variables to be statistically significant. Moreover, nearly all dyad hostility and sanction cost coefficients bear the expected negative signs.

Japanese polity is found to be positively correlated with export flows. Its hostilities with Australia, Korea, and Taiwan are all found to have had historically negative effects on Japanese exports to those countries. Australian hostilities with Japan over the bluefish tuna sanctuaries violation resulted in a lessening to Japanese exports to Australia. Japan also initiated a dispute with South Korea in 1999 with regards to a territorial conflict over the Takeshima islands, which is found to have had a negative effect on Japanese exports to South Korea. Moreover, Japanese exports to Taiwan were temporarily stifled due to Taiwan's handling of dispute over the Senkaku islands following its provocation of the PRC with regards to its independence status. Hostilities with China throughout the 90s however are still found to have no negative effects on Japanese exports to China or vise versa as presented earlier. Clearly, Sino-Japanese trade relations are seen as particularly important by both countries despite their disgruntled historical relations.

The same pattern regarding Japanese trade relations with China can be observed with respect to sanction costs to Japan. Japanese sanctions on China in 1987 taken in aggregate with Chinese import restrictions on Japanese exports in 1992 and 2001 are actually positively correlated with Japanese exports to China, which again suggests Japan's reluctance to jeopardize its trade relations with the

Chinese market. Sanction costs borne to the sender of sanctions have a much different effect on Japan with regards to its trade relations with Indonesia, India, Korea, and Taiwan. Indonesian import restrictions on Japanese goods in 2000 are found to have a stifling effect on Japanese exports to Indonesia as intended; Korean import restrictions in 2001 are found to have a similar effect. Moreover, Indian import restrictions in 1998 and Taiwanese import restrictions in 1994 are also found to have negatively affected Japanese exports to each of these respective countries. Note that these latter inferences are essentially correlating the pain of imposing a sanction by its sender to variation of exports flowing to the sender from the target. Taken together, it appears that Japan's trade relations are highly susceptible to political disruptions and that its locally-directed export economy very much relies on maintaining normal and favorable relations with its neighbors in the ASEAN+3 region.

The Japanese FTA with Indonesia is found to be positively correlated with Japanese exports to Indonesia; the same can be said about its FTA with Malaysia with regards to exports to Malaysia and its FTA with Vietnam with regards to exports to Vietnam. Interestingly, FTAs with its other major trading partners Thailand, Singapore, and the Philippines are all found to be negatively associated with exports. In sum, the findings presented here for Japan suggest that sanction costs have had a major role in damaging Japanese market access over the last 20 years.

South Korean polity is found to be positively correlated with its export levels. All political-economic variables bear a negative association with South Korean exports however. Maritime disputes with China in 1994 and Japan in 1999 are both found to have had a negative effect on South Korean exports to these two respective countries. Similarly, sanction costs borne to India and China for their import restrictions against Korean exports have been effective in explaining downward trends in South Korean exports to these countries. South Korean FTAs with India and Singapore are also negatively associated with exports to these countries.

The South Korean case certainly deserves additional investigation: its reliance on non-ASEAN markets may insulate it from many of the negative effects it experiences in its own region. Nevertheless, taken in aggregate, its market access in the ASEAN+3 region exceeds that of China and Japan.

Not much can be inferred from the Malaysian gravity model, except that an ongoing Singaporean export restriction from 1995 has had a damaging impact on Malaysian trade to Singapore. This is most likely due to a reciprocal set of restrictions enacted by Malaysia against Singapore. The roots of this conflict are outside the scope of this paper.

Malaysian FTAs with Japan and New Zealand have had mixed effects: Malaysian exports to Japan have worsened since the deal's inception in 2006. Exports to New Zealand have however improved since their FTA's signing in 2010. Taken together with the sanction cost effects above, Malaysia suffers from relatively poor market access compared to its neighbors, although it is in nearly the same standing as Indonesia in this regard.

New Zealand's polity has complemented its export volume to the ASEAN+3 region. Its relations with the countries in this region have been very normal however, so not much can be said about sanction cost or dyad hostility effects. Its FTA with Australia stands out however: it bears a negative effect on New Zealand's trade to Australia. Among the five FTAs investigated for New Zealand, only this coefficient stands-out as statistically significant.

The Philippines polity is also found to complement its exports in the ASEAN+3 region. This country has experienced hostilities between the early 90s and the late 2000s with Vietnam, Taiwan, and China; however, only dyad hostilities with China are found to have a statistically significant and negative effect on bilateral trade. As presented above, these hostilities have been sporadic, ongoing, and territorial in nature, amongst the fiercest in the region. The country's FTA with Japan - signed in 2008 - is found to have a positive effect on exports to Japan.

The Philippines suffers from the poorest market access score relative to other markets in the ASEAN+3 region, if we exclude New Zealand from the analysis. Its poor market access may in fact be partly due to its highly strained relations with China.

Singapore is the second of the two countries whose polity is negatively correlated with exports to the ASEAN+3 region. Sanction costs to the sender of sanctions are also all found to all bear negative correlations to exports with sanctioning partner countries. In particular, Indonesian import restrictions on Singaporean goods are indeed correlated with lower Singaporean exports to Indonesia in the model. Furthermore, Singaporean export restrictions on the Malaysian economy, bear their expected negative effect on Singaporean exports to Malaysia as well.

Singaporean FTAs with Australia and New Zealand are found to positively affect Singaporean exports to these countries, whereas FTAs with China and Japan have the opposite negative effect. These differences may have their roots in the legacy of imperial ties with the U.K.

The model for Thailand finds all coefficients on political-economic variables to be statistically significant. Hostilities with Vietnam in 1995 are plausibly represented by the negative sign on dyad hostility with Vietnam. This particular conflict has its roots in a border dispute along a portion of the Mekong River. Moreover, sanction costs to the sender of the sanction are negative in the case of Thailand's trade relationship with Malaysia. This negative effect follows from the South Thailand Insurgency of 2006-2007 in which fugitives of the Thai state fled to Malaysia during a coup attempt. Lastly, FTA's honored by the Thai government are all shown to have a statistically positive effect on trade with the exception of trade with Japan. It is possible that Thai-Japanese trade may need to account for flooding occurring in 2011 which severely damaged Japanese automobile manufacturing activities in Thailand.

Taiwan's polity is found to be uncorrelated with its export flows to the ASEAN+3 region, which is telling given the dynamic nature of its polity score over the study time-period. Polity may only have an effect on matters of domestic civil society. Hostilities with China, Japan, and the Philippines however are all found to have negatively affected Taiwanese exports to these countries. All of these hostilities can trace their roots to some form of territory dispute, many of these occurring across islands in the East and South China Seas. Sanction costs to the sender of sanctions also bear negative effects on Taiwan's economy: Taiwan's restriction of Japanese imports in 1994 is correlated to a lowered trend of Taiwanese exports to Japan. Turning to the matter of FTAs, these agreements are not legally recognized for Taiwan given its classification as a semi-autonomous region within the PRC.

Taken together, political-economic effects have not adversely affected Taiwan's market access standing in the ASEAN+3 region. In fact, Taiwan ranks third, just behind Australia and Thailand, if we exclude Vietnam as an outlier.

Conclusion

The analysis undertaken in this thesis has sought to test the theoretical correlation between wages and market access, as argued by Venables in his 2004 paper. Indeed, political-economic and geographic effects all bear plausible signs in the gravity model while also maintaining theoretical consistency - i.e. positive market access effects on wages. The degree to which market access changes country to country in the Asia-Pacific is of particular interest, and these rankings can be explained by the coefficients on political-economic variables estimated in the 1st stage gravity model. Moreover, estimates of bilateral transportation/trade costs can be produced within this framework using the wide array of political-economic and geographic information available on public databases. Predicted trade/transport costs are thus variable between regions, making their imputation into an NEG framework practical for intraregional spatial economic inference since symmetry conditions will differ across different country pairings. Therefore, this methodology may be attractive in any policy analysis that is international in scope.

Unlike many other reduced form estimations carried out by other authors for testing Venables' theory, the method proposed in this paper uses the Venables structural wage equation directly in a FIML estimation routine. This structural equation has its roots in NEG theory, in which wages take on a structural form with theoretical underpinnings in imperfect competition and IRS: these models assume monopolistic competition over space and the existence of composite commodities that are produced under increasing returns to scale - assumptions that are suitable in a macroscopic setting illustrated in this paper. Since heterogeneous functional forms of gravity are constructed for each country with respect to its trade partners, the use of a structural wage equation also implies that technology parameters of the IRS production function are heterogeneous across countries - another useful implication for avoiding unnecessary international generalizations.

