Foreign Direct Investment and the Real Exchange Rate: The Business Cycle Link

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Using a Band Pass filter we examine the relationship between the real exchange rate and foreign direct investment (FDI) into the United States. By isolating the irregular (high frequency), business cycle (medium frequency), and trend (low frequency) components of the data and studying the correlations by frequency band, we find the two series are linked at the business cycle frequencies. This relationship holds whether or not relative wealth and relative labor cost variables are included in the analysis. Tests show that, unlike what is found in raw data studies, the business cycle relationship is statistically significant and stable across periods of analysis. Further analysis shows a significant relationship between FDI and lagged values of its determinants.

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1 Introduction

The relationship between the real exchange rate and foreign direct investment (FDI) has been the topic of much recent research. Using raw data, these studies (e.g. Cushman, 1988; Froot and Stein, 1991; Klein and Rosengren, 1994; Dewenter, 1995) have concluded that a depreciation in the United States dollar increases foreign direct investment (FDI) flows into the United States. Nonetheless, the relationship between real exchange rates and FDI should not necessarily exist over time; FDI exhibits trend growth and many believe real exchange rates fluctuate around long-run purchasing power parity.[1] These concerns are borne out empirically. Stevens (1997) finds regressions of FDI on the real exchange rate show evidence of serious instability and, the significant relationship between the series disappears for some periods of analysis. Similarly, using fixed-effect regression techniques of the type employed by Klein and Rosengren (1994), we illustrate strong evidence of temporal instability between FDI, the real exchange rate, a measure of relative net worth, and relative labor costs in the U.S. for various periods over the last twenty years.

Does the real exchange rate influence FDI? We resolve this "FDI puzzle" by analyzing data decomposed by frequency band. Using a Band Pass filter, we isolate the irregular (high frequency), "business cycle" (medium frequency), and trend (low frequency) components of both quarterly aggregate and country-specific data. By eliminating the slow-moving and the orthogonal high frequency components of each series, we find a significant, positive relationship exists between the real exchange rate and FDI at the business cycle frequencies.[2] More importantly, it is only at business cycle frequencies that a statistically significant and stable relationship is observed regardless of the sample period.

Our empirical investigation of the relationship between FDI and the real exchange rate incorporates two alternate theories: first, FDI flows are sensitive to movements in the real exchange rate through Froot and Stein's imperfect capital markets hypothesis. The second and more traditional approach suggests FDI may be affected by changes in relative net worth and relative wages. We show that there exists a statistically significant relationship between FDI, the exchange rate and net worth over time. Moreover,

[1] For an overview of the purchasing power parity literature see Rogoff (1996).

[2] We define the U.S. real exchange rate as the nominal U.S. dollar per unit of foreign currency multiplied by the ratio of foreign to U.S. price indices.

this finding is not sensitive to the period of analysis. Additional investigation points to a strong, dynamic relationship between FDI and lagged values of its determinants at business cycle frequencies.

The remainder of the paper is as follows: Section 2 describes the data and filtering methods. Section 3 tests for existence and stability of the relationship between the real exchange rate and FDI by frequency band. Here, like Froot and Stein and Stevens, we examine the series using aggregate data. In addition, we incorporate relative net worth and relative wages into an analysis focusing on country-specific FDI into the United States using panel data methods similar to those found in Klein and Rosengren. Section 4 explores the dynamic character of FDI at business cycle frequencies. Section 5 concludes.

2 Data and Filtering

2.1 Data

Our data consists of quarterly time series between 1977:1 and 1994:1. We consider both aggregate data and a panel consisting of Canada, Japan, and the United Kingdom, the three largest source countries of FDI into the U.S.. FDI is the total equity inflow into the U.S., including retained earnings and intercompany transfers. This is an appropriate measure of FDI since it includes all forms of investment between multinational parents and subsidiaries. There is ample evidence of coordination among multinational plants that is picked up in this measure of FDI. Lastly, we examine FDI normalized by U.S. GDP, a practice common to this literature.[3,4]

For aggregate data, the real exchange rate is the International Monetary Fund's MERM composite, a trade-weighted average of U.S. to foreign real exchange rates. Our real exchange rate, q, is the inverse of the MERM, $q = \frac{1}{MERM}$. This definition is consistent with the real exchange rate as discussed previously. Country real exchange rates are constructed by multiplying the U.S. dollar nominal exchange rate by the ratio of foreign to U.S. consumer price indices.

