Undergraduate Economic Review

Volume 5 | Issue 1 Article 2

2009

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Undergraduate Economic Review

A publication of Illinois Wesleyan University

Volume V—2008-2009

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1. INTRODUCTION

There are a number of factors that can explain the direction, origin, modes, and quantities of Foreign Direct Investment (FDI). A country's overall trade policy will often consider these factors in order to maximize the range of benefits that are likely to follow. While FDI inflows will clearly add to the host countries productive capacity, the country may also expect benefits that are more ephemeral. Foreign firms are likely to bring higher levels of technology and management skills; the demand for highly skilled workers will increase in tandem with the average wage level. Value-added-in-production for those sectors that are heavily endowed with foreign capital, will likely increase along with profits and international competitiveness. Increases in efficiency per sector will spill over into other sectors in the form of lower input costs. For many developing countries in Latin America and Southeast Asia, these externalities have become an incentive to maximize FDI. Although the majority of arguments for and against protectionist policies might recognize these benefits, many other countries do not always follow the most appropriate policy in order to achieve them. This is expected. The political climate between countries will always be an active influence. Pre-existing multilateral and bilateral agreements will not always change in tandem with a countries comparative advantage. To model politics, however, is no simple task and goes well beyond the scope of this inquiry. This paper will confine itself to one small tangent of a *general* question: how can a trade policy affect the inflows of FDI. For simplicity, we define a nation's "trade policy" only in terms of its tariff schedule and exchange rates. More specifically then, this paper will investigate a *mechanism* through which tariff and exchange rates influence the inflows/outflows of FDI.

Although there are many mechanisms, this paper will consider the effect of a firm's sale orientation on the manner in which tariffs and exchange rates are likely influence FDI flows. A firm can sell to its domestic market (home nation), or export to a foreign market. If we assume that a firm has a pre-existing orientation, and that a firm's foreign investments will mirror the profitability of its foreign sales, then we can expect a close relationship between FDI flows and the returns to investment. Changes in tariff and exchange rates will have a strong influence on these returns, and therefore, the flows of FDI. According to our hypothesis, however, the firm's pre-existing sales orientation (domestic/foreign) will be the factor that initially determines the influence of tariff and exchange rates on FDI flows.

Even with a simplified understanding of "trade policy," the situation is not simple; there exist a number of hard and soft variables that become relevant when trying to explain FDI flows.

In line with common sense, a list of these variables has traditionally included: the host market size, transport costs, fixed costs of entry, the degree of copyright protection, economic and political stability, and the degree of competition already present in the host country. These factors will become more relevant to this paper as control variables when we expand this inquiry to include empirical data.

There are many practical examples in trade that may benefit from a comprehensive answer to this general question. In the mid-1980's, there was an overwhelming movement towards trade liberalization amongst the developing nations. China and other low-income Asian nations flooded the world market with labor-intensive goods, an initiative that was motivated, in part, by the benefits of additional foreign investment. With an increase in exports of low-skill-intensive goods, these nations could likewise expect a proportional increase in the wages of unskilled workers, predicted in the Stolper-Samuelson theorem.[1] This has not happened yet, and a recurrent issue in trade literature exists: where are these wage benefits for unskilled workers? At first, this question may seem unrelated to FDI inflows and our general question. Therefore, it is also the purpose of this paper to apply our theoretical model to this question, in order to demonstrate a linkage and a new perspective.

2. LITERATURE REVIEW

There are three avenues of theory that converge on our particular model of trade and capital flows: exchange rates, tariff jumping, and modes of Multinational Corporation (MNC) entrance into a host economy. Rather than folding each of these topics into the expansive literature on FDI, we will discuss each literature individually.

2.1 Tariff Jumping

Some authors argue that a positive relationship exists between tariff rates and the inflows of certain modes of FDI. The rationale is simple for this phenomenon, commonly called "tariff jumping." In the face of higher import tariffs, an MNC may find it profitable to move its production into the target market in order to "jump" over the added costs of exporting. The theory is contentious, and there is only a short history of empirical and theoretical efforts to

[1] For a discussion of this question, consult Martjit (2004), Wood (1997), or Lawrence and Slaughter (1993).

confirm/disprove its legitimacy. Most of the efforts to demonstrate tariff jumping empirically have referenced the behavior of Japanese firms in the 1990's. Barrell and Pain (1999) for example, demonstrate that anti-dumping (AD) protection is positively correlated with aggregate FDI inflows from Japan into the United States and Europe. These finding are confirmed in Blonigen and Feenstra (1997), who examine the Japanese FDI flows into the U.S using four digit SIC industry-level data. Belderbos (1997) observes data at the firm level, making a direct linkage between AD investigations and tariff jumping cases. This study uncovers striking results. Affirmative AD decisions will increase the probability of FDI from 19.6% to 71.8% in the European Community (EC), and 19.7% to 35.9% in the U.S. Furthermore, these findings confirmed that Japanese firms were 51.5% more likely to tariff jump after an affirmative case, compared to the 9.0% by firms from other countries.

In the theoretical literature, Massimo (1992) proposes a seminal work in a game theoretic approach to both confirm and counter the arguments of traditional tariff-jumping theory. Tariff Jumping is confirmed, insofar as the tariff will increase the MNC's profit incentive for entrance by raising the relative price of exporting. A tariff may thus undermine the host nations efforts to protect itself because it provides an incentive for foreign firms to enter the market. The results, however, depend entirely upon the existing market structure within the industry. With a high level of domestic competition or significant entry costs, the benefits of entrance are not likely to exceed those of continuing to export. Ellinsen and Warneryd (1999) present a model that offers a solution to the dilemma faced by the tariff-imposing nation. The government is omniscient and able to set a strategic tariff to maximize the protection of domestic firms, while minimizing these counteracting effects of tariff jumping.

To contrast these finding, Bruce (2002) investigates the incidences of FDI per sector and per firm in the US, and concludes that tariff jumping is only a viable option for MNCs with substantial assets, export volumes, and international experience. When the results are controlled for these variables, MNC's with Japanese majority ownership do not show any unusual propensity to tariff jump. The findings also offer a crushing comment on the Ellinsen and Warneryd (1999) model. Rather then comparing the benefits and costs in the macro-economy, AD investigators only consider what constitutes a "fair price" for the product, as determined by the costs of production and transport. The government is not omniscient, and has not taken into account the possible effects of tariff jumping. This idea is continued in Bruce (2004), where there author investigates into the welfare and competition-enhancing properties of tariff jumping.

In measuring the abnormalities in the estimated stock returns of traded firms that have filed for AD investigations, Bruce is able to confirm many of the finding in Massimo (1992). Distortions from an antidumping duty may be offset because higher returns to investment under protection may also encourage the entrance of foreign MNCs. Thus, abnormal returns to domestic firms would be lower on average. While Bruce recognizes that the likelihood of entrance may be affected by other variables—such as production costs or rivalry patterns—he concludes that Greenfield FDI has the largest negative impact on domestic firm profits. Bruce also observes that tariff jumping is more likely for those firms with considerable trade volumes**.** Buckley and Casson (1981) found this result to be solid; purchasing a plant in the foreign country will usually involve higher fixed costs than exporting. Although the marginal cost of exporting is lower, the *average cost* of producing in the target market will only be lower when there is a significant volume. From this discussion, we contend that MNC's are more likely to engage in tariff jumping when the majority of its target market is under the protection of foreign import tariffs.[2]

Increased tariffs may also deter firms from investing**.** Kravis and Lipsey (1982) examine the decisions of US multinational firms in the location of their overseas production. They conclude that openness in the host nation is indicative of easy world market access, and lower prices for material inputs in the production process of the foreign multinational affiliates in the host nations. Furthermore, Tuman and Emmert (2004) confirm this positive relationship between openness and FDI for those MNC's that intend to use the "recipient country as a base for intra-regional production." The rationale is simple: in the case that the products are intended for export, higher protection rates will result in higher input costs in the production process, and lower profit margins for the firm. The institution of tariffs may also indicate an overall trend towards protection in the host nation. With higher tariffs, the nations trading partners may institute retaliatory tariffs so that exports to the partner nations must face a disadvantage. Therefore, for those MNC's that intend to export rather than sell to the domestic market, an increase in tariffs will actually decrease the FDI inflows.[3]

2.2 Entry Modes

[2] Refer to Figure 1, Box 2
[3] Refer to Figure 1, Box 4

This paper intends to develop a model that is useful for policy recommendation. It may then be helpful to understand which types of FDI are likely to respond to which incentives and the degree that entry modes differ. A multinational firm can enter a foreign market through any of three ways: Greenfield FDI, Mergers and Acquisitions (M&A), or exporting. In one attempt to clarify these distinct modes, Koru (2004) uses as game theoretic model applied to firm-specific data for majority owned Swiss MNC's. The findings confirm an array of factors that influence different firms in their decision of entry mode. Although Koru cannot validate the tariff-jumping argument, larger firms that are more heavily invested in R&D research are more likely to enter through Greenfield FDI. These firms would prefer to use their own technology, and probably enjoy a considerable degree of scale economies. M&A entry however, offers a firm fast market access to a sales market or efficient inputs. Considerable trade and fixed costs had a more significant negative impact on acquisitions than on Greenfield FDI. Hill (1990) confirms these results by showing that the presence of large monopoly rents in the host country will usually disfavor the entrance by acquisitions compared with that by Greenfield.

We would like to make a note on Koru (2004) that could explain the lack of results supporting the tariff jumping argument. It could be that the inconclusive variables on the Greenfield FDI-response are the result of an improper method of disaggregating the different types of FDI. Why should FDI responses follow these categorizations? The MNC's reasons for investing are not always unique to the mode of entry. Perhaps it is the case that the aggregated group of firms that enter using Greenfield, do not demonstrate tariff jumping; but why aggregate according to this descriptor? After all, this is only an entry mode, and there is no consistent relationship between the firm characteristics as identified per entry modes, and reasons for investing. Why not assess the degree of tariff jumping by disaggregating according to entry costs? Or firm size? It is true that Koru (2004) found correlations between these variables and the mode of entry—but this result may suffer from aggregation bias because the connection between entry mode and the reasons for investment are accidental in many cases. Why not consider the location of sales, or the market size and trade volume when making classifications? By considering the influence of sales location on the MNC's decision to enter, this inquiry will address the aggregation bias issue.

2.3 Exchange Rate Influences

In the literature on FDI determinants, there exists a plethora of articles that consider the costs of investing: sunk costs, fixed costs, input costs, and transportation costs are all relevant to a MNC. Exchange rates, however, will also influence the final impact that these variables may have on the MNC's profits in terms of its home currency. Kohlagen (1977) and Cushman (1985) show that foreign production costs decline with a depreciating foreign currency, thus raising the profit incentive and stimulating FDI. Froot and Stein (1991) confirm these results in a model of an imperfect capital market, where a devaluation of the currency can lead to an overall decline in relative wealth, and may then encourage foreign acquisition.[4] Not all research, however, is unanimous in showing this relationship. In one study showing the outward FDI flows from the United States to 12 developing nations, Gorg and Wakelin (2002) show that an appreciation of the host currency is actually positively correlated with FDI flows, and a depreciation relative to the dollar is negatively correlated with FDI flows.[5] How can we resolve this discrepancy in results? Chen (2006) examines the impact of exchange rate movements on outward Taiwan FDI flows into China. In this paper, Chen distinguishes between Market and Cost oriented firms; "market" oriented refers to those firms that locate a subsidiary within a target market as the mode of entry. "Cost" oriented firms are those that locate production facilities in a country because the costs of production are relatively lower. These firms are *export*-oriented because the products are not sold in the country of manufacture. This paper develops a simple math model to demonstrate a few factors that influence the expected net-present-value-of-investing in China for Taiwanese firms. There is one central conclusion: the location of foreign MNC sales will determine the impact that exchange rate movements have on FDI flows. We will discuss this model in more detail in the following section.

We must also account for the volatility of exchange rates as a control in our empirical model. Lin Chen and Rau (2002) discuss the effects of exchange rate volatility on the timing of foreign direct investment for Market and Cost (export) oriented firms. They conclude that there is a divergent trend; under exchange rate uncertainty, market oriented firms are likely to delay investment while cost (export) oriented firms may actually accelerate FDI activity.