Several refinements can be made to the methodology posed in this paper, an obvious one being the inclusion of country-specific CPIs, so as to proxy for multilateral price indices. If CPI figures are not available, one could also use cross-country GDP deflators instead of CPI since real GDP and nominal GDP are derived from CPI figures. Furthermore, Thisse suggests modeling prices in the inverse demand function in a game-theoretic setting, in which Bertrand competition determines equilibrium prices. This theoretical structure would draw from a quasilinear utility specification, which is attractive for breaking utility components into interacting consumption bundles.

Consistency should also be achieved with previous studies utilizing the reduced form OLS fixed-effects approach to estimation. Venables and Knapp in particular consistently estimate the coefficient on market access to be around 0.4 to 0.5; however, these estimates assume an elasticity of substitution between 6 and 10 and a cost share on labor inputs of around 0.4 to 0.6. Presently, the results in this paper have reported market access coefficients assuming a near perfect elasticity of substitution and cost shares on labor inputs of around 0.9. The inclusion of price index information would also do much to alleviate any measurement errors caused by a nonsensical placeholder for supply access; however, on the same token, simultaneity problems between supply access and market access would then need to be addressed with an instrumentation strategy.

It should also be noted that since parameter estimates on distances are sometimes non-negative, alternative approaches to obtaining the global maximum of the likelihood estimation are suggested. Wymer and Donaghy suggest using a genetic algorithm that will identify optimal initial parameter values, from which a switch over to MLE will yield global maxima of parameters in MLE. This genetic algorithm approach is a combinatorial process and as such would offer a complete exploration of the response surface of the likelihood function to changes in the parameters. Once the genetic algorithm switches to a Newtonian algorithm, one would be in the neighborhood of a true global maximum likelihood solution.

Some other critics also note that the estimation method provided in this thesis benefits from large degrees of freedom, a feature which should be leveraged. Typically, one needs to use as many observations as one has independent variables. As there is no crunch on degrees of freedom with the current number of equations specified in the model's partial equilibrium, one would have room to factor include relationships outside the dyad to other regional trade partners. The addition of variables from these equations may not compromise the ample degrees of freedom already exhibited in this model framework.

Some further considerations regarding the quality of data have also been suggested. Dyadic distances are currently calculated from rhumb lines. Given that all trade in the ASEAN area occurs along discrete sea lines, it is feasible to calculate exact network distances using data on these shipping lines.

Last but not least, the transport cost measures calculated in this thesis should be imputed into an NEG model in order to make economic inferences on the nature of agglomeration between any given country-pair. Since transport costs are uniquely identified for each country in the Asia-Pacific, this exercise may yield predictive implications on future migration patterns and firm location decisions within the region. The careful use of the tools prescribed in this thesis can then be a powerful means to gauging the impacts of multilateral conflict and integration on standards of living in the 21st century.

APPENDIX

TABLE 1: TRANSPORT COSTS													
Freeness of Trade ϕ	**Australia**	**China**	**Indonesia**	**India**	**Japan**	**Korea**	**Malaysia**	**New Zealand**	**Philippines**	**Singapore**	**Thailand**	**Taiwan**	**Vietnam**
Australia		0.974130		0.919036	0.508431	0.811417	0.752152	0.022227		0.262963			2.065E-23
China	0.063490		0.001105	0.929992	0.156357			0.003077		0.120995	0.998153		0.000104
Indonesia	0.153272	0.993867		0.987799	0.126131	0.001008	0.972221	0.003336		0.111107	0.998128	0.949430	0.244430
India	0.112401	0.951026			0.292475		0.770987	0.000690	0.516318	0.375916	0.969128	0.360483	0.007736
Japan	0.112335	0.982939	0.054624							0.316356			0.000008
Korea	0.616132	0.980110			0.867014		0.810310	0.218060		0.558367		0.674472	0.107527
Malaysia		0.971102		0.990806	0.294731	0.739018		0.026125	0.538335	0.880254	0.943625		0.011050
New Zealand	0.562351	0.955524			0.473367	0.685292	0.664762		0.559429	0.105922			
Philippines			0.000237		0.208697	0.908428	0.847919	0.000210		0.272908	0.998095	0.174389	0.158340
Singapore		0.981601		0.961607	0.160832	0.780339		0.051117	0.750940		0.997934	0.045607	0.440987
Thailand	0.122608	0.982454	0.020304	0.943750	0.206680	0.762867		0.008831	0.037030	0.900118			
Taiwan	0.597918			0.996428	0.351353	0.828565	0.772355	0.041356		0.986128	0.998094		
Vietnam	0.133770				0.085639	0.756603	0.968766	0.000010		0.437815	0.998713	0.563701	

FIGURE 2: MARKET ACCESS EFFECT INDEX		
Country	**Raw**	**Adjusted**
Vietnam	2.629809	N/A
Australia	1.601298	0.822390
Thailand	1.216182	0.759498
Taiwan	1.092891	0.561283
Singapore	1.047220	0.537828
India	1.011403	0.519433
Korea	1.004261	0.515765
China	0.998874	0.512998
Japan	0.990152	0.508519
Indonesia	0.977892	0.502223
Malaysia	0.973169	0.499797
Philippines	0.931898	0.478601
New Zealand	0.662545	0.340268

POLITICAL ECONOMIC EFFECTS

KEY:

+ Positive coefficient
- Negative coefficient

Not applicable

Statistically significant at the 5% level

Variable not in model

FIGURE 3. AUSTRALIA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia	+			
China		+		
Indonesia		+	+	
India			+	
Japan		+		
Korea				
Malaysia				-
New Zealand				
Philippines				
Singapore				+
Thailand				+
Taiwan				
Vietnam				

FIGURE 4. CHINA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia		+		
China	+			
Indonesia		+	-	
India			-	
Japan		+	+	
Korea		+	-	
Malaysia				
New Zealand				+
Philippines		-		
Singapore				-
Thailand				
Taiwan		-		
Vietnam		+	-	

POLITICAL ECONOMIC EFFECTS

KEY:

- \+ Positive coefficient
- \- Negative coefficient
- Not applicable
- Statistically significant at the 5% level
- Variable not in model

FIGURE 5. INDONESIA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia		-	+	
China		-	+	
Indonesia	+			
India				
Japan			-	+
Korea			+	
Malaysia				
New Zealand		-		
Philippines				
Singapore			+	
Thailand				
Taiwan				
Vietnam				

FIGURE 6. INDIA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia			+	
China			+	
Indonesia				
India	-			
Japan			-	
Korea			-	-
Malaysia				
New Zealand				
Philippines				
Singapore				
Thailand				
Taiwan				
Vietnam				

POLITICAL ECONOMIC EFFECTS

KEY:

+ Positive coefficient

- Negative coefficient

Not applicable

Statistically significant at the 5% level

Variable not in model

FIGURE 7. JAPAN				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia		-		
China		+	+	
Indonesia			-	+
India			-	
Japan	+			
Korea		-	-	
Malaysia				+
New Zealand				
Philippines				-
Singapore				-
Thailand				-
Taiwan		-	-	
Vietnam				+

FIGURE 8. KOREA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				
China		-	-	
Indonesia			+	
India			-	-
Japan		-	-	
Korea	+			
Malaysia				
New Zealand				
Philippines				
Singapore				-
Thailand				
Taiwan				
Vietnam				

POLITICAL ECONOMIC EFFECTS

KEY:

+ Positive coefficient
- Negative coefficient

Dark grey	Not applicable
Light grey	Statistically significant at the 5% level
White	Variable not in model

FIGURE 9. MALAYSIA				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				+
China				
Indonesia				
India				
Japan				**-**
Korea				
Malaysia	-			
New Zealand				**+**
Philippines				
Singapore			**-**	
Thailand			+	
Taiwan				
Vietnam				

FIGURE 10. NEW ZEALAND				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				**-**
China				+
Indonesia		+		
India				
Japan				
Korea				
Malaysia				+
New Zealand	**+**			
Philippines				
Singapore				-
Thailand				+
Taiwan				
Vietnam				

POLITICAL ECONOMIC EFFECTS

KEY:

+ Positive coefficient
- Negative coefficient

Dark grey: Not applicable
Light grey: Statistically significant at the 5% level
White: Variable not in model

FIGURE 11. PHILIPPINES				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				
China		-		
Indonesia				
India				
Japan				+
Korea				
Malaysia				
New Zealand				
Philippines	+			
Singapore				
Thailand				
Taiwan		-		
Vietnam		-		

FIGURE 12. SINGAPORE				
Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				+
China				-
Indonesia			-	
India				
Japan				-
Korea				+
Malaysia			-	
New Zealand				+
Philippines				
Singapore	-			
Thailand				
Taiwan				
Vietnam				