[3] Results are similar using real FDI instead of FDI/GDP. We report the latter to be consisten with previous literature.

[4] We make one break from existing literature insofar as we do not take logs of any variable. This is due to the fact that negative values sometimes occur in the specific country FDI series (indicating an outflow of FDI).

To measure relative net worth, we use the ratio of U.S. to foreign Morgan Stanley stock market indices calculated using returns measured in local currencies. An aggregate foreign net worth index was constructed by taking a weighted average of the Morgan Stanley indices of the top nine source countries of FDI into the U.S. between 1981-1985. Those countries are, in order of highest percentages of total transactions value: the United Kingdom, Canada, Japan, Australia/New Zealand, the Netherlands, Switzerland, France, Germany, and Sweden. Aggregate net worth was weighted according to this ranking. Finally, relative wages are measured using the ratio of U.S. to foreign real wage indices, constructed from series available from the United Nations and the International Monetary Fund.[5] We used the same country sample and weighting scheme to obtain an aggregate real wage index.

2.2 Band Pass Filtering

We take our data series and isolate the trend, business cycle and irregular components of the series by applying an approximate band pass filter, as described by Baxter and King (1995). We provide a brief explanation of this technique. First, note that the Cramer (frequency domain) representation of a stochastic time series, y_t, is:

$$y_t = \int_{-\pi}^{\pi} e^{it\omega} \varphi(\omega)\, d\omega, \tag{1}$$

where $i = \sqrt{-1}$ and $\varphi(\omega)$ is a complex random variable which is uncorrelated across frequencies, ω. Now, consider "filtering" this series. That is, create a new series, x_t, using an n-sided moving average with weights h_j:

$$x_t = \sum_{j=-n}^{n} h_j y_{t-j}. \tag{2}$$

One requires only that $\sum_{j=-n}^{n} h_j^2$ is finite. Substituting in y_t's Cramer representation in the above expression, one has:

$$x_t = \sum_{j=-n}^{n} h_j \left[\int_{-\pi}^{\pi} e^{i(t-j)\omega} \varphi(\omega)\, d\omega \right]. \tag{3}$$

[5] See the Data Appendix for a complete discussion of the data set.

After switching the order of summation and integration and some algebra, x_t can be expressed as:

$$x_t = \int_{-\pi}^{\pi} e^{it\omega} \sum_{j=-n}^{n} h_j e^{-i\omega j} \varphi(\omega) \, d\omega \tag{4}$$

Thus filtering reweighs the series y_t where the weight at frequency ω is given by the frequency response function, $\sum_{j=-n}^{n} h_j e^{-i\omega j}$. In the time domain, band pass filtering is accomplished by appropriately choosing weights as to isolate specific frequency components.

The "irregular component" of the data series is the high frequency movements in a time series between 2-5 quarters. "Business cycle frequencies" capture movements in the data between 6-32 quarters, the duration of business cycles isolated by NBER researchers using the methods of Burns and Mitchell (1935). "Trend frequencies" capture slow movements in the data of more than 32 quarters.

Before highlighting the results of the band pass filter, it is of some interest to distinguish the band pass filters from the most commonly used business cycle filter, the Hodrick-Prescott (HP) filter. For the purpose of isolating trend components in time series, both filters are essentially the same. The difference between the two lies in the remaining "business cycle component" of a filtered series. The HP filter is a "high pass" filter and only removes low frequency (trend) components. Thus, the HP "business cycle component" commonly found in the literature also includes a high frequency component; whereas, the band pass business cycle component removes high frequencies. We prefer the band pass filter since it eliminates the risk that transient noise might disguise the underlying business cycle components of the data. To be consistent with the majority of business cycle literature, however, we do report statistics calculated from data filtered in a manner comparable to that obtained using the HP filter.