3. THE MODEL

[4] Refer to Figure 1, Box 1
[5] Refer to Figure 1, Box 3

Following the model and empirical research in Chen (2006), there are two sectors of firms in an open economy: "market" and "cost." Market sector firms are those MNC's that have the majority of their sales market within the boundaries of the host nation. The cost sector firms are those MNC's that have the majority of their sales market elsewhere; the only motivation for investing in the host nation is the cost incentive. Chen defines this term in his empirical model as follows.

Market Sector: If the percentage of an industry's sales in China in its total revenue is significantly greater than the weighted-average percentage of all industries at the 5% significant level, then the industry is referred to as market-oriented. These usually include such sectors as: Mining, transportation, storage, services

Cost Sector: If the percentage of reverse-imports of an industry from China in its total sales is significantly greater than the weighted-average percentage of all industries at the 5% significant level, then it is referred to as cost-oriented.

This distinction between market and cost-oriented is useful to understand the impact of exchange rates. For market-sector firms, a revaluation of the host currency will increase a firm revenue's in terms of the home nations currency. Every host nation sale is now worth more. Under the same revaluation, however, a cost sector firm will only experience an increase in host-nation wages relative to home-nation revenues; profits for the cost sector MNC have decreased. The opposite situation holds true for the devaluation of the currency. This relationship is shown below in boxes 1 and 3 of Figure 1.

Our model goes beyond Chen (2006) to explain the impact of tariffs on FDI flows in terms of the M and C sector distinction. In our above discussion on tariff jumping, we have incorporated two avenues of literature.

1) Papers that confirm tariff jumping for those firms with a large trade volume into the host nation: Barrell and Pain (1999), Blonigen and Feenstra (1997), Belderbos (1997), Massimo (1992), Ellinsen and Warneryd (1999), Bruce (2004), Buckley and Casson (1981). These papers suggest that market sector firms as defined by Chen, will also be more likely to tariff-jump.

2) Papers that confirm that tariffs will negatively impact FDI inflows: [Kravis and Lipsey (1982), Tuman and Emmert (2004)]. This literature suggests that import tariffs will deter cost sector firms from investing FDI in the host nation.

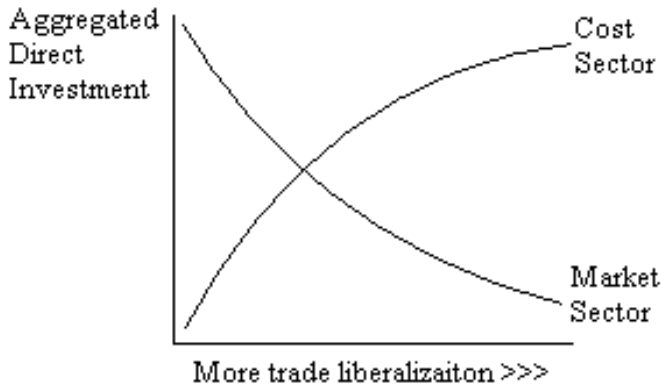
Therefore, given what we understand about exchange rate and tariffs, and their respective influences on market and cost sector firms, we can redefine these sectors according to figure 1.

Figure 1: The Market and Cost Sectors

	Exchange Rate Revaluation	Tariff Rate Increase
Market Sector (majority of sales in the country of investment)	**(1)** FDI increases	**(2)** FDI increases
Cost Sector (majority of sales outside the country of investment	**(3)** FDI decreases	**(4)** FDI decreases

For the visual people, we show the divergent relationship between incidences of FDI and trade liberalization for market and cost sector firms.

Figure 2: A Visual



3.1 The Present Value of Investing: Chen's Model

Chen offers a few equations to formalize his argument. Although we greatly simplify the model, these equations will be useful when we develop our own model for testing the relevance of tariffs *and* exchange rates. Beginning from the profit equations, we have an outline for the

basic characteristics of market and cost sector firms as a function of the exchange rate (R). Given these definitions:

V_m, V_c = The expected present value of the market and cost-oriented firm that stays in the market.
R = the exchange rate
P, P* = the price in the foreign and domestic market respectively
W = the wage rate in the foreign country
d = the discount rate
u = the growth rate of the exchange rate
E = the exchange rate
F_t = the total value for a firm to invest

we have the following equations for profit.

$$\Pi_M(R) = P_f R - W_f E \qquad (1)$$

$$\Pi_C(R) = P_d - W_f E \qquad (2)$$

These are then developed into equations that express the present value of investing in the host economy, as a function of the exchange rate.

$$V_m = \frac{(P - W)E}{d - u} \qquad (3)$$

$$V_c = \frac{P^*}{d} - \frac{W E}{(d - u)} \qquad (4)$$

If the country is going to maximize the total inflows of FDI, they should maximize the F_t

$$F_t = (V_m + V_c) / 2 \qquad (5)$$

To include tariffs in this model, we only have to define P in terms of P* as affected by the ad valorem tariff rate, t. The foreign price will increase by same proportion as the tariff, such that:

$$P = (1 + t)P^* \qquad (6)$$

Whenever there is tariff, P > P*, and all other variables held equal, V_m will increase while the V_c term will decrease. Thus with tariffs, market firms are more likely to tariff jump than cost firms. For the time being, this model satisfies our basic requirements for showing the divergence of market and cost sector firms in the face of tariffs and exchange rate movements.

3.2 Trade Liberalization: Basudeb's Model

This model has a few limitations that require some attention. First, these equations show only short term changes in the value of investing, and ignore the costs of capital. Second, the Chen model does not endogenize the wage rate, such that there is no link between prices, wages and capital. There is no way to show the broader impact that tariffs and re/devaluations can have on the economy as a whole. Therefore, this paper will refer frequently to the theoretical framework developed by Basudeb (1999), in which he develops a 2X3 and 3X3 framework to demonstrate some ambiguities and consequences of trade liberalization. Its conclusions call upon the Stolper Samuelsson (SS) predictions of the Heckschire Ohlin framework, and further assume that FDI can be tariff-jumping. When exchange rates devaluations are also assumed to increase the returns to foreign capital, then Basudeb contends that trade liberalization (lower tariffs and devaluations) must have ambiguous effects on FDI inflows. Even though tariffs raise the return to capital, a revaluation must increase the cost of labor, such that the firm's profits are ambiguously defined.

The model, however, misses the distinction between the market and cost sectors. Basudeb defines trade liberalization as a policy that will devalue the exchange rates and lower tariffs. In his two sector, two factor trade model described below, there is no mechanism to account for 1) the negative impact that tariffs can have on inflows of foreign capital (into the cost sector) and 2) the positive impacts that revaluations can have for foreign capital (into the market sector). This problem arises because rather than distinguishing sectors by the origin of revenue and location of sales(market/cost distinction), sectors are distinguished in accordance with tradition, that is, by the origin of capital (foreign/domestic). In doing so, Basudeb fails to recognize that "foreign capital" cannot be neatly aggregated into one variable. When exchange rates and tariffs are taken into account, the returns to capital are influenced heavily by the location of sales. For this reason, our inquiry intends to adapt the Basudeb model to account for the market and cost sector distinction.

w, r	The rewards paid to labor (wages) and capital (rent), respectively
M	The traditional importable sector (using domestic K capital only)
Y	The traditional exportable sector : (using domestic K capital only)
X	The modern exportable sector: (using foreign Z capital only)
L	The quantity of labor in the domestic market (used in both X and M)
K, Z	The quantities of domestic and foreign capital, respectively
P_y, P_y*	The domestic and world price of the traditional exportable sector

P_m, P_m* The domestic and world price of the traditional importable sector
P_x, P_x* The domestic and world price of the modern exportable sector
a_{ij} The quantity of the (i) factor required to produce the commodity (j). a_{lm} is Therefore the quantity of labor used importable sector.[6]
Θ_{ij} The factor shares of the (i) factor in the (j) industry. Θ_{lm} is therefore the labor's share of cost in the importable sector
(˜) Any variable with this symbol above it, denotes the relative change in that variable. Therefore ($\tilde{E}$) signifies the relative change in the exchange rate, or dE/E. Positive values of ($\tilde{E}$) will signify a devaluation.
E The domestic exchange rate: domestic currency per unit of foreign currency. Increasing values will signify a devaluation.
T = (t + 1) or the nominal tariff rate (t) on the importable good plus one.

The competitive zero profit conditions of the importable and exportable sectors are given by the following equations.

$$a_{lm}w + a_{km}r_k = P_m = EP_m{}^*T \qquad (7)$$

$$a_{lx}w + a_{kx}r_z = P_x = EP_x{}^* \qquad (8)$$

These competitive zero-profit equations are then differentiated to obtain the following

$$\Theta_{lm}\tilde{w} + \Theta_{km}\tilde{r}_k = \tilde{E} + \tilde{T} \qquad (9)$$

$$\Theta_{lx}\tilde{w} + \Theta_{zx}\tilde{r}_z = \tilde{E} \qquad (10)$$

Where the price reflects the value of the marginal product of the input, in this case, labor.

$$P_m = w\,(a_{lm} / \Theta_{lm}) \qquad (11)$$

After some manipulation, Basudeb is able to verify his predicted result for a two sector model:

$$\tilde{r}_z = \tilde{E} - \frac{\tilde{T}\beta_m\Theta_{lx}}{\beta\Theta_{zx}} \qquad (12)$$

Where β is the elasticity of labor demand in the whole economy, and β_m is the labor demand in the importable sector. The terms interact such that a exchange rate devaluation (positive values of $\tilde{E}$), Tariff reduction (negative values of $\tilde{T}$), and increased rents and thus likelihood of tariff jumping, are compatible goals.

[6] For clarification on the terms used in this model, please refer to Jones (1956); our explanation here borrows heavily from this article.

3.3 The Stolper Samuelson Effect

In this section, we will briefly explain the Stolper Samuelson (SS) theorem in the context of this paper, and how it is relevant to tariffs and exchange rates. Because the Basudeb model implicitly uses the same assumptions and structure, it is very easy to incorporate the predictions of the SS theorem. There are two possibilities, or "cases," that could result from trade restriction/liberalization. What is the SS theorem? Derived from the simple framework of the Heckscher-Ohlin Model, the SS model demonstrates how the relocation of production factors in an environment of changing commodity prices, can actually decrease economic welfare while trade is expanding. There are extreme assumptions that have historically limited its use in real-world situations.[7]

Costs of production depend on wages of factors
The supply of these factors in each economy is fixed
Goods of a particular industry are perfect substitutes for one another
Transport costs and technology differences do not exist
There is complete factor mobility between industries
Perfect competition and full employment

Heckscher-Ohlin (HO) provides a rich context for this theory to develop. The central insight of this model is that a country will export products that use relatively intensively those factors-of-production in which the country is relatively abundantly endowed. A country will import those products that require the relatively intensive use of those factors that are not endowed in relative abundance. The Stolper-Samuelson theory demonstrates how this link between inputs of factors and outputs of goods, is also parallel to the link between wages of factors and prices of goods (Wood 1995). In other words, a decrease in the price of a product will cause a decrease in the factor used relatively intensively in the production process.

Consider a small open economy where there are two factors of production (market and cost sector capital) and two commodities (raw materials, and software); using the symbols from our explanation of Basudeb and some intuitions gained from Chen with respect to which sectors are likely to be either market or cost sectors, raw materials (M) uses market capital (r_k) relatively intensively while software (C) uses more cost sector capital (r_z). Because we have assumed perfect competition and complete factor mobility across industries, the factor payments to market capital must be equal across industries; the same holds for cost sector capital. The actual quantity of rental returns to K or Z will equal their respective marginal products. Therefore, the

marginal physical product of M and C must be the same across industries, even though the factor intensity and rents for r_k and r_z will remain different. Changing prices for either factors-of-production (Z or K) or commodities (C or M) will affect the optimal r_z and r_k ratio; this happens because an increase in the rewards to an industry will increase the production of that commodity. Thus, "the price of each good produced must in equilibrium be equal to its unit production cost"(McCulloch 2005), or simply, the zero profit conditions that we have defined above in equations 7 and 8 above. We can see the relationships between industries in the following equations, where

$r_{k,}\, r_z$ The rental rates for market and cost sector capital respectively.