POLITICAL ECONOMIC EFFECTS

KEY:

+ Positive coefficient
- Negative coefficient

(dark grey)	Not applicable
(light grey)	Statistically significant at the 5% level
(white)	Variable not in model

FIGURE 13. THAILAND

Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				+
China				
Indonesia				
India				
Japan				-
Korea				
Malaysia			-	
New Zealand				+
Philippines				
Singapore				
Thailand	-			
Taiwan				
Vietnam		-		

FIGURE 14. TAIWAN

Effects:	Polity	Dyad Hostility	Sanction Cost	Free-Trade Agreement
Australia				
China		-		
Indonesia				
India				
Japan		-	-	
Korea				
Malaysia				
New Zealand				
Philippines		-		
Singapore				
Thailand				
Taiwan	+			
Vietnam		-		

FIGURE 15: COUNTRY LEGEND	
1	Australia
2	China
3	Indonesia
4	India
5	Japan
6	Korea
7	Malaysia
8	New Zealand
9	Philippines
10	Singapore
11	Thailand
12	Taiwan
13	Vietnam

FIGURE 16. FIML RESULTS: AUSTRALIA

Parameter	Parameter Value	Standard Error	T-Value
gm12	0.040078	0.015037	2.67
gm13	0.107990	0.044131	2.45
gm14	0.247477	0.060378	4.1
gm15	-0.002950	0.001521	1.94
gm16	-0.001175	0.000456	2.57
gm17	-0.002004	0.000981	2.04
gm18	0.121461	0.042202	2.88
gm19	0.082651	0.041187	2.01
gm110	0.100535	0.031636	3.18
gm111	-0.001182	0.000748	1.58
gm112	0.011401	0.009524	1.2
gm113	0.286683	0.043384	6.61
eta	-0.000816	0.000271	3.02
theta	3.298045	0.226779	14.54
psi	0.541936	0.010303	52.6
zeta	14.923277	0.565975	26.37
sigma	1.152338	0.002119	543.76
kpy1	2.825423	0.004993	565.91
ksu1	-0.091395	0.081782	1.12
kwto1	-23.909489	0.178765	133.75
kasn1	-0.289300	0.108898	2.66
kd12	0.763948	2.645160	0.29
kd13	0.754460	0.360905	2.09
kd15	4.023363	0.266865	15.08
ks13	1.045422	0.510318	2.05
ks14	-0.574160	0.149360	3.84
kln14	-1.450748	0.154581	9.39
kln16	-7.205607	1.661795	4.34
kln18	-3.029162	0.364327	8.31
kln19	-5.131640	1.872478	2.74
kln110	-4.925871	0.215420	22.87

Parameter	Parameter Value	Standard Error	T-Value
kf17	-9.222777	0.849102	10.86
kf110	0.659568	0.263606	2.5
kf111	1.963116	0.239048	8.21
nu1	-0.189266	0.025176	7.52
rho	18.124485	1.859425	9.75
xi12	2.645449	0.361150	7.33
xi13	1.900442	0.227029	8.37
xi14	2.768608	0.032770	84.49
xi15	0.841370	0.650505	1.29
xi16	-0.206937	0.215306	0.96
xi17	-0.153540	0.342727	0.45
xi18	2.323957	0.235353	9.87
xi19	1.639056	0.444666	3.69
xi110	0.091423	0.157501	0.58
xi111	-1.291070	0.189275	6.82
xi112	0.906056	0.200460	4.52
xi113	2.993407	0.020510	145.95
dl12	-1.919625	0.259498	7.4
dl13	-1.231957	0.157798	7.81
dl14	-1.786580	0.012296	145.3
dl15	-1.151998	0.446793	2.58
dl16	-1.153698	0.132198	8.73
dl17	-1.037418	0.090931	11.41
dl18	-0.860179	0.093178	9.23
dl19	-0.369503	0.015106	24.46
dl110	0.532989	0.051918	10.27
dl111	-1.331114	0.040335	33
dl112	-0.381181	0.007866	48.46
dl113	-1.496700	0.027486	54.45
dis11	0.576268	0.013597	42.38

FIGURE 17. FIML REGRESSION DIAGNOSTICS: AUSTRALIA	
Log-Likelihood	3349.683
Norm of Gradient	0.001399
Condition Number of Hessian	15400000
Full Value of Log-Likelihood	2129.956
Market Access Effect	1.601298
Freeness of Trade ϕ(1,2)	0.063490
Freeness of Trade ϕ(1,3)	0.153272
Freeness of Trade ϕ(1,4)	0.112401
Freeness of Trade ϕ(1,5)	0.112335
Freeness of Trade ϕ(1,6)	0.616132
Freeness of Trade ϕ(1,7)	1
Freeness of Trade ϕ(1,8)	0.562351
Freeness of Trade ϕ(1,9)	1
Freeness of Trade ϕ(1,10)	1
Freeness of Trade ϕ(1,11)	0.122608
Freeness of Trade ϕ(1,12)	0.597918
Freeness of Trade ϕ(1,13)	0.133770

FIGURE 18. FIML RESULTS: CHINA

Parameter	Parameter Value	Standard Error	T-Value
gm21	0.002227	0.000131	17.05
gm23	0.002042	0.000119	17.13
gm24	0.007376	0.000187	39.44
gm25	0.001109	0.000096	11.51
gm26	0.001075	0.000081	13.19
gm27	0.003025	0.000234	12.92
gm28	0.001540	0.000111	13.91
gm29	0.002132	0.000142	15.02
gm210	0.002158	0.000200	10.78
gm211	0.001916	0.000229	8.35
gm212	0.001755	0.000034	52.01
gm213	0.003354	0.000051	66.14
eta	-0.004600	0.000227	20.27
theta	-62.957488	17.410566	3.62
psi	0.997291	0.013223	75.42
zeta	-2.863478	0.025497	112.31
sigma	1.003847	0.018820	53.34
kpy2	2.506610	0.020919	119.82
kwto2	7.398293	2.039616	3.63
kasn2	-10.996197	1.664974	6.6
kd21	2.893992	1.971049	1.47
kd23	0.207564	0.522990	0.4
kd25	3.853446	0.522680	7.37
kd26	11.014357	1.878299	5.86
kd29	-3.170632	1.029697	3.08
kd212	-2.253242	0.046091	48.89
kd213	2.321464	0.049107	47.27
ks23	-1.003165	17.141720	0.06
ks24	-2.140432	1.958521	1.09
ks25	1.302264	0.020632	63.12
ks26	-3.268410	0.008520	383.62
ks213	-1.549510	0.022158	69.93
kln27	-0.320201	0.010083	31.76

Parameter	Parameter Value	Standard Error	T-Value
kln210	0.001826	0.007776	0.23
kln212	-0.235518	0.005788	40.69
kf28	11.328720	0.136430	83.04
kf210	-2.587827	0.017279	149.77
nu2	6.267480	0.005265	1190.45
rho	0.126327	0.000658	191.89
xi21	0.000848	0.000016	54.54
xi23	0.000041	0.000000	144.94
xi24	-0.000471	0.000003	145.61
xi25	-0.001910	0.000010	195.17
xi26	0.000011	0.000001	10.67
xi27	0.000012	0.000001	11.56
xi28	-0.000849	0.000008	111.74
xi29	0.000000	0.000003	0.01
xi210	-0.000136	0.000002	57.31
xi211	-0.000023	0.000002	10.85
xi212	-0.000747	0.000006	117.68
xi213	0.003094	0.000027	116.33
dl21	-0.433967	0.001522	285.09
dl23	-0.283310	0.002421	117.04
dl24	-1.841924	0.007925	232.41
dl25	0.089993	0.000796	112.99
dl26	0.357345	0.002063	173.23
dl27	-0.961091	0.003131	306.93
dl28	-0.053740	0.000400	134.25
dl29	-0.114832	0.001733	66.28
dl210	-0.891159	0.008254	107.97
dl211	-0.575007	0.009892	58.13
dl212	0.724829	0.014638	49.52
dl213	0.191937	0.006926	27.71
dt24	-0.176736	0.000824	214.51
dt213	-0.024260	0.000987	24.58
dis22	0.000010	0.000000	3875.55