2.3 Some Preliminary Evidence

Examining data filtered in this manner allows us to isolate certain regularities in a series that are not necessarily apparent when examining raw data. However, even when data has been linearly or HP filtered, an accurate picture of how two (or more) series are related is still uncertain due to movements in the data at irregular frequencies associated with seasonality, measurement error, or simply white noise. This should be especially true when examining highly volatile variables such as exchange rates which are extremely susceptible to high frequency movements. Indeed, we are much more confident in the strength of the relationship between the two series when considering only business cycle frequencies, relative to raw or detrended data. To illustrate, we plot a decomposition of the aggregate FDI and real exchange rate series in Figures 1 and 2. At first glance, there does not seem to be any obvious relationship between the series. Over the 1980's, the real exchange rate exhibits cyclic behavior, deviating from and returning to long run purchasing power parity. Conversely, FDI flows into the United States trend upward over the same period. Driven by the upward trend in both series over the latter half of the 1980's, the correlation between the two series is +0.41 over those years.

A relationship is no more clear when looking at the irregular and trend components of the two series, plotted in the bottom two panels of Figure 1. At irregular frequencies, the correlation between the real exchange rate and FDI/GDP is for all intents and purposes zero for the entire sample period. Trend frequencies tell a somewhat different story. Because of the previously mentioned trend in both series in the late 1980's, the correlation between the two series is +0.74 at trend frequencies. However, there is no *a priori* reason to believe this common trend is anything but temporary, a suspicion we confirm by looking at subsamples. For example, between 1984:3-88:2 (when the real exchange rate was increasing in value from its long run rate) the correlation between the two series is +0.98. However, between 1980:1 and 1984:2 (when the real exchange rate was falling from its long run level) this correlation is -0.51.

The relationship between the real exchange rate and FDI/GDP begins to manifest itself when we remove the trend component. The top panel of Figure 2 plots the two series with the trend component removed (this corresponds to HP filtered data).[6] Casual observation suggest some degree of comovement between the series. However, at +0.24, detrended data is less correlated than raw data is, suggesting irregular movements in the two series are mitigating their relationship. This suspicion is confirmed when one looks at the pure business cycle components of the series found in the bottom panel of Figure 2. The correlation between business cycle components is +0.40 during the 1980's, just as strong as that observed in raw data. Business

[6] This figure is similar in spirit to Froot and Stein's Figure 1.

cycle correlations are also consistent across various subperiods. For example, the correlations between FDI/GDP and the real exchange rate are +0.61 and +0.44 respectively for the 1984:3-88:2 and 1980:1-1984:2 sample periods previously mentioned.

3 Existence and Stability

A common concern found in this literature is the extreme sensitivity of the real exchange rate/FDI relationship to the sample period. Stevens (1997) shows, using aggregate, raw data, that this relationship does not statistically exist and is unstable for a variety of subperiods between 1973 and 1991. We also observe this difficulty when using panel data methods on an empirical model comparable to Klein and Rosengren (1994). However, by isolating the business cycle component, or to a lesser extent by detrending, we show the relationship between the series is temporally robust, regardless of data type. That is, the relationship between the real exchange rate and FDI statistically exists and is stable across subperiods.

3.1 Univariate Analysis

To illustrate, we estimate the following for aggregate FDI inflows into the U.S.:

$$\left(\frac{FDI}{GDP}\right)_t^f = \alpha_0 + \alpha_1 q_{t-1}^f + \varepsilon_{it}, \tag{5}$$

where q is the real exchange rate, f denotes the frequency band {raw, irregular business cycle, trend and raw-trend}, and ε is a possibly serially correlated error. When using raw data, we estimate two versions of this model; one including a linear time trend, the other without. The results reported for f = raw, i = aggregate, and including a time trend are consistent with both Froot and Stein (1991) and Stevens. Our primary focus is on business cycle frequency band.