M, C The quantity of the commodities of raw materials (M) and Software (C), respectively

$$a_{km}\,(r_k / r_z)\, r_k + a_{kc}\,(r_k / r_z)\, r_z = P_M \qquad (15)$$

$$a_{zm}\,(r_k / r_z)\, r_k + a_{zc}\,(r_k / r_z)\, r_z = P_C \qquad (16)$$

In these equations, $a_{ij}\,(r_k / r_z)$ indicates the quantity of input of factor (i) in producing good (j) that will be cost minimizing. Therefore, $a_{km}\,(r_k / r_z)$ is the quantity of market sector capital used in the production of raw materials, that will be most efficient. Insofar as there are increased rewards, the marginal product changes in tandem with changes in the rental ratio (r_k / r_z). This means simply that a country's quantity and direction of production is determined by the relative price of each good, or simply:

$$(P_m / P_c) \qquad (17)$$

To assume that a sector will use a mixture of capital (r_k / r_z) , is an assumption that gives this model a little more practical application. In this way, we are able to show the *relative* changes in rewards to capital as the tariff structure changes for/against the different sectors (M and C).

Normally, SS (Stolper Samuelson) model would predict that a price increase, would result in a similar increase in the price of the input used most intensively in the production process, and reduce the rewards to the other sector. If we assume that our country is producing a

[7] Most notable is the assumption for constant technology; the literature suggests that changes in technology are the

homogenous product that uses market sector capital relatively intensively, an autonomous increase in the price of the market sector good will increase the price of market capital (here denoted as r(m) rather than r(k)). This will encourage the country to substitute r(m) for now less expensive cost sector capital (here denoted as r(c) rather an r(z)). If we look below to figure 3, we can see this process happen in the context of a one commodity, two factor model. According to the Stolper Samuelson theory, an increase in the rental rate of market sector capital will accompanied by a lower share of market sector capital in the production process. Isoquant I moves to the position of isoquant II, showing a lower share of r(m). The budget line with slope – r(c)/r(m) becomes less steep and matches with a higher rental rate of r(m). This process is a prediction that we call Case 1.

> **Case 1)** Trade restrictions negatively impact the returns to cost sector capital (r_c) even while the price (P_c) increases. The opposite can be shown for the market sector capital (r_k). This is our basic theory, but it is important to demonstrate because the results are counterintuitive.

However, there is an alternative. The situation could also resemble the diagram in figure 3.2 if inflows of capital are so extreme that the returns to investment actually decrease from the increased supply of capital,[8] and market sector firms dominate the economy, then what would happen with an increase of tariffs and exchange rates? The returns to market sector capital would now increase, so much so that the an influx of foreign capital will increase the quantity of r(m) country wide. The rental rates will now decrease from the oversupply, and the share of now cheaper r(m) used in the production process would increase, shown by a movement of Isoquant I to the position of isoquant II, and the now steeper slope of – r(c)/r(m). This process is what we call Case 2.

> **Case 2)** This is a more extreme case. When trade restrictions increase the returns to market capital, the supply response from tariff jumping and exchange rates is so extreme that it may actually decreases the returns to market capital. The same effect may happen for the cost sector; in the case of a tariff reduction and price decrease, r_c may increase so much as to illicit an inflow of foreign capital, thus decreasing r_c and neutralizing the effect of liberalization. The results in Bruce (2004) confirms that this could happen in

most popular and well-documented explanation for price and wage changes, i.e. Lawrence and Slaughter (1993)

some circumstances where competition in the host market is weak. This affect is analogous to the J-curve effect; the empirical observation that exchange rates have a tendency to over adjust in the short run.

This framework is not a refutation of the Stolper-Samuelson theorem for one major reason. The SS framework assumes no international capital mobility, and fixed quantities of capital. This begs the question: why should we ever compare this model to the SS theorem? Because our contention rests on the assumption that some industries may have an extremely strong positive elasticity of capital flows or substitution. A large positive value could readjust the proportions of fixed capital for a nation that exists in autarky.

Figure 3:
The Stolper Samuelson Theorem: Case 1 and Case 2

Figure 3.1: Case 1

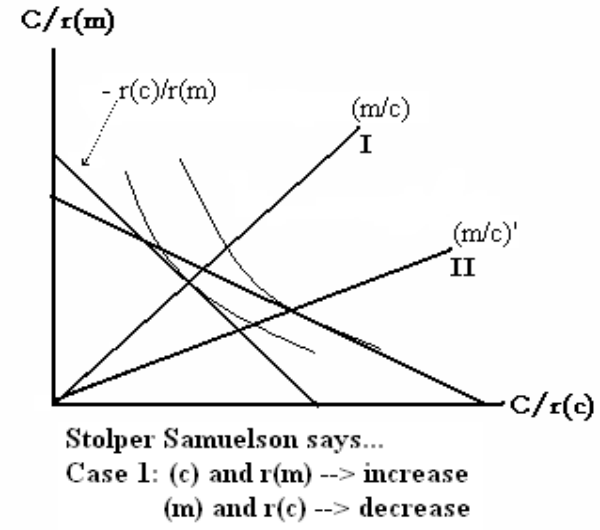
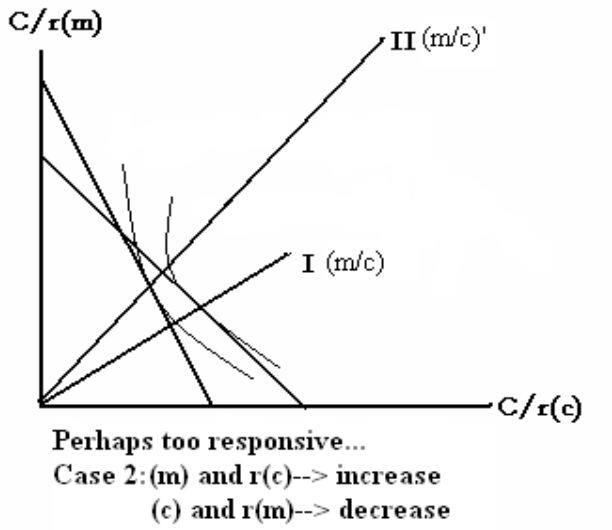


Figure 3.2: Case 2



[8] Refer to Bruce (2004) for a discussion about this being a real possibility.

3.4 Elasticities

These equations refer only to the rents paid to capital in the market and cost sectors. In the SS theorem we assume perfect capital mobility, and we must also assume that the price of Z is the same across sectors, and the same holds for K. In Basudeb (1999), however, Z and K are unique to the cost and market sector, respectively. Therefore we have adopted the approach in the SS model, to answer questions posed in the Basudeb model. Case one is a simple statement of our hypothesis. Case two is more extreme, and it would depend on the elasticity of capital's marginal product. This paper goes more in depth into the elasticities of substitution between market and cost sector factors of production in Appendix A.1.

$$\beta_M = \frac{\tilde{a}_{km} - \tilde{a}_{zm}}{((\tilde{r}_k / \tilde{r}_z)\tilde{r}_k) - \tilde{E} - T)} \quad \text{or} \quad \beta_M = \frac{(\tilde{a}_{km} + \tilde{a}_{zm}) - \tilde{a}l_m}{(\tilde{r}_k / \tilde{r}_z)\tilde{r}_k - (\tilde{w} - \tilde{E} - \tilde{T})} \qquad (18)$$

Or it may depend on the elasticity of substitution between market and cost sector capital.[9]

$$\beta_M = \frac{\tilde{a}_{km} - \tilde{a}_{zm}}{\tilde{r}_k - \tilde{r}_z} \quad \text{or} \quad \beta_M = \frac{(\tilde{a}_{km} + \tilde{a}_{zm}) - \tilde{a}l_m}{(\tilde{r}_k + \tilde{r}_z) - \tilde{w}} \qquad (19)$$

3.5 Effects on "r" and "w"

From our discussion about wages and rents, we can make the following predictions with respect to the effects of price changes (because of tariffs and exchange rates) on the returns to market sector capital, cost sector capital, and the wage rate of a homogenous labor force.

Figure 4: Summary of Results

				Returns to w	
	Prices	**Returns to r_k**	**Returns to r_z**	**Cost Sector Dominates**	**Market sector dominates**
Trade Liberalization	Decrease	Decreases	Increases	Increase	Decreases
Trade Restriction	Increases	Increases	Decreases	Decreases	increases

Notice how the wage rate will either decrease or increase depending on which sector dominates (that is, constitutes the majority) the economy of the host country under the conditions of either

[9] Assuming as we already have for this extension, that these are not mutually exclusive categories of capital.

trade liberalization (decreasing tariffs and devaluations) or trade restriction (increasing tariff rates and revaluations). When we look at the United States where the majority of foreign investment is market oriented, compared to Taiwan where the cost sector dominates, perhaps we would expect to see this mechanism show itself as a decrease in the wage gap between nations.

Of course, in reality there is no such thing as homogenous labor force, nor is there any real political connection between tariffs and exchange rates.[10] Many countries will lower tariffs and watch their exchange rates rise from the increased foreign demand of their (now) more accessible products. In other cases, however, a country may forcibly maintain their currency below value to encourage other countries to buy their products, and thus, effectively devalue their currency. Or a developing nation's trading partners may have currencies that are appreciating faster than their own. We have seen these trends in China, some South America countries, and many of the developing Southeast Asian nations since the late 1990's.

4) The Empirical Model

The predictions of our theoretical model (that is, Case 1) are in accordance with Stolper-Samuelson predictions; however, the subtle mechanisms have changed. Rather than expecting a direct relationship between world product prices and wage rates, we now expect multinational firms to mediate that relationship. Because tariffs and exchange rates influence the returns to multinational firm investment, the Stolper Samuelson predictions must now also take into account tariffs and exchange rates. What data and which countries are the most appropriate to use to test this model? Given the frameworks in Chen (2005) and Basudeb (1999), it would be helpful if our data followed the proceeding descriptions.

1) The country should be large and relatively open to investment; there will be more incidences of FDI when trade volumes are also large, and ad-valorem tariffs should only have a significant impact for high trade volumes.[11]
2) The country should have floating exchange rates to avoid any distortions from an over/undervalued currency.

[10] There is no political linkage, but there is an economic one; an increase in the tariff rates will cause upward pressure on the domestic currency, because US citizens are now buying less foreign goods.
[11] Bruce (2002). pg 36

3) Although Chen (2005) assumes that there are only imports, and reverse exports (those exports that are imported back into the home country)[12] there is no reason *per se* that we should follow Chen's approach.
4) We do not have access to the detailed firm-level data that was used in the Chen study, so the highest degree of disaggregation is necessary to show how industries react differently to tariffs and exchange rates. Detailed industry data is a requirement.

Although this paper has an implied focus on the FDI in developing countries, there are developed nations that fully satisfy all of these requirements. This paper will use trade/capital flow data for the US and Japan between 1980 and 1999 across major sectors. Between these trading partners, there is a considerable degree of trade *and* direct investment data that is widely available and accurate. Both nations also have floating exchange rates.

We will approach the data from at least three directions. 1) Using a panel data regression, we will investigate into the influences that exchange and tariff rates have on FDI. This model will use fixed effects in the regression because we assume that each industry will have a particular orientation towards either selling domestically, or exporting. 2) Then, using a two equations model with two-stage least square regressions, we will make a policy analysis about the benefits and costs of raising or lowering tariff and exchange rates in each individual industry, and finally 3) to test Case 2 we will observe the elasticities of major industrial sectors as they correspond to changes in the tariff and exchange rates.

4.1) Panel Data Regressions

We will need two regressions because of data limitations. Tariff data is not widely available or even meaningful, at the high level of aggregation that we are using in this model. Our first regression is not able to include tariff data because it will look into 10 broad sectors of the economy. This first regression will only be able to assess the importance of the MC ratio as it impacts the way that exchange rates influence the inflows and outflows of FDI. The second regression will look more intimately into four industries within the manufacturing sector, and can therefore include a measure for the average nominal tariff rate.

[12] In the Chen model equations, there is only domestic and foreign exchange rates; there is no world rate. Also, See Huang (2005) for a discussion about reverse imports.

Panel Regression 1:

To estimate the relationship between exchange rates, FDI, and the orientation of an investing firm (MC ratio), we will use a panel data approach to observe the inflows of Japanese FDI per major industry in the US for years between 1980 and 1999. The theoretical model that we estimate is as follows:

$$FDI = f(ER, ERVOL, MC, WAGE) \quad (20)$$

Or, to be more specific:

$$FDI_{it} = \beta_0 + \beta_1 MC_{it} + \beta_2 ER_{it} + \beta_3 ERVOL_{it} + \beta_4 WG_{it} + \beta_5(MC_{it} * ER_{it}) + \beta_6(MC_{it}\ ERVOL_{it}) + \varepsilon \quad (21)$$

FDI — Real values of total FDI inflows per industry from Japanese owned US affiliates. This is the dependent variable.