FIGURE 19. FIML REGRESSION DIAGNOSTICS: CHINA	
Log-Likelihood	3101.18
Norm of Gradient	0.032597
Condition Number of Hessian	3.35E+18
Full Value of Log-Likelihood	1881.452
Market Access Effect	0.998874
Freeness of Trade $\phi(2,1)$	0.974130
Freeness of Trade $\phi(2,3)$	0.993867
Freeness of Trade $\phi(2,4)$	0.951026
Freeness of Trade $\phi(2,5)$	0.982939
Freeness of Trade $\phi(2,6)$	0.980110
Freeness of Trade $\phi(2,7)$	0.971102
Freeness of Trade $\phi(2,8)$	0.955524
Freeness of Trade $\phi(2,9)$	1
Freeness of Trade $\phi(2,10)$	0.981601
Freeness of Trade $\phi(2,11)$	0.982454
Freeness of Trade $\phi(2,12)$	1
Freeness of Trade $\phi(2,13)$	1

FIGURE 20. FIML RESULTS: INDONESIA

Parameter	Parameter Value	Standard Error	T-Value
gm31	-0.000192	0.000071	2.7
gm32	-0.000462	0.000133	3.48
gm34	-0.000076	0.000025	3.05
gm35	-0.000465	0.000688	0.68
gm36	-0.000164	0.000045	3.65
gm37	-0.000223	0.000046	4.81
gm38	-0.000064	0.000060	1.05
gm39	-0.000493	0.000140	3.52
gm310	-0.000296	0.000099	2.98
gm311	-0.000380	0.000080	4.78
gm312	-0.000145	0.000051	2.85
gm313	-0.000143	0.000067	2.12
eta	0.000863	0.000395	2.19
theta	77.963812	2.420434	32.21
psi	0.957712	0.008845	108.28
zeta	6.071979	0.530312	11.45
sigma	1.067761	0.013849	77.1
kpy3	0.791637	0.027855	28.42
ksu3	-14.691695	3.500928	4.2
kwto3	-14.386152	0.276301	52.07
kasn3	-0.660923	0.359333	1.84
kd31	-75.649856	3.184499	23.76
kd32	-121.668707	2.305942	52.76
kd38	-18.860428	4.878184	3.87
ks31	3.389720	0.206421	16.42
ks32	88.931044	2.959031	30.05
ks35	-70.720420	3.483423	20.3
ks36	54.779727	2.126226	25.76
ks310	73.985250	4.353866	16.99
kln37	-9.765779	0.620219	15.75

Parameter	Parameter Value	Standard Error	T-Value
kln310	4.598583	0.500042	9.2
kf35	9.352881	0.318781	29.34
nu3	-24.083521	0.607601	39.64
rho	36.827127	0.793889	46.39
xi31	19.076850	0.811310	23.51
xi32	1.081813	0.048428	22.34
xi34	-26.861651	1.384545	19.4
xi35	7.751295	0.392078	19.77
xi36	1.628219	1.565717	1.04
xi37	18.492836	1.177868	15.7
xi38	-0.308542	0.013229	23.32
xi39	-8.401804	0.316420	26.55
xi310	14.716526	1.401275	10.5
xi311	-0.141590	0.199192	0.71
xi312	11.516671	1.523095	7.56
xi313	-24.875435	1.376578	18.07
dl31	-13.892925	0.452507	30.7
dl32	8.013078	0.590271	13.58
dl34	-52.915993	2.244731	23.57
dl35	-2.144504	0.334362	6.41
dl36	-1.073258	0.472830	2.27
dl37	-14.881862	0.488617	30.46
dl38	-22.490051	0.829472	27.11
dl39	15.659284	1.058190	14.8
dl310	0.942085	0.085259	11.05
dl311	7.427301	0.716123	10.37
dl312	-8.190069	0.238455	34.35
dl313	-8.835319	0.487459	18.13
dt37	-4.160604	0.105341	39.5
dis33	0.295754	0.000079	3737.72

FIGURE 21. FIML REGRESSION DIAGNOSTICS: INDONESIA	
Log-Likelihood	2.97E+03
Norm of Gradient	2.30E-02
Condition Number of Hessian	3.82E+08
Full Value of Log-Likelihood	1.75E+03
Market Access Effect	0.977892
Freeness of Trade ϕ(3,1)	1
Freeness of Trade ϕ(3,2)	0.001105
Freeness of Trade ϕ(3,4)	1
Freeness of Trade ϕ(3,5)	0.054624
Freeness of Trade ϕ(3,6)	1
Freeness of Trade ϕ(3,7)	1
Freeness of Trade ϕ(3,8)	1
Freeness of Trade ϕ(3,9)	0.000237
Freeness of Trade ϕ(3,10)	1
Freeness of Trade ϕ(3,11)	0.020304
Freeness of Trade ϕ(3,12)	1
Freeness of Trade ϕ(3,13)	1

FIGURE 22. FIML RESULTS: INDIA

Parameter	Parameter Value	Standard Error	T-Value
gm41	-0.000643	0.000194	3.32
gm42	-0.001222	0.000464	2.63
gm43	-0.000955	0.000277	3.44
gm45	-0.000231	0.000117	1.98
gm46	-0.000642	0.000256	2.51
gm47	-0.000930	0.000278	3.34
gm48	-0.000995	0.000518	1.92
gm49	-0.000965	0.000321	3.01
gm410	-0.000976	0.000388	2.52
gm411	-0.000642	0.000235	2.73
gm412	-0.000687	0.000358	1.92
gm413	-0.002005	0.000490	4.09
eta	0.010064	0.002595	3.88
theta	21.517396	0.477155	45.1
psi	0.977575	0.004491	217.66
zeta	-0.006839	0.009449	0.72
sigma	1.011406	0.002254	448.71
kpy4	-0.856609	0.007401	115.74
ksu4	0.409973	0.231582	1.77
kwto4	-0.581605	0.005287	110.01
kasn4	15.994756	0.324542	49.28
ks41	4.750817	1.031737	4.6
ks42	0.578849	0.079526	7.28
ks45	-29.664103	0.261398	113.48
ks46	-3.960059	0.076218	51.96
kln41	-0.409397	0.001753	233.6
kln46	-0.008238	0.001817	4.53
kln48	-0.004431	0.000832	5.33
kln49	0.238503	0.001693	140.9
kln410	0.049033	0.001318	37.21

Parameter	Parameter Value	Standard Error	T-Value
kf46	-0.672958	0.269323	2.5
nu4	-4.655547	0.007654	608.25
rho	-0.497564	0.014162	35.13
xi41	0.703971	0.008557	82.27
xi42	-0.388464	0.006877	56.49
xi43	-0.844391	0.006431	131.31
xi45	-0.280425	0.007980	35.14
xi46	-1.528701	0.006393	239.11
xi47	0.200100	0.008248	24.26
xi48	2.946456	0.005869	502
xi49	-0.502254	0.006517	77.07
xi410	0.579189	0.006894	84.02
xi411	0.006767	0.002903	2.33
xi412	-0.495881	0.007012	70.72
xi413	0.908277	0.008952	101.47
dl41	-0.334019	0.006632	50.37
dl42	-0.606868	0.005351	113.41
dl43	-0.127699	0.007554	16.91
dl45	-0.518487	0.006941	74.7
dl46	0.127719	0.009992	12.78
dl47	-0.098860	0.002775	35.63
dl48	0.133667	0.004193	31.88
dl49	0.107739	0.007869	13.69
dl410	-0.411235	0.006778	60.67
dl411	-0.641921	0.003858	166.37
dl412	-0.037284	0.001350	27.62
dl413	0.239044	0.003221	74.22
dt42	0.720980	0.006013	119.91
dis44	0.229618	0.000380	603.89

FIGURE 23. FIML REGRESSION DIAGNOSTICS: INDIA	
Log-Likelihood	2805.213
Norm of Gradient	0.004126
Condition Number of Hessian	17000000
Full Value of Log-Likelihood	1585.485
Market Access Effect	1.011403
Freeness of Trade $\phi(4,1)$	0.919036
Freeness of Trade $\phi(4,2)$	0.929992
Freeness of Trade $\phi(4,3)$	0.987799
Freeness of Trade $\phi(4,5)$	1
Freeness of Trade $\phi(4,6)$	1
Freeness of Trade $\phi(4,7)$	0.990806
Freeness of Trade $\phi(4,8)$	1
Freeness of Trade $\phi(4,9)$	1
Freeness of Trade $\phi(4,10)$	0.961607
Freeness of Trade $\phi(4,11)$	0.943750
Freeness of Trade $\phi(4,12)$	0.996428
Freeness of Trade $\phi(4,13)$	1