We estimate the above equation using a Generalized Method of Moments-Instrument Variable (GMM-IV) procedure for our entire sample period and four other randomly chosen subperiods. We are interested in whether α_1 is significantly different from zero and if this relationship is sensitive to the time period of analysis. Although we are estimating filtered data, we do not, in general, have to worry about measurement error problems. This is because the adverse effects on the estimator is mitigated by removing the high frequency observations (Harvey, 1981). Even if there was measurement error, however, it would cause attenuation, biasing our estimate of α_1 towards zero. This possibility would therefore only strengthen any significant relationship we find between the series.

Table 1 presents these results. Raw data regressions suggest there is not a uniformly robust relationship between the two series. One immediately observes Stevens' critique: with the exception of the 1980:1-1991:1 and 1983:1-1989:1 periods, a relationship between FDI and the real exchange rate does not statistically exist when estimating (5) with a linear trend. These results improve somewhat by eliminating the trend but the previous conclusion remains—there is no consistent relationship between FDI and the real exchange rate over time.

By considering frequency bands we find the only stable link between the series exists at the business cycle frequencies. All the irregular frequency coefficients are, with one outlier, insignificant as expected. The trend coefficients are significant at 99% in all subsamples.[7] This is expected due to FDI flowing into the US over the entire sample and the real exchange rate appreciating over the same period. By simply detrending the data we find an insignificant coefficient over the full sample, but two significant coefficients in the subsamples. Nevertheless, it is only when we look at the business cycle frequencies do we find a robust relationship over time. Over the entire sample period and in all subperiods, we find all coefficients to be significant at the 99% level.

The stability of the business cycle relationship is further supported by Chow tests. Table 1 reports the results using the entire sample as the reference period.[8] First, when considering raw data, one immediately observes the Stevens critique. In three of four instances, Chow tests do not reject the null hypothesis of structural stability when using raw data and incorporating a linear trend. However, removal of the trend regressor explains these seemingly favorable results. Without a trend, none of the subsamples displays structural stability, suggesting that it is the trend term behind these findings.

[7] We are ignoring any stationarity issues which arise with using trend components.

[8] The null hypothesis we test is for coefficient equality in each subperiod relative to the entire sample. A significant F-statistic rejects the null hypothesis.

With one exception, Chow tests on frequency bands provide similar results. Irregular frequency coefficients are all stable at zero, an unsurprising result, and trend and HP-type regressions are uniformly unstable. Things improve markedly at business cycle frequencies, however. At business cycle frequencies, we find all coefficients to be stable relative to the full sample, regardless of subperiod. Hence only at the business cycle frequencies do we find a statistically significant relationship between FDI and the real exchange rate.

3.2 A Multivariate Model

There are two leading theories relating real exchange rates to FDI. The most common of these suggests that the real exchange rate affects relative labor costs and hence FDI. The notion is that capital flows adjust to movements in the real exchange rate since they alter the relative cost of production in a country. Thus, a depreciation of, say, the U.S. dollar, decreases relative labor costs in the U.S., spurring an FDI inflow. The second link between FDI and the exchange rate is through Froot and Stein's (1991) wealth hypothesis. Since a foreigner who wants to acquire an U.S. enterprise must make a bid for that facility in dollars, movement in the exchange rate alters the foreigner's dollar net worth, which affects the bid and FDI into the U.S.

Our empirical analysis of the above two theories is similar to Klein and Rosengren (1994), who use a raw data panel at annual frequencies. We consider a panel of the three largest contributors to U.S. FDI inflows—Canada, Japan, and the United Kingdom. As previously mentioned, we use quarterly data. In addition to the real exchange rate, we include a measure of relative net worth and relative real labor costs to our list of explanatory variables for FDI. Using fixed-effect techniques, we estimate the following model:

$$\left(\frac{FDI}{GDP}\right)_t^f = \beta_1 q_t^f + \beta_2 \left(\frac{NW}{NW^*}\right)_t^f + \beta_3 \left(\frac{w}{w^*}\right)_t^f + \varepsilon_t, \tag{6}$$

where $\frac{NW}{NW^*}$ is the real net worth in the U.S. relative to the foreign country, $\frac{w}{w^*}$ is the real wage in the U.S. relative to that of in the foreign country and the remaining notation is consistent with that of Section 3.[9] The net worth and wage data is discussed in Section 2 and in the Data Appendix. When

[9] Note that fixed effect models do not include a constant.

we use raw data, we again estimate versions with and without a linear trend. The results reported for f = raw are comparable to Klein and Rosengren.