ERVOL: — The exchange rate volatility in terms of yen per dollar. This is likely to be a positive influence for cost oriented firms, while a negative influence on market oriented firms.

MC*ERVOL — *Whenever MC and ERVOL have different signs, MC*ERVOL should be positive*. For example, if MC is positive and ERVOL is negative, then MC*ERVOL should be positive, showing that a market oriented firm will invest whenever the volatility of exchange rates would otherwise have a negative impact on FDI inflows.
When MC is negative and ERVOL is positive, then MC*ERVOL should remain positive, showing that cost oriented firms are attracted to investing under these conditions.
*Whenever MC and ERVOL have the same signs, MC*ERVOL should be negative* for the same reasons.

MC: — The percentage of domestic sales of totals sales in each industry for foreign majority owned MNC's. This value will range between 0 and 1, with market oriented firms having values closest to 1. We expect the sign of this coefficient to be the same sign as the sign on the ER coefficient.

ER — Nominal Exchange rate of the foreign currency (yen) in terms of the US dollars. This term is important for the interaction terms. We expect the sign of this coefficient to the same as the sign on the MC Coefficient.

MC*ER — When both MC and ER are positive, MC*ER should be positive
When both MC and ER are negative, MC*ER should be negative

When MC and ER have opposite signs, then FDI flows are happening irrespective of either MC ratios or exchange rates. For example, +MC, -ER, +MC*ER, shows that market oriented firms are investing without concern for the exchange rate.

WG — The Ratio of the US real wage rate over the foreign countries real wage rate. This controls for the cost incentive of investing in the host nation, and we expect that this variable will be unambiguously negative.

CAP — The capacity utilization rates per major US industrial sector from 1980 until 1999.

KL — The capital labor ratio for all major US industrial sectors from 1980 until 1999, or more precisely, the ratio of "fixed capital stock" to "equivalent persons employed full time."

TAR — The average nominal tariff rate of each industry for major industrial sectors. This data is only reliable for the years 1981 until 1989. We include more highly aggregated proxy values into our three equations model (in Section 4.2) for all other years.

T — A simple time trend variable

KLCAP — The elasticity of the capital labor ratio, with respect to changes in the capacity utilization rate. Refer to appendix A.1 for a full explanation of what this variable signifies.

WGUS — The US average wage per year for full time persons employed in the industry.

Figure 5: Panel Regression 1

Dependent Variable: FDI
Sample: 1980 1999
Total panel (balanced) observations: 200
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficients	Standard Error	t-Statistic	P-Value
MC?	2340.446	13426.97	0.174309	0.8619
ER?	-90.22561	70.67371	-1.276650	0.2039
ERVOL?	-151.0825	552.8808	-0.273264	0.7851
WG?	825.4646	873.5168	0.944990	0.3464
MC?*ER?	104.1064	76.31116	1.364235	0.1748
MC?*ERVOL?	206.7812	603.9502	0.342381	0.7326
ER?(-2)	118.6405	72.50074	1.636404	0.1041
MC?*ER?(-2)	-134.0207	76.34681	-1.755420	0.0815
T?	610.0069	274.5826	2.221579	0.0280
AR(1)	0.860846	0.099021	8.693534	0.0000

R-squared	0.852908	F-statistic	43.16622
Adjusted R-squared	0.833149	Prob(F-statistic)	0.000000
S.E. of regression	1963.350	Durbin-Watson stat	2.058611

Fixed Effects Coefficients	
_CHEM—C	-18332.93
_FOOD—C	-16747.69

_INSURE--C	-8686.439
_MACH—C	-2889.883
_MANUF--C	-18101.57
_METAL--C	-9376.746
_REAL—C	-11662.22
_RETAIL--C	-12986.27
_WHOLE--C	-17049.97

The first thing we note about this final regression is that the signs on MC and ER are opposites. As we have mentioned, when MC and ER have opposite signs, then FDI flows are happening irrespective of either MC ratios or exchange rates. Also the sign on the WG variable is now incorrect, because it has changed to positive from negative. One the many changes we have made in this regression, however, is the inclusion of a lagged ER term. Because multinational companies may move slowly to react to market signals, the exchange rates in the past could have more explanative power than present exchange rates. The sign for the ER(-2) term is positive, and therefore consistent with MC term being positive. MC*ER is not negative however, which contradicts our model. Therefore, even the lagged ER term is not consistent with our hypothesis. The only coefficient sign that confirms our hypothesis, is the MC*ERVOL variable because it is positive.

Unfortunately, the second thing we should notice is that none of the coefficients are statistically significant at the 0.05 significance level except for MC*ER(-2) which now carries the wrong sign. Because there were serious problems with autocorrelation in other specifications, we added the autoregressive term AR(1) as a control. The Durbin Watson statistic is 2.097, showing that we have adequately controlled for autocorrelation. The AR(1) coefficient is also very significant, showing that it should remain in the model as a control for serially correlated residual values. This regression also corrects for heteroskedacity because there are several possible sources of inconstant variance. 1) Data entry errors: between 1980 and 1999 the trade classification systems changed dramatically, and it is likely that as categories changed, so has the variance. 2) Growth in trade between the US and a developing Japan, leads to growth in the variance of trade. For these reasons, we have corrected the regression with the White method. Also, the fixed effects coefficients are very unstable, as their signs and values change dramatically between different specifications. This seems to indicate that the model is unstable and not adequate at explaining the inflows and outflows of FDI.

Panel Regression 2: Major Manufacturing Sectors

Unfortunately, we are unable to estimate the same regression equation with tariff rates: FDI and tariff data are not always published for compatible industry classifications. Therefore, we are forced to explain the MC ratio, not FDI flows, in terms of tariff and exchange rates for only four of the industries within the manufacturing sector: Primary metal production (METAL), Miscellaneous manufacturing (MANUF), chemical production (CHEM), and industrial machinery (MACH). But how can we simply assume that the MC ratio and FDI flows are synonymous? They are not equivalent but they are definitely related, as we will see in regression 2 and the two equations model shown in the following section.

Throughout much of this paper, we have assumed that MNC's had a pre-existing orientation towards the domestic or export market; but there is no reason to suppose that a profit maximizing firm could not change its orientation over time to adjust to a changing environment. We can expect all firms to sell more domestically when exchange rates increase, because any sale will now yield more profit for the MNC in terms of the home currency. Any increase in the exchange rate should put upwards pressure on the MC ratio. Tariffs rates put similar pressure on the MC ratio because increased tariff rates will put upwards pressure on input prices for the production process. Those firms that are accustomed to exporting will now find that their products are less price-competitive because the cost of production has increased. Therefore, cost oriented firms will be more inclined to sell domestically; again we see that the tariff rate puts upwards pressure on the MC ratio.

But have we not just argued for an impossible circle? When tariffs and exchange rates increase, the MC ratio increases. When the MC ratio increases, the impact of tariffs and exchange rates will unambiguously increase the quantity of inflows of FDI. In this situation, any increase in tariffs and exchange rates will unambiguously increase FDI. To some degree, this may be true, but there are a number of provisos. 1) Tariffs and exchange rates do not always move in the same direction. 2) Firms *are* oriented towards the domestic or export markets. They are not likely to quickly change their orientation quickly, or in accordance with short run variables like exchange rates. All the same, we have made the relationship clear between the MC ratio, FDI inflows/outflows, and tariff and exchange rates. Assuming this relationship, we use a panel data regression with the following model to explain the MC ratio in terms of tariffs, exchange rates, and the FDI flows.

$$MC = f(ER, TAR, FDI) \qquad (23)$$

Or, to be more specific:

$$MC_{it} = \beta_0 + \beta_1 ER_{it} + \beta_2 TAR_{it} + \beta_3 FDI_{it} + \varepsilon \quad (24)$$

Figure 6: Panel Regression 2

Dependent Variable: MC
Sample: 1981 1989
Total panel (balanced) observations: 32
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficients	Standard Error	t-Statistic	P-Value
ER?	-0.000567	0.000252	-2.252774	0.0320
TAR?	-0.015049	0.028168	-0.534244	0.5972
FDI?	-6.51E-06	6.80E-06	-0.958133	0.3459

R-squared	0.618408	F-statistic	7.832894
Adjusted R-squared	0.539458	Prob(F-statistic)	0.000045
S.E. of regression	0.060547	Durbin-Watson stat	1.091326

Fixed Effects Coefficients	
_CHEM—C	1.042809
_MACH—C	1.044202
_MANUF--C	1.040266
_METAL--C	1.172173

We should first notice that every coefficient has the wrong sign. The expected values for ER and TAR were both positive, and insofar as ER and TAR raise the MC ratio, FDI should also increase in tandem with ER and TAR; all three independent variables should be positive. Furthermore, only ER is significant with a t-statistic of -2.25. When we look to the entire regression, we see that explanatory power of the equation is also poor. Although the f-statistic is significant, the adjusted R^2, at a value of 0.61, is poor for a time series panel regression. The Durbin-Watson statistic is showing signs of autocorrelation, although with only 32 observations and 8 years of data, an AR(1) term would only take away from the degrees of freedom. Again, we have a regression model that does not adequately explain the MC ratio, or FDI inflows/outflows.

4.2) A Three Equations Model

The unsatisfactory results of regressions one and two could be a result of endogeneity in the independent and dependent variables. In this section we develop a three equations model to explain and predict values for FDI, MC, and WGUS. Why do we need three equations? Not only can the MC ratio influence the relationship of tariff and exchange rates on FDI, but we should also consider how tariffs, exchange rates, and FDI influence the MC ratio. Furthermore, given our discussion regarding the Stolper Samuelson Theorem, we can expect the wages of a particular industry to be endogenous as well. How so? The existing wage rate in a country can have a strong influence on a firm's likelihood of investing. When the cost of labor is lower, cost of production is lower, profits are higher, and so is the incentive for direct investment. This is the reason why we included a wage ratio (WG) of US and Japanese industries. Even more importantly however, an increase in the wage rate of a particular industry will encourage a substitution of labor for capital. Or different types of labor and capital can become substitutes for each other; whether there is an exchange of foreign for domestic capital, or high for low skilled labor. These substitutions will be influenced and reflected in the capacity utilization rates and capital/labor ratios of an industry. We can expect to find these substitutions in the MC ratio of any given industry, insofar as this ratio reflects a firm's preference for either export or domestically oriented factors of production. For this reason we have included the US wage rate per industry (WGUS) into the MC equation. And yet, insofar as capital labor ratios and capacity utilization rates can influence WGUS and MC, there should be included another set of parameters to control for WGUS as a separate function. Therefore, we have three equations that collectively account for the changes in FDI, MC, and WGUS. These equations are shown below.

FDI = f(MC, WG, ER, ERVOL, TAR)
MC = f(ER, TAR, FDI, WGUS, KL)
WGUS = f(TAR, KL, CAP)

Or to be more specific:

$$FDI_t = \beta_0 + \beta_1 MC_t + \beta_2 WG_t + \beta_3 ER(-1)_t + \beta_4 ERVOL_t + \beta_5 TAR_t + \varepsilon \quad (26)$$

$$MC_t = \beta_0 + \beta_1 ER(-2)_t + \beta_2 TAR_t + \beta_3 FDI_t + \beta_4 WGUS_t + \beta_5 KL_t + \beta_5 KLCAP_t + \varepsilon \quad (27)$$

$$WGUS_t = \beta_0 + \beta_1 TAR_t + \beta_2 KL_t + \beta_3 CAP_t + \beta_4 T_t + \varepsilon \quad (28)$$

In contrast to our panel regressions, this model is estimated using the set of time series data belonging to a particular industry. Because of data restrictions, we are only able to estimate this model for the following industries: Primary and Fabricated Metals (METAL), Chemical production (CHEM), non-electrical machinery production (MACH) and miscellaneous manufacturing (MANUF). Also, because reliable data for TAR only spans between the years 1981 until 1989, the series of graphs shown below is limited to that time period. The results for the three equations regressed against the data for the four industries, are shown below in figure 4.