FIGURE 24. FIML RESULTS: JAPAN

Parameter	Parameter Value	Standard Error	T-Value
gm51	-0.001741	0.001285	1.35
gm52	-0.001755	0.000510	3.44
gm53	-0.000681	0.000524	1.3
gm54	-0.001728	0.000768	2.25
gm56	-0.013167	0.002855	4.61
gm57	-0.001019	0.000722	1.41
gm58	-0.000779	0.001900	0.41
gm59	-0.000948	0.000492	1.93
gm510	-0.000395	0.000405	0.98
gm511	-0.001045	0.000534	1.96
gm512	-0.000781	0.000558	1.4
gm513	-0.001701	0.000465	3.66
eta	0.000237	0.000240	0.99
theta	2.743512	0.496667	5.52
psi	0.930724	0.007705	120.79
zeta	0.069746	0.034343	2.03
sigma	1.085118	0.004392	247.09
kpy5	0.844297	0.051969	16.25
kwto5	0.175572	0.035205	4.99
kasn5	0.639017	0.058030	11.01
kd51	-0.244582	0.075693	3.23
kd52	0.167682	0.071385	2.35
kd56	-0.982071	0.030239	32.48
kd512	-1.275659	0.056018	22.77
ks52	0.346409	0.041700	8.31
ks53	-1.422875	0.346540	4.11
ks54	-0.748328	0.150794	4.96
ks56	-0.515955	0.101847	5.07
ks512	-0.294970	0.039576	7.45
kf53	0.016997	0.004201	4.05
kf57	0.382036	0.066555	5.74

Parameter	Parameter Value	Standard Error	T-Value
kf59	-0.107843	0.015464	6.97
kf510	-0.061835	0.006754	9.16
kf511	-0.001903	0.000934	2.04
kf513	0.006964	0.004931	1.41
nu5	0.246170	0.020708	11.89
rho	-0.159904	0.035103	4.56
xi51	-0.004304	0.003952	1.09
xi52	0.201444	0.030061	6.7
xi53	0.131453	0.027923	4.71
xi54	0.264267	0.027173	9.73
xi56	0.118635	0.021595	5.49
xi57	-0.049569	0.022634	2.19
xi58	-0.049205	0.034537	1.42
xi59	0.086939	0.003004	28.95
xi510	0.092891	0.022381	4.15
xi511	0.267361	0.021687	12.33
xi512	-0.104556	0.024911	4.2
xi513	0.195118	0.026967	7.24
dl51	-0.913681	0.060106	15.2
dl52	-2.805150	0.126738	22.13
dl53	-2.988690	0.222581	13.43
dl54	-1.746136	0.098859	17.66
dl56	-0.462873	0.118357	3.91
dl57	-1.641555	0.102455	16.02
dl58	-0.962893	0.292498	3.29
dl59	-2.316881	0.100122	23.14
dl510	-2.518150	0.103674	24.29
dl511	-2.207007	0.058739	37.57
dl512	-1.819379	0.062037	29.33
dl513	-3.490689	0.078154	44.66
dis55	0.302401	0.002731	110.71

FIGURE 25. FIML REGRESSION DIAGNOSTICS: JAPAN	
Log-Likelihood	2759.233
Norm of Gradient	0.012913
Condition Number of Hessian	1.08E+33
Full Value of Log-Likelihood	1539.506
Market Access Effect	0.990152
Freeness of Trade $\phi(5,1)$	0.508431
Freeness of Trade $\phi(5,2)$	0.156357
Freeness of Trade $\phi(5,3)$	0.126131
Freeness of Trade $\phi(5,4)$	0.292475
Freeness of Trade $\phi(5,6)$	0.867014
Freeness of Trade $\phi(5,7)$	0.294731
Freeness of Trade $\phi(5,8)$	0.473367
Freeness of Trade $\phi(5,9)$	0.208697
Freeness of Trade $\phi(5,10)$	0.160832
Freeness of Trade $\phi(5,11)$	0.206680
Freeness of Trade $\phi(5,12)$	0.351353
Freeness of Trade $\phi(5,13)$	0.085639

FIGURE 26. FIML RESULTS: KOREA

Parameter	Parameter Value	Standard Error	T-Value
gm61	0.000355	0.000120	2.96
gm62	0.004443	0.002101	2.11
gm63	0.000339	0.000137	2.48
gm64	0.000537	0.000198	2.72
gm65	0.000197	0.000158	1.25
gm67	0.000416	0.000117	3.54
gm68	0.000318	0.000125	2.54
gm69	0.000454	0.000095	4.8
gm610	0.000339	0.000138	2.45
gm611	0.000313	0.000128	2.44
gm612	0.000359	0.000132	2.72
gm613	0.003604	0.001411	2.55
eta	-0.001765	0.000824	2.14
theta	-0.169105	0.003103	54.51
psi	0.745146	0.159273	4.68
zeta	0.045378	0.006693	6.78
sigma	1.336325	0.110806	12.06
kpy6	0.105242	0.014154	7.44
kwto6	0.033927	0.003467	9.79
kasn6	0.092349	0.007485	12.34
kd62	-30.357922	0.888589	34.16
kd65	-1.016379	0.028016	36.28
ks62	-1.209622	0.029669	40.77
ks63	19.754665	60.444125	0.33
ks64	-1.760643	0.031103	56.61
ks65	-109.232970	61.021031	1.79
kln61	-0.007576	0.000321	23.63
kln64	0.011438	0.000071	161.78
kln68	-0.001941	0.000048	40.59
kln69	0.004966	0.000340	14.59
kln610	-0.000879	0.000033	26.99
kf64	-0.004192	0.001367	3.07
kf610	-0.018966	0.000289	65.72
nu6	10.743270	0.003435	3127.15
rho	0.096991	0.000103	941.5
xi61	0.000004	0.000000	94.1
xi62	-0.000746	0.000049	15.08
xi63	0.000473	0.000043	11.04
xi64	-0.000546	0.000154	3.55
xi65	-0.000395	0.000007	53.7
xi67	-0.000301	0.000038	8
xi68	-0.000747	0.000099	7.57
xi69	-0.000307	0.000044	6.94
xi610	0.000014	0.000065	0.21
xi611	-0.000528	0.000030	17.54
xi612	-0.000256	0.000038	6.76
xi613	-0.000774	0.000022	35.13
dl61	-0.069870	0.000787	88.75
dl62	-0.091473	0.000398	229.76
dl63	-0.089171	0.000282	316.55
dl64	-0.095012	0.000059	1609.77
dl65	-0.059873	0.001079	55.49
dl67	-0.107134	0.000030	3531.21
dl68	-0.122549	0.000041	2986.68
dl69	-0.035564	0.000140	254.53
dl610	-0.089720	0.000035	2587.15
dl611	-0.097956	0.000069	1428.32
dl612	-0.076318	0.000021	3700.87
dl613	-0.102525	0.000019	5384.29
dis66	-0.000194	0.000000	390.38

FIGURE 27. FIML REGRESSION DIAGNOSTICS: KOREA	
Log-Likelihood	3842.202
Norm of Gradient	0.017185
Condition Number of Hessian	1660000
Full Value of Log-Likelihood	2622.474
Market Access Effect	1.004261
Freeness of Trade ϕ(6,1)	0.811417
Freeness of Trade ϕ(6,2)	1
Freeness of Trade ϕ(6,3)	0.001008
Freeness of Trade ϕ(6,4)	1
Freeness of Trade ϕ(6,5)	1
Freeness of Trade ϕ(6,7)	0.739018
Freeness of Trade ϕ(6,8)	0.685292
Freeness of Trade ϕ(6,9)	0.908428
Freeness of Trade ϕ(6,10)	0.780339
Freeness of Trade ϕ(6,11)	0.762867
Freeness of Trade ϕ(6,12)	0.828565
Freeness of Trade ϕ(6,13)	0.756603

FIGURE 28. FIML RESULTS: MALAYSIA

Parameter	Parameter Value	Standard Error	T-Value
gm71	0.000082	0.000023	3.57
gm72	0.000111	0.000024	4.68
gm73	0.000095	0.000031	3.1
gm74	0.000081	0.000038	2.11
gm75	0.000051	0.000018	2.89
gm76	0.000055	0.000026	2.07
gm78	0.000091	0.000053	1.72
gm79	0.000063	0.000025	2.47
gm710	0.000050	0.000016	3.08
gm711	0.000074	0.000019	3.82
gm712	0.000061	0.000021	2.87
gm713	0.000153	0.000042	3.67
eta	0.015569	0.010735	1.45
theta	-82.220258	2.366235	34.75
psi	0.958728	0.008301	115.49
zeta	3.544984	0.237414	14.93
sigma	1.071805	0.013915	77.02
kpy7	-0.320712	0.421627	0.76
kwto7	5.899517	1.121249	5.26
kasn7	3.919299	1.181266	3.32
ks710	-38.523194	4.051305	9.51
ks711	0.862970	0.539502	1.6
kln72	-0.021325	0.034754	0.61
kln73	-0.653350	0.211663	3.09
kln710	1.342264	0.224847	5.97
kln712	0.024636	0.013414	1.84
kf71	3.020895	3.563405	0.85
kf75	-3.041108	0.481000	6.32
kf78	3.889132	1.279667	3.04
nu7	80.428141	0.441181	182.3