Tables 2 and 3 report the results of estimating (6) using both raw and filtered data.[10] When examining the results in Table 2, one observes the same difficulty found in raw aggregate data manifesting itself in the panel model also when estimated using raw data. After finding significant coefficients on the real exchange rate, relative net worth, and relative labor costs over the entire sample, one observes that these coefficients are rarely significant over the same subperiods used in Section 3. In fact, both the real exchange rate and relative wage coefficients are only significant in one of four subsample regressions.[11] In the case of the significant real exchange rate coefficient in the 1980:1-1984:4 subperiod, it is of the wrong sign. The coefficient on relative net worth fares slightly better as it is significant in two of four subsamples. Chow tests also reject the notion of a stable coefficient vector and/or a stable real exchange rate coefficient over time when using raw data. These results illustrate that Klein and Rosengren's analysis is sensitive to their data period and again lead us to strongly doubt even the existence of a relationship between FDI and the real exchange rate in raw data.

The link between FDI and the real exchange rate is found once we consider the business cycle data. Additionally, we find support for the wealth hypothesis at the business cycle frequencies. Table 3 illustrates that in the business cycle frequency regressions the real exchange rate and relative net worth coefficients are significant and of the correct sign at 1% for both the full sample and in all subsamples. The real wage regressor is insignificant for the entire sample and although significant in the 1980:1-1984:4 subperiod, it has the wrong sign. Unfortunately, formal stability tests are disappointing as Chow tests reject stability in all subsample regressions. However, by excluding the real wage regressor we find stability of the entire coefficient vector for all business cycle subperiod regressions.[12]

[10]We do not include a discussion of the irregular and trend frequency results because of, as expected, the poor fit of these regressions.

[11]Since the FDI we are considering is occurring between developed countries, we do not expect relative wages to have much explanatory power. Thus, we do not view insignificant relative wage coefficients as especially problematic at any frequency band.

[12]Although stability results are improved by excluding the relative wage regressor, overall regresson results suffer. For additional information, see Appendix B, which contains additional tables of business cycle regression results obtained from estimating (6) after removing the relative wage regressor.

Finally, we report the results obtained by estimating (6) using data detrended in a manner similar to using the HP filter. These results support our view that it is of great important to eliminate both low and high frequency components when filtering the data. These results, again found in Table 3, illustrate that the irregular component acts to mask any relationship between FDI and its determinants: coefficient significance is rarely observed and Chow tests suggest that the coefficients are stable at a value of zero. In other words, the "true" relationship between FDI, the real exchange rate and relative net worth exists only at business cycle frequencies.

4 An Issue of Lags

We now turn to the dynamic relationship between FDI and the real exchange rate. Since capital investment is a long term process, it stands to reason that FDI today might be in response to past levels of the real exchange rate, relative net worth and relative wages. Indeed, Figure 3 suggests a lagged relationship between the business cycle components of FDI and the real exchange rate. Further cursory investigation of business cycle components of FDI and the real exchange rate also points to a lagged relationship between the two series, as seen in Figure X. Figure X plots the business cycle cross correlogram for date t FDI/GDP versus date $t+k$ real exchange rates, $k = -8, -7, ..., 7, 8$, for both aggregate and specific country data. As one observes, the business cycle correlation between the real exchange rate and FDI/GDP is strongest when we lag the real exchange rate approximately four quarters.[13,14]

To further examine this relationship we extend our regression equation

[13] Econometric tests confirm that the real exchange rate Granger causes FDI and not vice versa.

[14] An issue which might cause some concern in this context is the possibility that the filtering procedure might induce spurious cycles in the resulting data series. Perhaps the most famous example of this phenomenon is the Kuznets filter (Abramovitz, 1969), which (falsely) created twenty year cycles in the data. We are confident our methods avoid this pitfall as we find evidence of a lagged relationship between FDI/GDP and the real exchange rate in the raw data. Using raw data, Dewenter (1995) also finds similar evidence. Thus, the causal relationship between FDI/GDP and the real exchange rate is not being created as a result of filtering; rather, filtering is simply clarifing it.