We should note a few interesting characteristics of the coefficients. 1) Because all of these industries are what can be called "market oriented" (with an MC ratio higher than 0.5), the coefficients for a particular variable across industries should be identical. With only a few exceptions, however, the coefficients for each variable across industries will change dramatically in size and value. 2) Few of the coefficients are significant. With the exception of WG in equation 1, or the coefficients in equation 3, all other variables are insignificant at the 0.05 level of significance. 3) We should note the positive coefficients on ER in equation 2. In contrast to our earlier findings in regression 2 where ER, TAR, and FDI were all negative, we now see at least a divergence of tariff and exchange rate influences. Although these findings are still contradictory to our model, they are still helpful for understanding the relationship between tariffs, exchange rates, and FDI, as we will discuss below. 4) We can assess the equations in general by looking first to the adjusted R^2 statistic. The R^2 is abysmal for the second equation, and even becomes negative for the CHEM regression. In equations 1 and 3, however, the regression equations explain an average of almost 70% of the variation of the dependent variable. As we have already remarked about the panel regressions, heterskedacity and autocorrelation are likely to be an issue. All of our regressions were corrected by the White method, and the WG equation includes a time trend variable. Unfortunately because there are so few observations, we were unable to include an autoregressive term to correct for autocorrelation.

Figure 7: Regression Results for FDI, MC, and WGUS Equations

	Variables											*Adj R^2*
	Equations	MC	WG	ER	ERVOL	TAR	KL	WGUS	FDI	CAP	KLCAP	T	
Equation 1	CHEM	-2881.1	-890.93	-12.225	10.636	-301.48							0.7735
FDI		(-0.5396)	(-2.7984)	(-1.8456)	(0.1141)	(-0.7477)							
	METAL	-115422.0	-4702.41	-6.8911	158.71	3592.44							0.8799
		(-1.18028	(-3.21959)	(-0.2216)	(0.7599)	(1.1226)							
	MANUF	-12545.7	-584.77	13.27	81.726	-1057.6							0.4452
		(-0.9475)	(-1.4710)	(2.414)	(1.0681)	(-0.961)							
	MACH	-14935.1	-9704.1	-22.258	227.05	4163.79							0.8789
		(-0.2266)	(-6.6350)	(-0.2967)	(0.7169)	(0.4205)							
Equation 2	CHEM			0.0064		-0.5795	-2.8056	-0.0661	0.0002		-0.0189		-0.057
MC				(1.2524)		(-1.3881)	(-1.4554)	(-1.44)	(1.1407)		(-0.6224)		
	METAL			0.0001		0.0532	-0.0092	-0.0022	-1.71E-06		0.0004		0.7298
				(0.6035)		(0.7144)	(-0.7010)	(-0.6011)	(-1.3051)		(0.7864)		
	MANUF			0.0007		-0.0209	0.0159	0.0152	-1.11E-05		-0.0009		0.1194
				(1.8553)		(-1.4981)	(0.4811)	(0.9258)	(-0.6695)		(-0.4260)		
	MACH			0.0015		-0.2093	0.0316	0.0214	-4.06E-06		0.006607		0.5997
				(1.7262)		(-1.3197)	(1.058)	(0.978)	(-0.4583)		(0.7036)		
Equation 3	CHEM					-7.3799	-33.101			0.2900		2.8823	0.9544
WGUS						(5.2964)	(-12.979)			(1.7254)		(0.0000)	
	METAL					9.866	-1.964			0.3364		1.2184	0.853
						(1.754)	(-4.226)			(3.663)		(0.0000)	
	MANUF					1.1658	-1.5626			0.1996		1.4245	0.9879
						(6.9556)	(-32.628)			(3.1890)		(0.0000)	
	MACH					3.1395	-1.3489			0.3728		1.7499	0.9289
						(0.7002)	(-9.2129)			(3.1190)		(0.0000)	

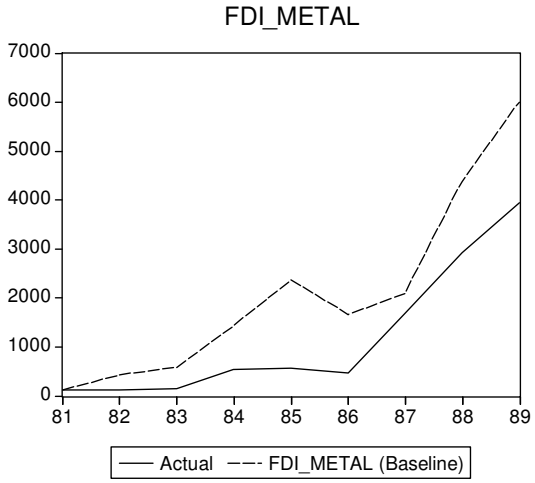
Graph Series 1:

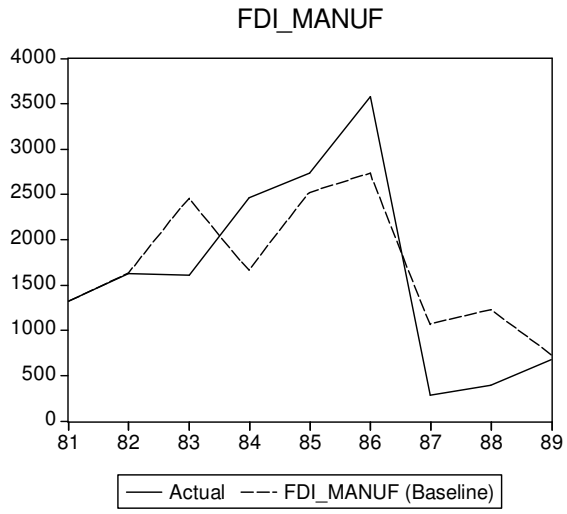
Although our regression results cannot confirm our theoretical model, we can refer to the series of graphs (figures 5-8), to see how well the model predicts changes in actual values of the dependent variables. When comparing the actual vs. baseline values for the model, the are some striking similarities.. The baseline solution will often follow the changes in direction of the actual values. Graph series 1 consists of 12 graphs: 3 dependent variables for each of the 4 industries.

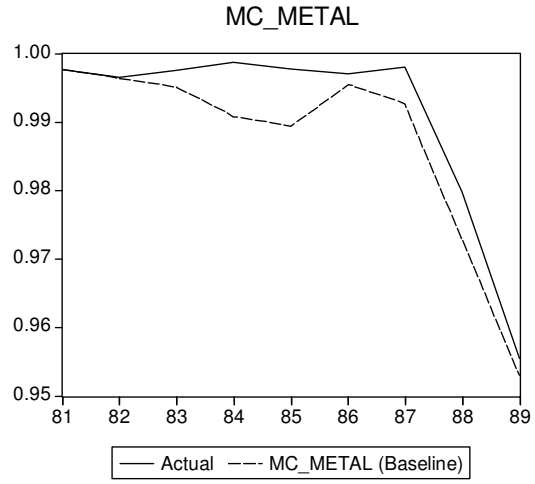
Graph Series 2 and 3:

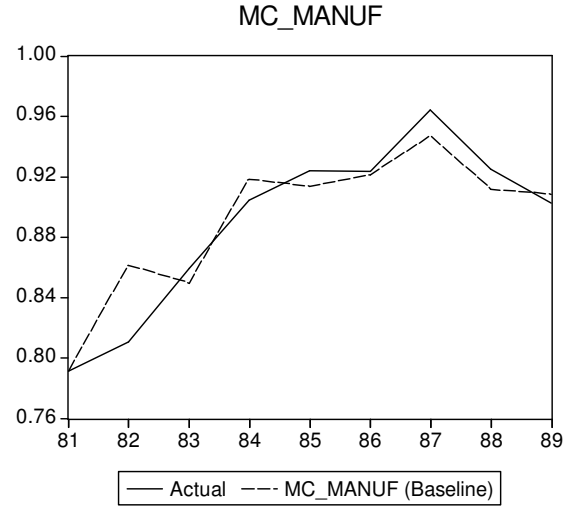
To test the responsiveness of this model to changes in the tariff and exchange rate, we have included graph series 2 and 3. In graph series 2, we show a comparison between the baseline regression and "scenario 1," which is the recalculated baseline values for a 30 percent reduction in the exchange rate. In graph series 3, we compare the baseline against "scenario 2," which the change from the baseline from a 30% depreciation of the exchange rate, *and* a 30% reduction in the tariff rate. Therefore, we can say that scenario 2 shows the impact of "trade liberalization" on four manufacturing industries.

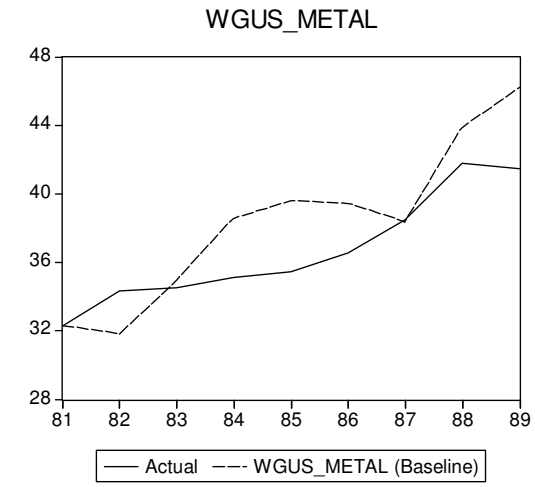
4.3) Baseline vs. Actual: Graph Series 1