Parameter	Parameter Value	Standard Error	T-Value
rho	0.089299	0.041514	2.15
xi71	0.000054	0.000016	3.33
xi72	0.000003	0.000006	0.55
xi73	-0.000095	0.000046	2.06
xi74	0.000032	0.000013	2.37
xi75	-0.000036	0.000021	1.72
xi76	-0.000002	0.000008	0.25
xi78	0.000026	0.000017	1.47
xi79	0.000036	0.000018	1.94
xi710	0.000081	0.000062	1.3
xi711	0.000023	0.000018	1.33
xi712	0.000038	0.000016	2.4
xi713	-0.000129	0.000059	2.2
dl71	-0.108524	0.023523	4.61
dl72	0.012916	0.107310	0.12
dl73	-0.138030	0.054669	2.52
dl74	-0.442172	0.063770	6.93
dl75	0.311691	0.056857	5.48
dl76	-0.348994	0.090259	3.87
dl78	-0.198341	0.186178	1.07
dl79	-0.297188	0.060786	4.89
dl710	0.639265	0.224349	2.85
dl711	0.291106	0.117904	2.47
dl712	-0.446817	0.229212	1.95
dl713	-0.061241	0.088030	0.7
dt73	0.055297	0.216097	0.26
dt710	-1.324687	0.226158	5.86
dt711	0.296932	0.071040	4.18
dis77	0.000062	0.000012	5.05

FIGURE 29. FIML REGRESSION DIAGNOSTICS: MALAYSIA	
Log-Likelihood	3133.432
Norm of Gradient	0.021785
Condition Number of Hessian	1.91E+12
Full Value of Log-Likelihood	1913.704
Market Access Effect	0.973169
Freeness of Trade ϕ(7,1)	0.752152
Freeness of Trade ϕ(7,2)	1
Freeness of Trade ϕ(7,3)	0.972221
Freeness of Trade ϕ(7,4)	0.770987
Freeness of Trade ϕ(7,5)	1
Freeness of Trade ϕ(7,6)	0.810310
Freeness of Trade ϕ(7,8)	0.664762
Freeness of Trade ϕ(7,9)	0.847919
Freeness of Trade ϕ(7,10)	1
Freeness of Trade ϕ(7,11)	1
Freeness of Trade ϕ(7,12)	0.772355
Freeness of Trade ϕ(7,13)	0.968766

FIGURE 30. FIML RESULTS: NEW ZEALAND

Parameter	Parameter Value	Standard Error	T-Value
gm81	0.160758	0.209493	0.77
gm82	0.222446	0.536113	0.41
gm83	0.199388	1.350027	0.15
gm84	0.093922	0.394630	0.24
gm85	0.140969	0.121138	1.16
gm86	0.298491	1.668300	0.18
gm87	0.258973	1.940111	0.13
gm89	-0.001205	0.020550	0.06
gm810	0.147773	0.033673	4.39
gm811	0.228039	0.836693	0.27
gm812	0.151021	0.117966	1.28
gm813	-0.002061	0.002938	0.7
eta	0.029580	0.062474	0.47
theta	-0.445935	5.268803	0.08
psi	1.081107	0.194798	5.55
zeta	-0.361166	0.099097	3.64
sigma	1.396099	0.520504	2.68
kpy8	0.315830	0.053583	5.89
kwto8	1.865026	1.805596	1.03
kasn8	2.023641	2.050748	0.99
kd83	0.017362	1.538428	0.01
kln81	0.387064	3.406559	0.11
kln84	-0.571730	22.710777	0.03
kln86	-2.167303	2.484101	0.87
kln89	0.664775	7.448153	0.09
kln810	-2.040573	21.325976	0.1
kf81	-1.608989	0.734797	2.19
kf82	0.824001	8.617405	0.1
kf87	0.429635	6.710070	0.06

Parameter	Parameter Value	Standard Error	T-Value
kf810	-0.042744	5.771497	0.01
kf811	0.350709	4.045048	0.09
nu8	1.293657	1.399457	0.92
rho	2.274005	7.055705	0.32
xi81	0.926301	0.924213	1
xi82	0.927371	1.292113	0.72
xi83	1.027690	1.404122	0.73
xi84	1.595398	3.693758	0.43
xi85	-2.351020	0.636832	3.69
xi86	0.061768	0.157773	0.39
xi87	0.052543	1.007662	0.05
xi89	-0.845485	0.452772	1.87
xi810	0.661487	4.479471	0.15
xi811	0.512913	1.078467	0.48
xi812	-0.029265	0.498171	0.06
xi813	-0.248508	2.659987	0.09
dl81	-1.368624	0.650395	2.1
dl82	-1.581322	0.810157	1.95
dl83	-1.608373	1.163208	1.38
dl84	-2.014701	0.270032	7.46
dl85	1.420966	0.249656	5.69
dl86	-0.654592	0.132666	4.93
dl87	-0.967996	0.839087	1.15
dl89	-2.303910	1.572824	1.46
dl810	-1.060528	0.451249	2.35
dl811	-1.263185	0.080676	15.66
dl812	-0.883194	0.012212	72.32
dl813	-3.180318	0.263190	12.08
dis88	0.239922	0.002046	117.24

FIGURE 31. FIML REGRESSION DIAGNOSTICS: NEW ZEALAND	
Log-Likelihood	3132.618
Norm of Gradient	0.002832
Condition Number of Hessian	59900000
Full Value of Log-Likelihood	1912.891
Market Access Effect	0.662545
Freeness of Trade ϕ(8,1)	0.022227
Freeness of Trade ϕ(8,2)	0.003077
Freeness of Trade ϕ(8,3)	0.003336
Freeness of Trade ϕ(8,4)	0.000690
Freeness of Trade ϕ(8,5)	1
Freeness of Trade ϕ(8,6)	0.218060
Freeness of Trade ϕ(8,7)	0.026125
Freeness of Trade ϕ(8,9)	0.000210
Freeness of Trade ϕ(8,10)	0.051117
Freeness of Trade ϕ(8,11)	0.008831
Freeness of Trade ϕ(8,12)	0.041356
Freeness of Trade ϕ(8,13)	0.000010

FIGURE 32. FIML RESULTS: PHILIPPINES

Parameter	Parameter Value	Standard Error	T-Value
gm91	-0.005665	0.006102	0.93
gm92	0.005143	0.001939	2.65
gm93	-0.001076	0.000602	1.79
gm94	0.458660	0.149534	3.07
gm95	-0.001142	0.000352	3.24
gm96	-0.000492	0.000239	2.06
gm97	-0.000721	0.000346	2.08
gm98	0.141193	0.035538	3.97
gm910	0.165114	0.076276	2.16
gm911	0.249659	0.046604	5.36
gm912	0.013701	0.003815	3.59
gm913	0.248007	0.075494	3.29
eta	-0.000004	0.000042	0.09
theta	-2.103429	1.751619	1.2
psi	0.982123	0.010255	95.77
zeta	1.159924	0.336931	3.44
sigma	1.092611	0.009517	93.79
kpy9	1.465461	0.098132	14.93
kwto9	-3.147678	0.160924	19.56
kasn9	-2.493474	0.153086	16.29
kd92	-1.437739	0.234395	6.13
kd912	-15.012393	9.008294	1.67
kd913	-0.113041	0.486744	0.23
kln91	-0.424766	0.267596	1.59
kln94	-6.306576	0.304085	20.74
kln96	-0.056112	0.018655	3.01
kln98	-7.341289	0.232584	31.56
kln910	0.148278	0.012998	11.41

Parameter	Parameter Value	Standard Error	T-Value
kf95	0.879555	0.274464	3.2
nu9	-4.930101	0.340299	14.49
rho	-0.372713	0.190834	1.95
xi91	-2.104556	0.229780	9.16
xi92	2.665199	0.179813	14.82
xi93	-1.528552	0.185062	8.26
xi94	5.937746	0.091897	64.61
xi95	-0.224306	0.090523	2.48
xi96	-6.205380	0.123134	50.4
xi97	-1.807240	0.194710	9.28
xi98	8.547711	0.348525	24.53
xi910	5.423554	0.644860	8.41
xi911	11.219540	0.562788	19.94
xi912	2.323534	0.209791	11.08
xi913	4.931035	0.093245	52.88
dl91	3.463768	0.338650	10.23
dl92	1.577503	0.153758	10.26
dl93	0.394136	0.118140	3.34
dl94	-1.584394	0.030064	52.7
dl95	0.806096	0.096787	8.33
dl96	0.824108	0.077432	10.64
dl97	-0.864971	0.119320	7.25
dl98	-1.514253	0.087507	17.3
dl910	-0.378193	0.312658	1.21
dl911	-4.596028	0.424824	10.82
dl912	1.476053	0.026841	54.99
dl913	0.159355	0.094042	1.69
dis99	0.409969	0.004267	96.09