(6) to include lags of all dependent variables:

$$\left(\frac{FDI}{GDP}\right)_t^{BC} = \sum_{j=0,1}^{J} \beta_{1j} q_{t-j}^{BC} + \sum_{j=0,1}^{J} \beta_{2j} \left(\frac{NW}{NW^*}\right)_{t-j}^{BC} + \sum_{j=0,1}^{J} \beta_{3j} \left(\frac{w}{w^*}\right)_{t-j}^{BC} + \varepsilon_{it}, \tag{7}$$

We estimate two versions of (7), one which includes lags and contemporaneous values of each regressor and one which only includes lagged explanatory. In each case, $J = 4$ lags were used. As reported in Table 4, the results of estimating (6) provide strong evidence of a dynamic relationship between FDI/GDP and its determinants. Regardless of what variant of the model was used, the real exchange rate regressors are significant at 1% for all time horizons. Examination of the relative net worth coefficients also points to a strong, dynamic relationship between the two variables. In fact, when we estimate (6) including contemporaneous regressors, we find that net worth only influences FDI with a lag. In addition, the relative net worth coefficients get larger over time, adding further credence to the lagged relationship. Finally, including lagged values of the relative real wage variable also helps us clarify the affect they have on FDI. In each case, the real wage coefficients are significant only after a two quarter lag and beyond.

One interesting result obtained from estimating these models are sign changes on a variable's coefficients over time. That is, we note the signs of coefficients changing depending on which lag is being observed. This, however, is theoretically problematic in only one instance. Assuming a one-time, positive shock to exchange rates, the net effect on FDI/GDP after four quarters, obtained from summing the real exchange rate coefficients, is approximately zero. Assuming a similar disturbance to relative net worth, FDI/GDP ultimately falls after one year, as expected. However, such a shock to relative wages (U.S. wages increase relative to foreign wages) results in increased FDI into the U.S. after one year. Although these results are somewhat troubling, they are not totally unexpected, given the business cycle results from the previous section.

5 Conclusion

Previous studies tying FDI behavior to the real exchange rate invariably face one major problem: the relationship between FDI and the real exchange rate does not and should not consistently exist in the raw data. This paper examines the often contentious relationship between the real exchange rate and FDI, using both aggregate and panel data. Following previous work by Stevens (1997), our analysis again casts serious doubt on the existence of a relationship between FDI and its determinants over time when using raw data. By using filtered data, however, we reconcile the link between these series in both aggregate and panel data. We demonstrate that a temporally robust relationship between the real exchange rate and FDI does exist at business cycle frequencies.

The link between the series at the business cycle is consistent with the wealth hypothesis developed by Froot and Stein (1991) and further examined by Klein and Rosengren (1994). We extend our business cycle analysis to include a more dynamic model of FDI and find that the real exchange rate, net worth, and to a lesser effect, relative labor costs significantly affect FDI at time horizons of up to one year.

Our results lead us to conclude that a consistent relationship does indeed exist between FDI and real exchange rates. However, this relationship is only to be found at business cycle frequencies. As a result, we believe frequency band analysis can therefore provide for more accurate predictions of FDI behavior as well as a better understanding of FDI actions as they occur relative to traditional raw data inquiries.

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A Data Appendix

Real Exchange Rates

The aggregate real exchange rate (q) used in this paper is the inverse of the MERM composite, a trade-weighted average of US/foreign real exchange rates. [1972:1-1994:1]

Individual real exchange rates for Canada, Japan, and the United Kingdom are defined by the appropriate U.S. nominal exchange rate multiplied by the foreign price index divided by the U.S. price index. The price indices used here are CPI data (1984=100). [1972:1-1994:1]

Sources: MERM: Citibase and IMF. Nominal exchange rates: Citibase. CPI data: Citibase and Directory of International Statistics (United Nations).