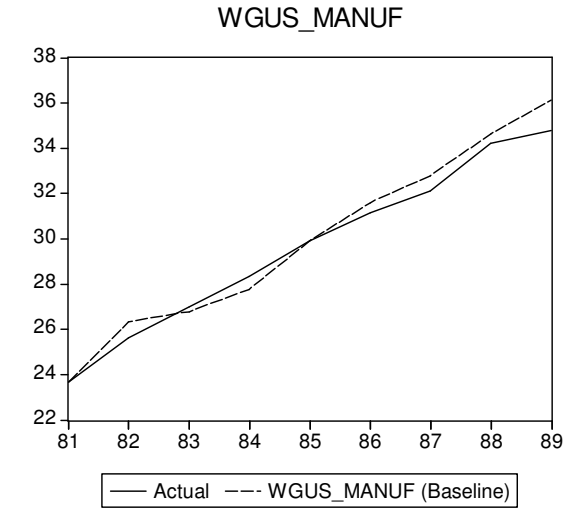


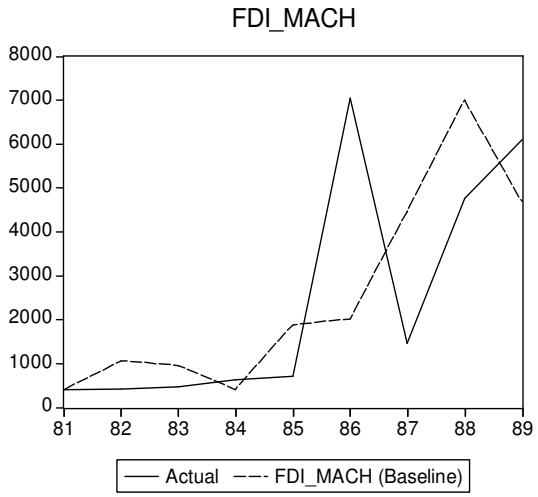


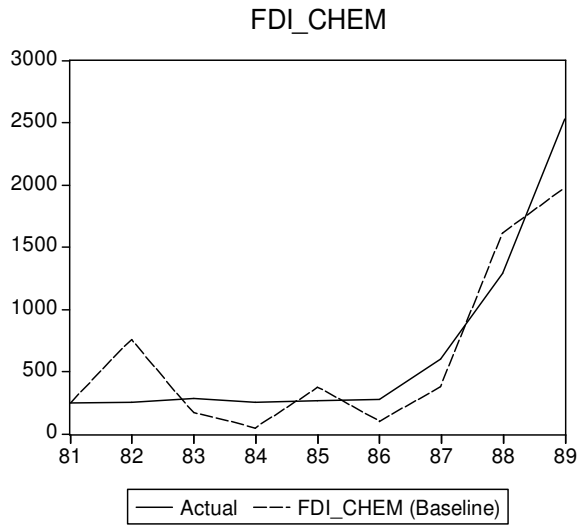


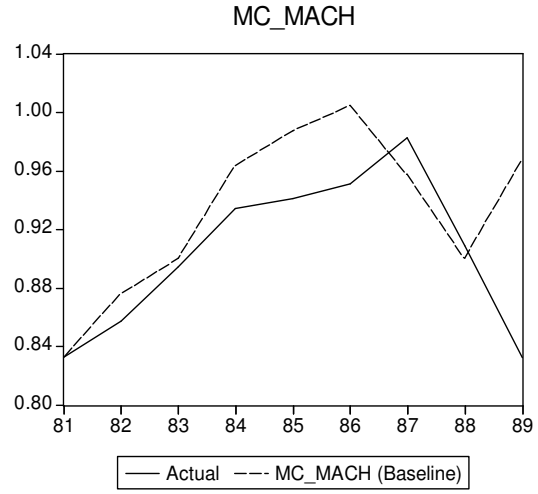


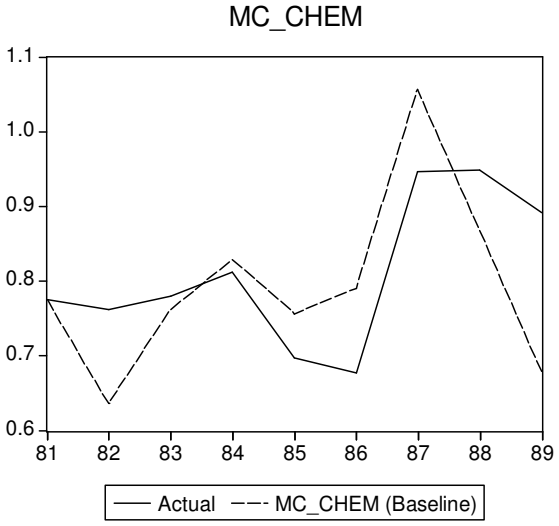


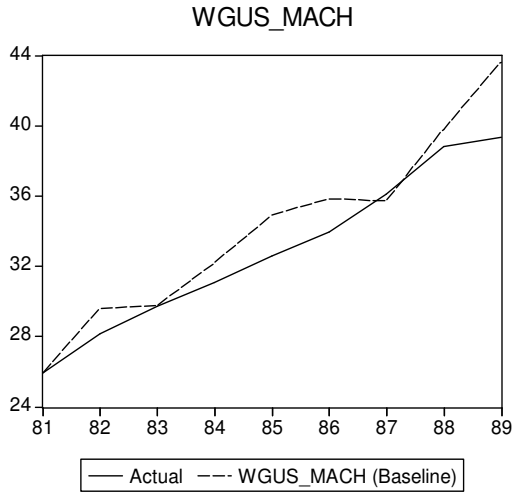


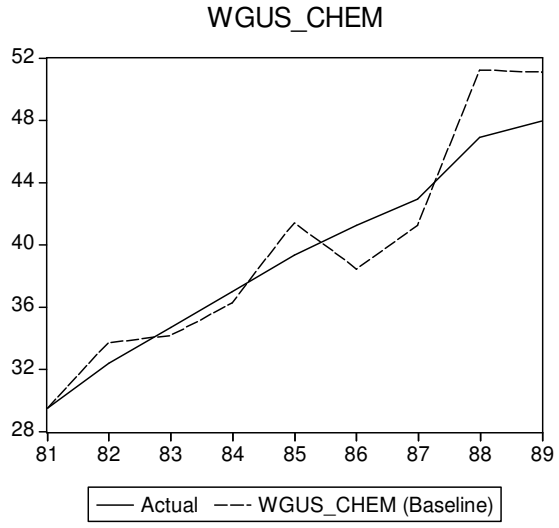

FDI_MACH
8000
7000
6000
5000
4000
3000
2000
1000
0
81 82 83 84 85 86 87 88 89
Actual
FDI_MACH (Baseline)


FDI_CHEM
3000
2500
2000
1500
1000
500
0
81 82 83 84 85 86 87 88 89
Actual
FDI_CHEM (Baseline)

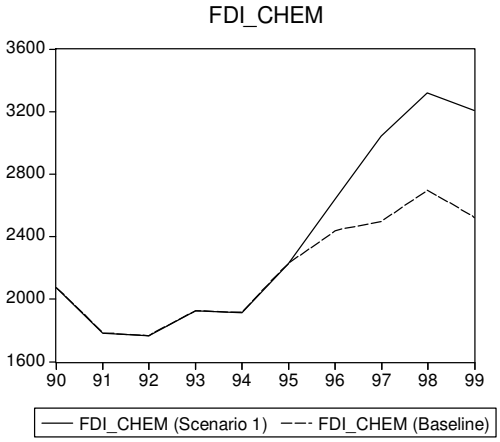

MC_MACH
1.04
1.00
0.96
0.92
0.88
0.84
0.80
81 82 83 84 85 86 87 88 89
Actual
MC_MACH (Baseline)

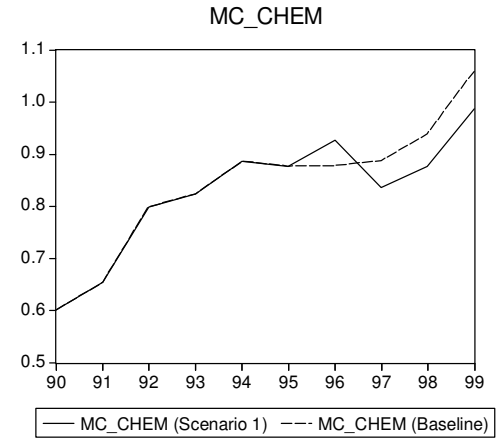

MC_CHEM
1.1
1.0
0.9
0.8
0.7
0.6
81 82 83 84 85 86 87 88 89
Actual
MC_CHEM (Baseline)

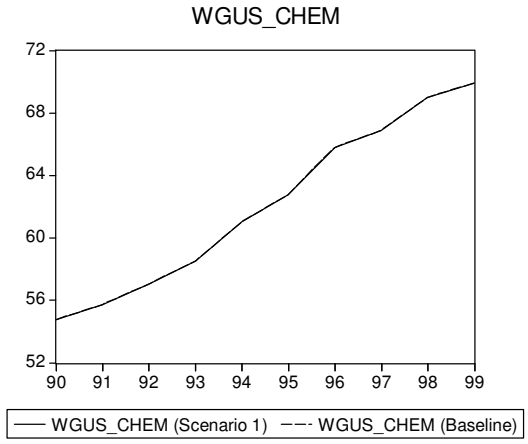

WGUS_MACH
44
40
36
32
28
24
81 82 83 84 85 86 87 88 89
Actual
WGUS_MACH (Baseline)

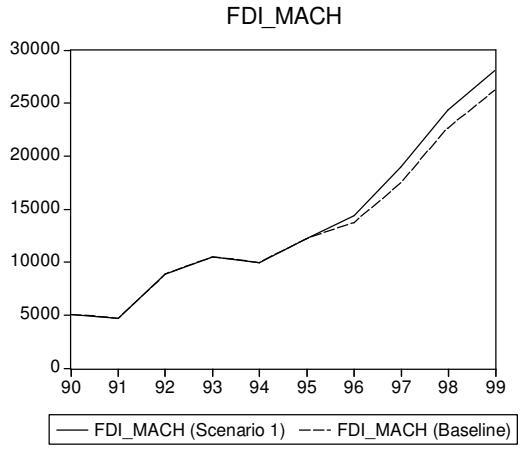

WGUS_CHEM
52
48
44
40
36
32
28
81 82 83 84 85 86 87 88 89
Actual
WGUS_CHEM (Baseline)

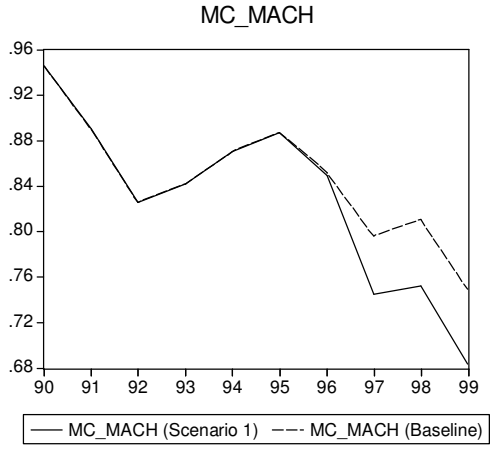
4.4) Policy Analysis of Exchange rate devaluation: Graph Series 2

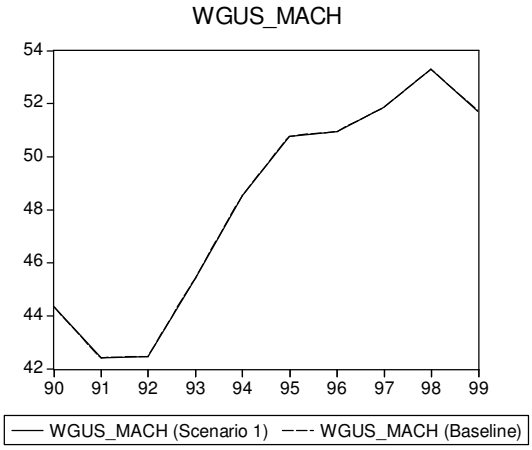


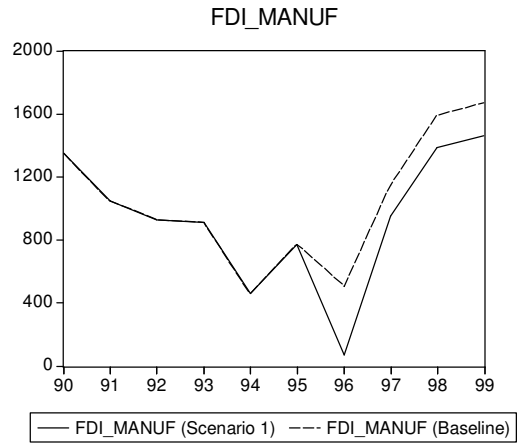


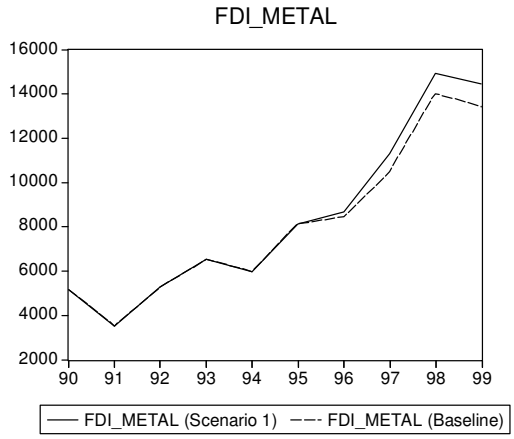


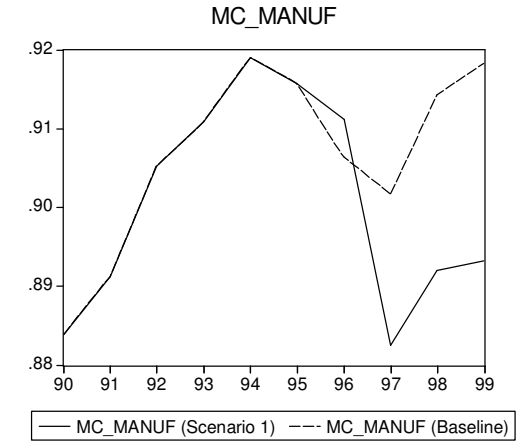


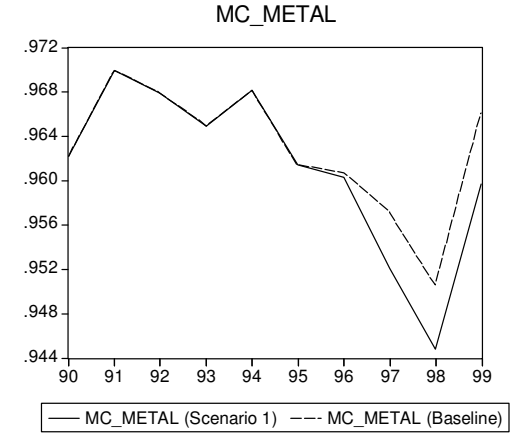


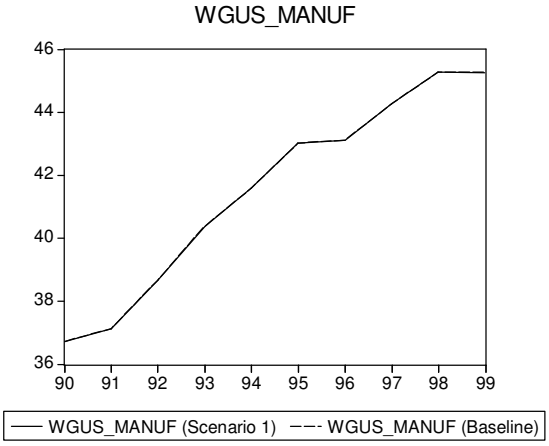


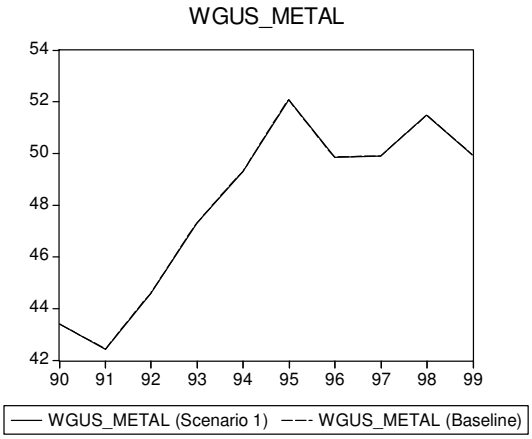

FDI_MANUF
2000
1600
1200
800
400
0
90 91 92 93 94 95 96 97 98 99
FDI_MANUF (Scenario 1)
FDI_MANUF (Baseline)