FIGURE 33. FIML REGRESSION DIAGNOSTICS: PHILIPPINES	
Log-Likelihood	2360.257
Norm of Gradient	0.0112
Condition Number of Hessian	4680000000
Full Value of Log-Likelihood	1140.529
Market Access Effect	0.931898
Freeness of Trade ϕ(9,1)	1
Freeness of Trade ϕ(9,2)	1
Freeness of Trade ϕ(9,3)	1
Freeness of Trade ϕ(9,4)	0.516318
Freeness of Trade ϕ(9,5)	1
Freeness of Trade ϕ(9,6)	1
Freeness of Trade ϕ(9,7)	0.538335
Freeness of Trade ϕ(9,8)	0.559429
Freeness of Trade ϕ(9,10)	0.750940
Freeness of Trade ϕ(9,11)	0.037030
Freeness of Trade ϕ(9,12)	1
Freeness of Trade ϕ(9,13)	1

FIGURE 34. FIML RESULTS: SINGAPORE

Parameter	Parameter Value	Standard Error	T-Value
gm101	0.209394	0.052427	3.99
gm102	0.005478	0.001460	3.75
gm103	0.054052	0.000514	105.19
gm104	0.105455	0.041839	2.52
gm105	0.086687	0.033995	2.55
gm106	0.317503	0.048502	6.55
gm107	0.096694	0.028925	3.34
gm108	-0.000977	0.000540	1.81
gm109	-0.001991	0.000988	2.01
gm1011	0.045951	0.026769	1.72
gm1012	0.292347	0.056296	5.19
gm1013	0.067908	0.002877	23.6
eta	-0.004752	0.001000	4.75
theta	5.027579	1.263956	3.98
psi	0.838679	0.024579	34.12
zeta	1.038022	0.352092	2.95
sigma	1.138588	0.011663	97.63
kpy10	-0.199467	0.038144	5.23
kwto10	1.461956	0.292382	5
kasn10	1.469680	0.294951	4.98
ks103	-4.632630	1.479535	3.13
ks107	-0.191353	0.097239	1.97
kln101	1.764602	0.476823	3.7
kln102	-1.291834	0.931711	1.39
kln103	0.730069	0.336019	2.17
kln104	-0.391597	0.373309	1.05
kln106	-1.628383	0.688919	2.36
kln107	-0.935916	0.187146	5
kln108	-0.205459	0.157486	1.3
kln109	0.851565	0.192324	4.43
kln1012	-1.059783	0.601891	1.76
kf101	0.503099	0.096455	5.22

Parameter	Parameter Value	Standard Error	T-Value
kf102	-1.339328	0.200280	6.69
kf105	-0.264849	0.053306	4.97
kf106	0.058295	0.077542	0.75
kf108	1.459103	0.234622	6.22
nu10	1.214950	0.081906	14.83
rho	1.964280	0.576665	3.41
xi101	0.561271	0.217323	2.58
xi102	3.472206	0.287731	12.07
xi103	2.896007	0.426510	6.79
xi104	0.906354	0.173354	5.23
xi105	0.922794	0.180655	5.11
xi106	0.870303	0.012754	68.24
xi107	0.260355	0.201392	1.29
xi108	-2.982539	0.437737	6.81
xi109	-1.397822	0.165847	8.43
xi1011	-0.065469	0.211528	0.31
xi1012	0.025419	0.081882	0.31
xi1013	1.301886	0.396277	3.29
dl101	-0.848986	0.113480	7.48
dl102	-2.148401	0.170544	12.6
dl103	-2.854846	0.006268	455.46
dl104	-0.905666	0.116088	7.8
dl105	-1.002223	0.095152	10.53
dl106	-0.684171	0.003121	219.23
dl107	-0.184633	0.177026	1.04
dl108	-1.652707	0.107695	15.35
dl109	-1.094151	0.035427	30.88
dl1011	-0.104451	0.054808	1.91
dl1012	-0.144049	0.001352	106.51
dl1013	-0.816376	0.015956	51.17
dt107	0.898132	0.313401	2.87
dis1010	0.346764	0.018370	18.88

FIGURE 35. FIML REGRESSION DIAGNOSTICS: SINGAPORE	
Log-Likelihood	2860.807
Norm of Gradient	0.003948
Condition Number of Hessian	598000000
Full Value of Log-Likelihood	1641.079
Market Access Effect	1.047220
Freeness of Trade ϕ(10,1)	0.262963
Freeness of Trade ϕ(10,2)	0.120995
Freeness of Trade ϕ(10,3)	0.111107
Freeness of Trade ϕ(10,4)	0.375916
Freeness of Trade ϕ(10,5)	0.316356
Freeness of Trade ϕ(10,6)	0.558367
Freeness of Trade ϕ(10,7)	0.880254
Freeness of Trade ϕ(10,8)	0.105922
Freeness of Trade ϕ(10,9)	0.272908
Freeness of Trade ϕ(10,11)	0.900118
Freeness of Trade ϕ(10,12)	0.986128
Freeness of Trade ϕ(10,13)	0.437815

FIGURE 36. FIML RESULTS: THAILAND

Parameter	Parameter Value	Standard Error	T-Value
gm111	0.001124	0.000165	6.83
gm112	0.001689	0.000258	6.55
gm113	0.001572	0.000133	11.86
gm114	0.001413	0.000071	19.92
gm115	0.000679	0.000052	13.05
gm116	0.001405	0.000132	10.67
gm117	0.001106	0.000069	16.15
gm118	0.001093	0.000066	16.46
gm119	0.001163	0.000083	14.07
gm1110	0.000678	0.000077	8.84
gm1112	0.000732	0.000048	15.24
gm1113	0.001979	0.000095	20.77
eta	-0.002867	0.000532	5.39
theta	-165.210230	30.564291	5.41
psi	0.666542	0.005560	119.87
zeta	2.560529	0.001234	2075.76
sigma	1.870345	0.005030	371.8
kpy11	0.305056	0.000048	6293.84
ksu11	10.085961	2.635133	3.83
kwto11	0.197642	0.064877	3.05
kasn11	0.191011	0.064877	2.94
kd1113	-4.308845	0.000868	4963.5
ks117	-26.005111	12.654171	2.06
kf111	0.626287	0.710561	0.88
kf115	-0.118318	0.236466	0.5
kf118	-3.383650	0.766798	4.41
nu11	6.745637	0.000871	7740.43

Parameter	Parameter Value	Standard Error	T-Value
rho	0.831155	0.000682	1218.73
xi111	-0.000487	0.000065	7.53
xi112	-0.001983	0.000047	42.54
xi113	-0.000636	0.000066	9.61
xi114	-0.000703	0.000121	5.79
xi115	-0.000787	0.000170	4.64
xi116	-0.001410	0.000075	18.68
xi117	-0.000534	0.000112	4.78
xi118	-0.000627	0.000102	6.17
xi119	-0.000281	0.000129	2.18
xi1110	-0.001274	0.000071	18.03
xi1112	-0.001999	0.000140	14.27
xi1113	-0.001777	0.000108	16.38
dl111	0.179219	0.000485	369.33
dl112	0.213532	0.000369	579.22
dl113	-0.040392	0.001607	25.14
dl114	0.092626	0.001319	70.2
dl115	-0.081082	0.000416	195.07
dl116	-1.276539	0.003300	386.87
dl117	-0.036847	0.002776	13.27
dl118	0.171867	0.000303	566.4
dl119	0.036185	0.000494	73.22
dl1110	0.115207	0.000596	193.25
dl1112	-0.040594	0.000520	78.02
dl1113	-0.014531	0.000417	34.87
dt117	0.202908	0.000049	4102.98
dis1111	-0.000002	0.000000	10.26