FDI_METAL
16000
14000
12000
10000
8000
6000
4000
2000
90 91 92 93 94 95 96 97 98 99
FDI_METAL (Scenario 1)
FDI_METAL (Baseline)

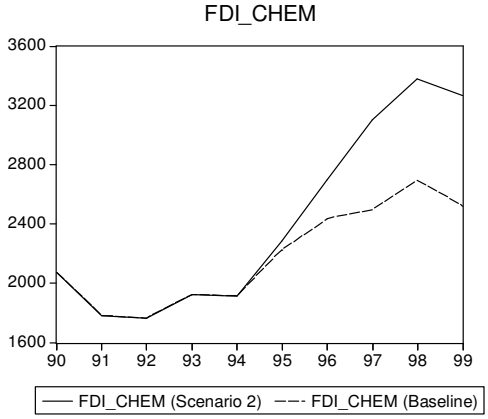

MC_MANUF
.92
.91
.90
.89
.88
90 91 92 93 94 95 96 97 98 99
MC_MANUF (Scenario 1)
MC_MANUF (Baseline)

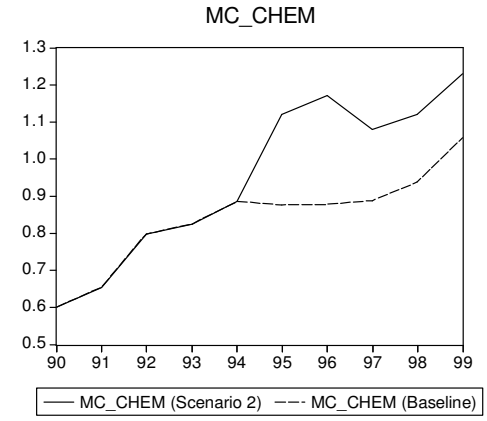

MC_METAL
.972
.968
.964
.960
.956
.952
.948
.944
90 91 92 93 94 95 96 97 98 99
MC_METAL (Scenario 1)
MC_METAL (Baseline)

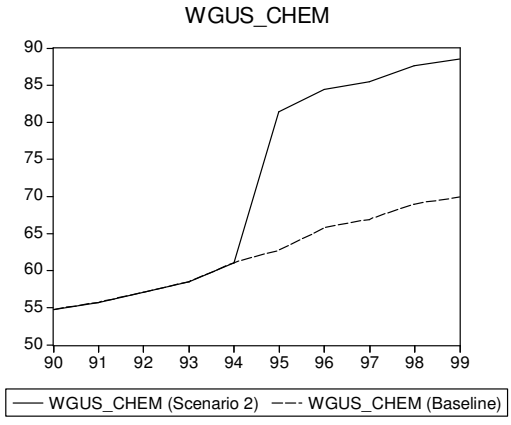

WGUS_MANUF
46
44
42
40
38
36
90 91 92 93 94 95 96 97 98 99
WGUS_MANUF (Scenario 1)
WGUS_MANUF (Baseline)

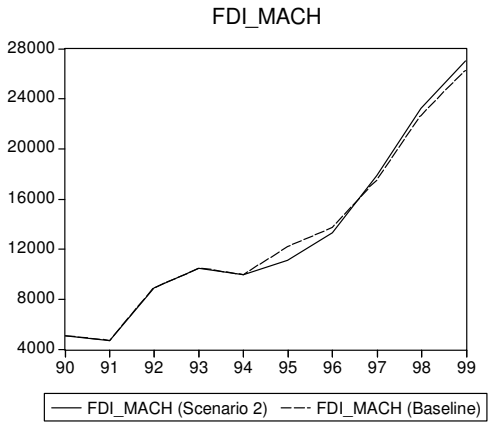

WGUS_METAL
54
52
50
48
46
44
42
90 91 92 93 94 95 96 97 98 99
WGUS_METAL (Scenario 1)
WGUS_METAL (Baseline)

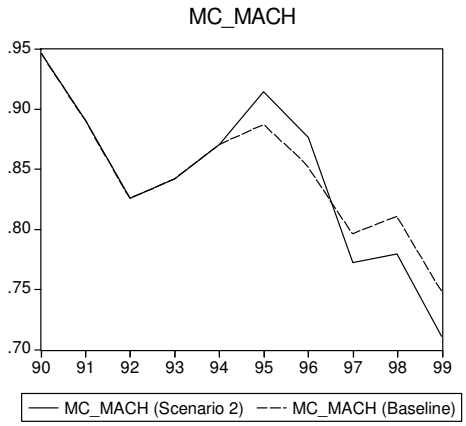
4.5) Policy Analysis of Trade Liberalization: Graph Series 3

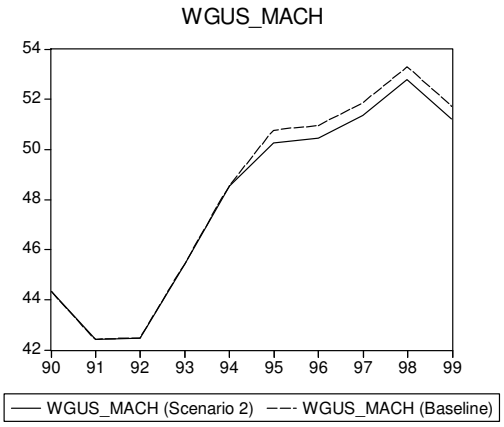


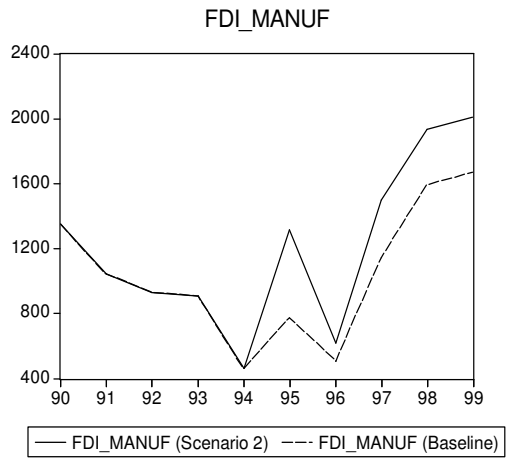


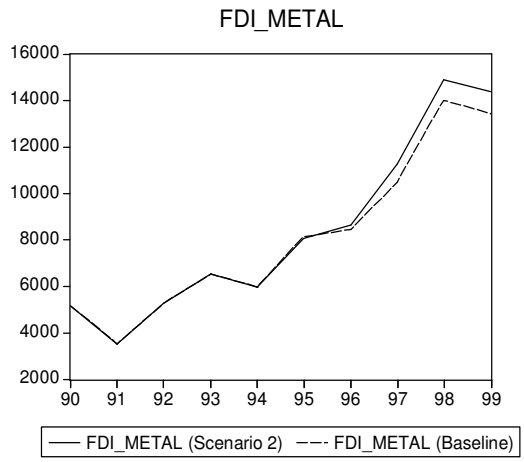


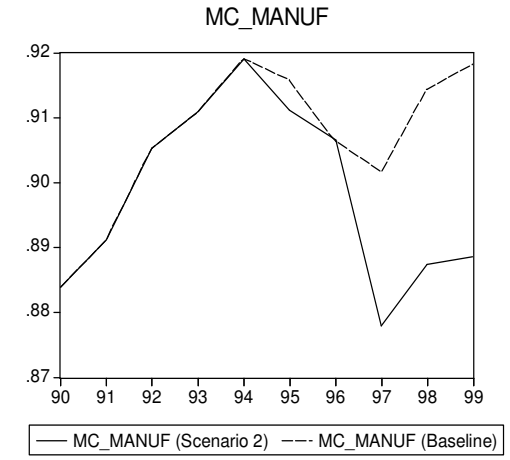


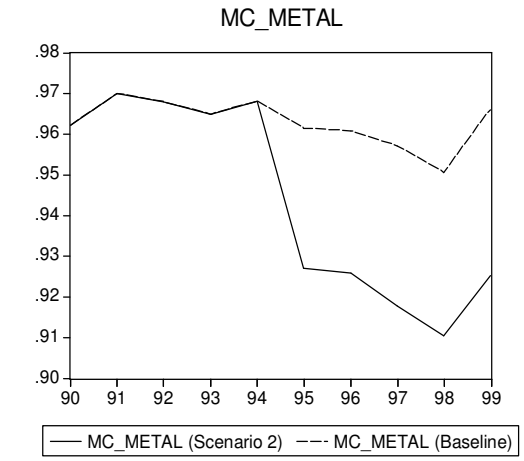


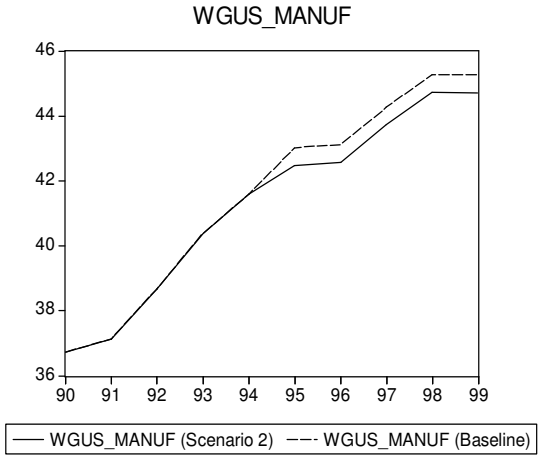


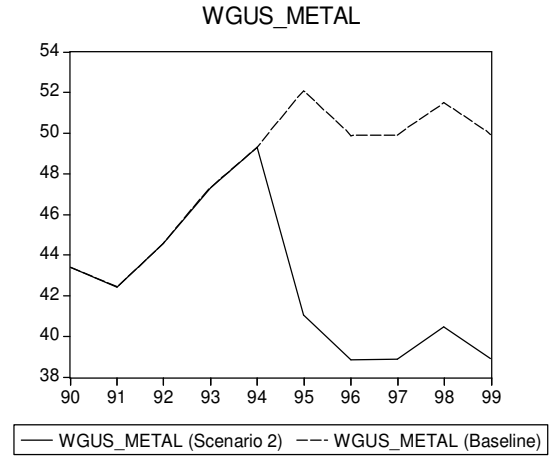

FDI_MANUF
2400
2000
1600
1200
800
400
90 91 92 93 94 95 96 97 98 99
FDI_MANUF (Scenario 2)
FDI_MANUF (Baseline)


FDI_METAL
16000
14000
12000
10000
8000
6000
4000
2000
90 91 92 93 94 95 96 97 98 99
FDI_METAL (Scenario 2)
FDI_METAL (Baseline)


MC_MANUF
.92
.91
.90
.89
.88
.87
90 91 92 93 94 95 96 97 98 99
MC_MANUF (Scenario 2)
MC_MANUF (Baseline)


MC_METAL
.98
.97
.96
.95
.94
.93
.92
.91
.90
90 91 92 93 94 95 96 97 98 99
MC_METAL (Scenario 2)
MC_METAL (Baseline)


WGUS_MANUF
46
44
42
40
38
36
90 91 92 93 94 95 96 97 98 99
WGUS_MANUF (Scenario 2)
WGUS_MANUF (Baseline)


WGUS_METAL
54
52
50
48
46
44
42
40
38
90 91 92 93 94 95 96 97 98 99
WGUS_METAL (Scenario 2)
WGUS_METAL (Baseline)

5.) Conclusions

There are few important things to note about these results. 1) We hypothesized that FDI and the MC ratio would always move in the same direction, while wages should follow FDI flows; both variables are linked to a firm's revenues and returns to investment. For most industries, however, the graphs show that FDI and MC move in opposite directions. Under exchange rate depreciation, or "complete liberalization," we can see that FDI usually increases, the MC usually decreases, and the wage rate usually decreases. These results can be explained by economic theory. When the exchange rate depreciates, domestic firms will find it cheaper to sell their products abroad; as they export more, the MC ratio will fall. Our theory differs insofar as we expected the fall in exchange rates and tariffs to also bring about a fall in the returns to investment for market oriented firms. For every fall in the exchange rate, the firms would suffer a loss of profits; because we implicitly assumed that the MC ratio was stickier than FDI inflows/outflows, we hypothesized that every exchange rate change would affect FDI flows more than the MC ratio. It seems, however, that firms are able to rapidly change the ratio of domestic to foreign sales, which allows them to avoid the losses in revenue from exchange rate changes. Therefore, when exchange rates depreciate, the MC ratio will decrease rather than inflows of FDI; foreign firms can become more export oriented in order to take advantage of the now cheaper US assets under exchange rate depreciation.