FIGURE 37. FIML REGRESSION DIAGNOSTICS: THAILAND	
Log-Likelihood	3048.779
Norm of Gradient	0.034933
Condition Number of Hessian	1730000000
Full Value of Log-Likelihood	1829.051
Market Access Effect	1.216182
Freeness of Trade ϕ(11,1)	0.023901
Freeness of Trade ϕ(11,2)	0.788904
Freeness of Trade ϕ(11,3)	0.570683
Freeness of Trade ϕ(11,4)	0.683543
Freeness of Trade ϕ(11,5)	1
Freeness of Trade ϕ(11,6)	0.491891
Freeness of Trade ϕ(11,7)	0.591029
Freeness of Trade ϕ(11,8)	0.106701
Freeness of Trade ϕ(11,9)	1
Freeness of Trade ϕ(11,10)	1
Freeness of Trade ϕ(11,12)	0.234114
Freeness of Trade ϕ(11,13)	1

FIGURE 38. FIML RESULTS: TAIWAN

Parameter	Parameter Value	Standard Error	T-Value
gm121	0.001046	0.000648	1.61
gm122	0.134218	0.030779	4.36
gm123	0.028941	0.020682	1.4
gm124	0.173841	0.044592	3.9
gm125	-0.001302	0.000723	1.8
gm126	-0.000854	0.000283	3.02
gm127	-0.005179	0.001717	3.02
gm128	0.150018	0.058205	2.58
gm129	-0.002151	0.001069	2.01
gm1210	-0.002879	0.000764	3.77
gm1211	0.041514	0.014974	2.77
gm1213	0.172649	0.018474	9.35
eta	0.042768	0.007710	5.55
theta	-23.897765	1.473792	16.22
psi	0.825050	0.009314	88.58
zeta	6.148525	0.367133	16.75
sigma	1.109029	0.006406	173.12
kpy12	0.021856	0.012685	1.72
kwto12	3.779044	0.856993	4.41
kasn12	-5.066322	1.092780	4.64
kd122	-0.129911	0.002119	61.31
kd125	-14.315524	1.397140	10.25
kd129	-1.375834	0.552210	2.49
kd1213	-0.000790	0.111567	0.01
ks125	-4.013748	0.172884	23.22
kln122	-20.125697	0.476277	42.26
kln127	-15.615255	0.785055	19.89
kln1210	15.954592	0.633503	25.18

Parameter	Parameter Value	Standard Error	T-Value
nu12	1.725633	0.019815	87.09
rho	42.034629	1.496309	28.09
xi121	0.503374	0.042791	11.76
xi122	3.813806	0.024478	155.8
xi123	-0.269849	0.195289	1.38
xi124	0.940159	0.010294	91.33
xi125	0.747371	0.632065	1.18
xi126	-4.188879	0.853645	4.91
xi127	4.434972	0.402791	11.01
xi128	-1.346478	0.204601	6.58
xi129	0.679069	0.991601	0.68
xi1210	-2.894391	0.219088	13.21
xi1211	-0.978551	0.216474	4.52
xi1213	0.792762	0.115269	6.88
dl121	0.574730	0.007627	75.35
dl122	-1.310330	0.018323	71.51
dl123	-0.058154	0.172289	0.34
dl124	-1.112235	0.067673	16.44
dl125	-1.241559	0.367474	3.38
dl126	-0.493003	0.344350	1.43
dl127	-1.511200	0.085518	17.67
dl128	0.191707	0.056237	3.41
dl129	-2.446090	0.070409	34.74
dl1210	-1.534751	0.064370	23.84
dl1211	0.409795	0.095703	4.28
dl1213	-0.695813	0.045623	15.25
dis1212	0.306342	0.008405	36.45

FIGURE 39. FIML REGRESSION DIAGNOSTICS: TAIWAN	
Log-Likelihood	3353.845
Norm of Gradient	0.000775
Condition Number of Hessian	50000000
Full Value of Log-Likelihood	2134.118
Market Access Effect	1.092891
Freeness of Trade $\phi(12,1)$	1
Freeness of Trade $\phi(12,2)$	1
Freeness of Trade $\phi(12,3)$	0.949430
Freeness of Trade $\phi(12,4)$	0.360483
Freeness of Trade $\phi(12,5)$	1
Freeness of Trade $\phi(12,6)$	0.674472
Freeness of Trade $\phi(12,7)$	1
Freeness of Trade $\phi(12,8)$	1
Freeness of Trade $\phi(12,9)$	0.174389
Freeness of Trade $\phi(12,10)$	0.045607
Freeness of Trade $\phi(12,11)$	1
Freeness of Trade $\phi(12,13)$	0.563701

FIGURE 40. FIML RESULTS: VIETNAM

Parameter	Parameter Value	Standard Error	T-Value
gm131	-0.004424	0.004103	1.08
gm132	-0.001319	0.005223	0.25
gm133	-0.000726	0.003597	0.2
gm134	0.110289	0.597504	0.18
gm135	-0.003580	0.011183	0.32
gm136	1.456186	3.571509	0.41
gm137	-0.000979	0.001281	0.76
gm138	0.081373	0.021435	3.8
gm139	0.005079	0.027417	0.19
gm1310	0.618767	0.212310	2.91
gm1311	-0.000623	0.000523	1.19
gm1312	-0.026565	0.394159	0.07
eta	-0.001739	0.000512	3.4
theta	-6.131722	28.610990	0.21
psi	0.314120	1.737611	0.18
zeta	0.328632	0.125453	2.62
sigma	1.210542	0.103315	11.72
kpy13	-0.403779	0.245255	1.65
kwto13	0.608574	5.436758	0.11
kasn13	1.618989	4.699088	0.34
kd132	10.541372	69.775957	0.15
kd139	6.358750	24.450072	0.26
kd1311	-11.580662	7.544674	1.53
kd1312	0.206736	56.119549	0
ks132	-11.468706	13.179911	0.87
kf135	2.580433	0.863648	2.99
nu13	1.975904	0.270476	7.31

Parameter	Parameter Value	Standard Error	T-Value
rho	6.445869	21.137583	0.3
xi131	34.252551	28.933476	1.18
xi132	-5.874924	17.104145	0.34
xi133	-12.097502	0.176274	68.63
xi134	2.153142	8.819378	0.24
xi135	4.259246	5.174257	0.82
xi136	0.473063	0.240736	1.97
xi137	-13.109641	3.135792	4.18
xi138	-3.286734	2.845341	1.16
xi139	5.025826	8.606187	0.58
xi1310	-0.647424	0.166719	3.88
xi1311	-15.892827	8.566551	1.86
xi1312	-2.199475	2.920596	0.75
dl131	-28.119882	20.660827	1.36
dl132	-4.259591	5.786900	0.74
dl133	-0.868097	0.560420	1.55
dl134	-2.847084	4.272436	0.67
dl135	-6.428340	0.459946	13.98
dl136	-1.309437	0.012547	104.36
dl137	-2.965393	0.402329	7.37
dl138	0.604551	0.605654	1
dl139	-0.321770	0.067531	4.76
dl1310	-0.532674	0.017495	30.45
dl1311	-0.519664	0.088086	5.9
dl1312	0.488289	0.068100	7.17
dt132	-0.592963	0.008490	69.85
dis1313	0.484776	0.004056	119.53

FIGURE 41. FIML REGRESSION DIAGNOSTICS: VIETNAM	
Log-Likelihood	1677.877
Norm of Gradient	0.001413
Condition Number of Hessian	76400000
Full Value of Log-Likelihood	458.1498
Market Access Effect	2.629809
Freeness of Trade $\phi(13,1)$	2.065E-23
Freeness of Trade $\phi(13,2)$	0.000104
Freeness of Trade $\phi(13,3)$	0.244430
Freeness of Trade $\phi(13,4)$	0.007736
Freeness of Trade $\phi(13,5)$	0.000008
Freeness of Trade $\phi(13,6)$	0.107527
Freeness of Trade $\phi(13,7)$	0.011050
Freeness of Trade $\phi(13,8)$	1
Freeness of Trade $\phi(13,9)$	0.158340
Freeness of Trade $\phi(13,10)$	0.440987
Freeness of Trade $\phi(13,11)$	1
Freeness of Trade $\phi(13,12)$	1

FIGURE 42: WAGE AND MA CORRELATION			
Key	**Country**	**Average Wages**	**Raw Market Access Effect**
1	**Australia**	96.251488	1.601298
2	**China**	86.21708	0.998874
3	**Indonesia**	83.62524	0.977892
4	**India**	94.894088	1.011403
5	**Japan**	101.07364	0.990152
6	**Korea**	83.16548	1.004261
7	**Malaysia**	93.0056	0.973169
8	**New Zealand**	97.78972	0.662545
9	**Philippines**	101.687958	0.931898
10	**Singapore**	85.74548	1.047220
11	**Thailand**	103.659176	1.216182
12	**Taiwan**	90.34	1.092891
13	**Vietnam**	78.153317	2.629809

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