2.) Because our model does not include ER in the equation for the MC ratio, all the results for scenario 1 in Graph series 2 show that exchange rates have no influence on US wages. This is a limitation of our model. We predicted that exchange rates changes are too short term to directly influence wages, which reveals our assumption that wages are sticky in the short run. Rather than directly influencing wages, all short run changes in the exchange rate would influence US wages *via* the capacity utilization rate (CAP). We included tariffs (TAR) in the wage equation, because we assume that tariff rates change more slowly than exchange rates. Firms can makes plans for the future based on current values of the tariff rate, while they cannot do so for the exchange rate. In this model we assumed that all exchange rate changes would manifest themselves in the return to capital, which intern would effect the capacity utilization rate, and therefore US wages

Why do wages fall under trade liberalization? A standard response would be competition. Lower trade restrictions means that more firms are able to compete with each other on a level playing field. There is more competition, lower product prices, and therefore lower factor prices and wages. The Stolper-Samuelson theorem states that a reduction in the price of a good, will reduce the price of the factors of production used relatively intensively in the production of that good; as market sector goods become cheaper, so does labor. But in terms of our model, what does this mean? When wages follow the MC ratio, there are two possible implications.

1) When trade liberalization makes it more profitable to be export oriented, we predicted according to case 1, that 'cost sector capital' would become more expensive, which would encourage a substitution of cost sector capital for market sector capital. As we said, r(c) would increase, while the quantity of (r) decreased. The rental rates of market and cost sector capital are inversely related. These four industries are all market oriented, which means that under trade liberalization, we should expect the rental rates to decrease. And because the rents have decreased, wages have decreased. We see evidence for this in the positive relationship between CAP and WGUS; as capital becomes more 'utilized' and 'valuable,' so does labor. When market capital becomes less valuable, so does market sector labor and FDI should decrease; but this does not happen. Why does FDI not follow the MC ratio and wages? This brings us to the second possibility.

2) The elasticity of the MC ratio means that we cannot neatly distinguish between market and cost sectors. If there is difference in the factors of production between these two sectors, it is unobservable. Therefore, when there is trade liberalization, exporting becomes more profitable, all firms (even market-oriented firms) become more cost-oriented, and wages should increase. And yet we see that wages decrease when FDI increases! Perhaps we are seeing a situation similar to Case 2, in which the oversupply of foreign firms actually bids-down the price of labor. Because this FDI is coming because assets are less expensive (cost oriented), and not because a firms revenues have increased in terms of the home currency (market oriented), domestic wages are more contingent on world prices and world wages.

Therefore, although we cannot neatly distinguish between market and cost sectors, perhaps we should still think in terms or MC ratios, or being oriented towards the "market" or the "cost" benefits of investing in the host country. If trade liberalization re-orients domestic industries towards exporting, and exporting is always cost-oriented, we cannot then conclude that "cost-oriented" is synonymous with a "decrease in domestic wages."

This paper was not intended as an argument against 'liberalizing trade,' because most of the results are incomplete. There are a few avenues to expand our understanding of the relationship between the MC ratio, FDI, wages, rental rates, exchange rates, and tariffs. Firstly, we could investigate into the elasticities of the MC ratio and FDI flows with respect to changes in the tariff and exchange rate. Because these elasticities may differ between countries, industries, or industry sectors, this information may be useful when assessing the costs and benefits of a government trade policy. Secondly, we can include a fourth equation for the capacity utilization rate that is somehow dependent on the exchange rate. Thirdly, find data for the service sectors and other industries that are more export oriented. Unfortunately, nominal tariff rates do not apply to many of these sectors, so it may be difficult to positively identify the degree of trade restriction.

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7.) Appendix

A.1.) Case 2 and Factor Substitution

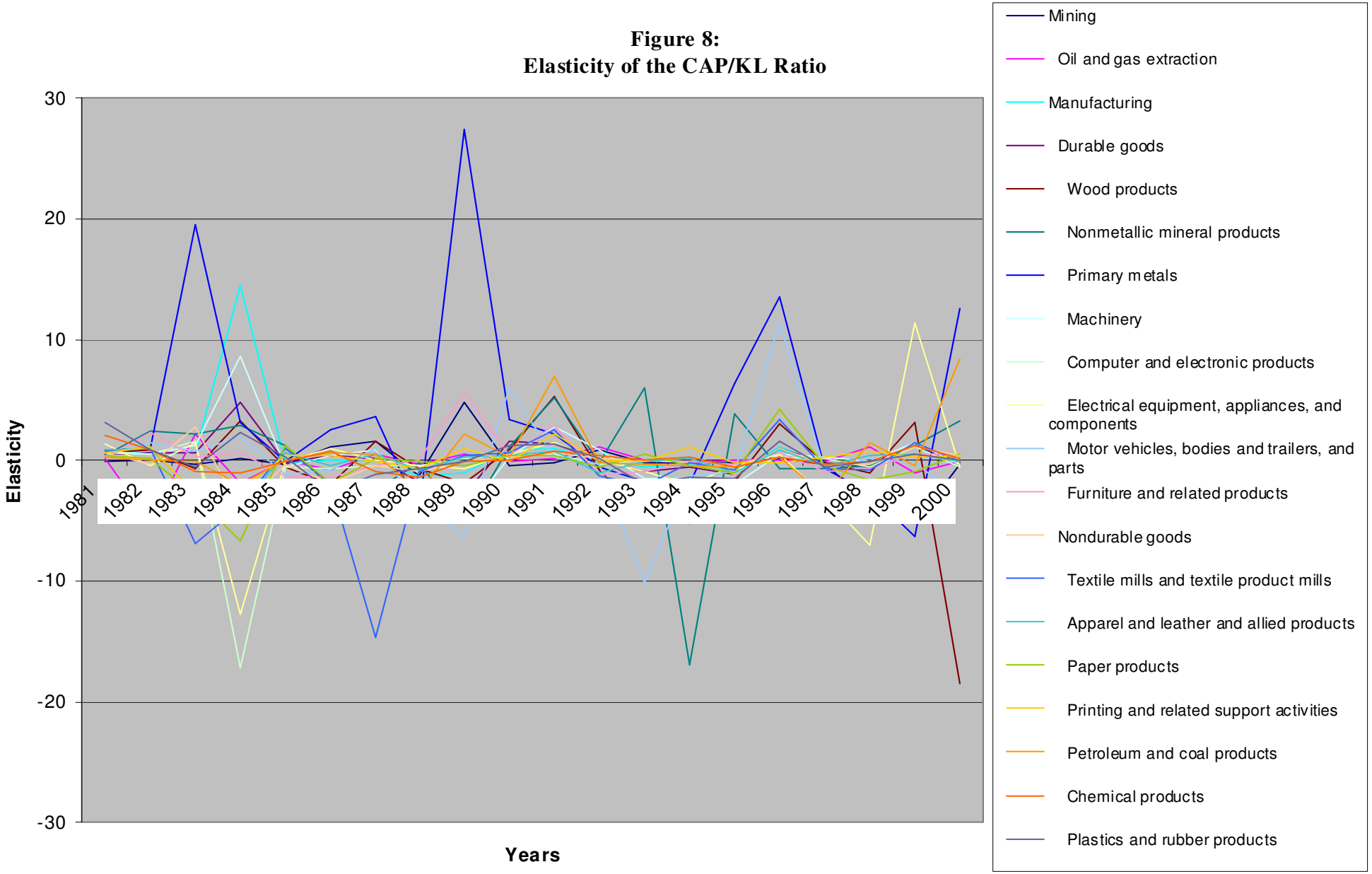
But what about Case 2? In section 3.4 we delineate some of the differences between Case 1 and Case 2. The most important distinction between cases, is the responsiveness of industries to follow incentives brought about by tariffs and exchange rates. For Case 1, when the sector is dominated by market oriented firms, and there is trade restriction, we can expect the rental rate of market sector capital to increase, and the usage (or share) of that capital should decrease. For Case 2 however, the rental rates should decrease (because there is an oversupply) and the share of market sector capital should increase. Therefore, looking at the elasticities of the share of capital with respect to the rental rate, we can determine the degree and direction of responsiveness to see if Case 1 or Case 2 dominates. The elasticity can be calculated by the following expression where KL_a is the average KL ratio for all observations.

$$\frac{(CAP_t - CAP_{t-1} / CAP_a)}{(KL_t - KL_{t-1} / KL_a)}$$

This expression is analogous to $\dfrac{\%\Delta r}{\%\Delta a_{it}}$

If these values are weak and negative for an industry, then that industry is following the prediction of Case 1. If the elasticity values are strong and negative, then that industry is following the predictions of Case 2. The results shown below in Figure 3, however, do not show any conclusive results either way. At a time when consistently negative values for the elasticity would confirm our hypothesis, we calculated both positive and negative values. Therefore, the data that we were able to include was not able to confirm the hypothesis.

Figure 8:
Elasticity of the CAP/KL Ratio



A.2.) Another practical application

In the introduction of this paper, we presented a problem: why have the wages of unskilled labor not shown a proportional increase with the demand for unskilled labor. According to the standard SS argument, a reduction in barriers of trade would balance the discrepancy in prices between trading nations. If textiles are an unskilled intensive good, we would expect the price of textiles to be lower in the developing nations, and higher in those that are developed; the opposite case should hold for the rental rates on machinery. A reduction in tariffs should equalize the prices of textiles between nations, forcing up the price of textiles and pushing down the price of machinery. This price increase will raise the value of the marginal product of unskilled labor, raise the wage and encourage more unskilled employment. If the factor content of the exporting sector is relatively unskilled labor intensive, the argument continues, then increased openness and exporting should raise the wage of unskilled labor, and close the wage gap. Wood (1997) presents an extensive review of literature on this subject, and cites a number of empirical papers that confirm the unskilled labor intensity of the export sectors. These papers however, are unable to confirm a closing wage gap in South America. While many Asian nations (such as the Tigers) show some upwards trend in the wages of unskilled labor, Mexico and South America continue to suffer a growing differential. This defies most standard explanations: minimum wages, union activity, political turmoil and differences in infrastructure have all been controlled for in the calculations.

What are some explanations? Latin America is better endowed with natural resources and land. 1) It could be that all manufacturing imports acted as substitutes in Latin America, whereas only skill intensive manufactures were imported as substitutes in Asia. Therefore, non-traded sectors in Latin America must be more skill intensive relative to the non-traded sectors in East Asia. This is one possibility that Wood calls "farfetched."[13] 2) Unskilled labor in Latin countries may be less mobile. 3) This may be the impact of technology biased trade, where openness also allows a nation to have access to technology, and in the interest of securing future growth, an economy will often foster biased growth in those high-tech industries. 4) The increased openness of third world nations since the 1960's has effectively flooded the world's labor market with unskilled workers. there is no easy linkage between trade openness and the differences that we can observe in the wage gaps of South America and Asia. This paper offers a fifth explanation. If Case 1 holds true in third world circumstances, then I argue that trade liberalization, in combination with the abundance of

natural resources and demand for goods in South America, fosters primarily cost-sector growth which may have been less skill-intensive given our discussion of the modes of entry and the characteristics of firms.

[13] Now, consider this argument carefully; the reasoning is very similar to what this paper contends, with one significant difference. According to Wood, wage gaps occur because of import competition in the sector that is most traded and least skilled.