Foreign Direct Investment

Foreign direct investment flows into the United States, measured in billions of current dollars. Aggregate data [1972:1-1994:1] ; Country Specific [1976:1-1994:1]

Sources: Aggregate FDI: Citibase. Country specific FDI: Survey of Current Business.

Gross Domestic Product and Other Price Indices

United States current GDP, seasonally adjusted. Real FDI is constructed using the U.S. GDP deflator (1987=100).

Source: Citibase.

Wage Rate

Real Wage Index spliced with Earnings in Manufacturing Index

Sources: International Monetary Fund and United Nations, respectively.

Net Worth

Morgan Stanley Capital International data, an index created using local dollar returns.

Source: provided by Marianne Baxter and Urban Jermann.

B Additional Regression Results

This appendix contains the results obtained by estimating regression equation (6) excluding the relative wage regressor. Thus, our regression equation is:

$$\left(\frac{FDI}{GDP}\right)_t^f = \gamma_1 q_t^f + \gamma_2 \left(\frac{NW}{NW^*}\right)_t^f + \varepsilon_t, \tag{B1}$$

Notation corresponds to that found in Section 3 and results compare to Tables 2 and 3.

TABLE B.1
Fixed-Effect Regression and Stability Results for Aggregate Data Including Trend
(excluding relative wage regressor)

	q	*nw/nw**	*Trend*	*Chow*
80:1-91:1	1.76×10^{-6} (2.36×10^{-6})	-3.37×10^{-4}** (1.31×10^{-4})	2.95×10^{-8} (1.44×10^{-7})	
83:1-91:1	2.36×10^{-8} (2.04×10^{-6})	-2.20×10^{-4}* (1.12×10^{-4})	1.57×10^{-8} (1.54×10^{-7})	4.62
80:1-84:4	-2.03×10^{-5}** (8.19×10^{-6})	-9.09×10^{-4}** (2.39×10^{-4})	1.23×10^{-7} (4.87×10^{-7})	7.41
85:1-91:1	3.86×10^{-6} (2.81×10^{-6})	-5.80×10^{-4}* (1.50×10^{-4})	-3.31×10^{-8} (2.79×10^{-7})	12.82*
83:1-89:1	1.37×10^{-6} (1.95×10^{-6})	4.51×10^{-5} (1.55×10^{-4})	1.03×10^{-8} (2.03×10^{-7})	6.96

Fixed-Effect Regression and Stability Results for Aggregate Data
(excluding relative wage regressor)

	q	*nw/nw**	*Chow*
80:1-91:1	1.76×10^{-6} (2.40×10^{-6})	-3.34×10^{-4}** (1.25×10^{-4})	
83:1-91:1	2.77×10^{-8} (2.04×10^{-6})	-2.19×10^{-4}* (1.10×10^{-4})	3.14
80:1-84:4	-2.03×10^{-5}** (8.45×10^{-6})	-9.01×10^{-4}** (2.33×10^{-4})	8.83*
85:1-91:1	3.84×10^{-6} (2.73×10^{-6})	-5.81×10^{-4}* (1.50×10^{-4})	3.16
83:1-89:1	1.37×10^{-6} (1.93×10^{-6})	4.61×10^{-5} (1.52×10^{-4})	9.43*

NOTES:
1) White (1980) heteroskedasticity-corrected Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level
4) All Chow tests are performed by introducing a set of dummies and interactive dummies for the subperiods in question into the original equation. Joint significance of these new coefficients was then tested.
5) All stability tests are performed relative to the full sample, 1980:1-1991:1.

TABLE B.2
Fixed-Effect Regression and Stability Results for Business Cycle Frequencies
(excluding relative wage regressor)

	q	*nw/nw**	*Chow*
80:1-91:1	-4.82×10^{-6}**	-1.01×10^{-3}**	
	(2.19×10^{-6})	(1.25×10^{-4})	
83:1-91:1	-6.76×10^{-6}**	-1.14×10^{-3}**	1.58
	(2.51×10^{-6})	(1.94×10^{-4})	
80:1-84:4	-6.89×10^{-6}	-9.64×10^{-4}**	4.63
	(5.18×10^{-6})	(1.76×10^{-4})	
85:1-91:1	-6.55×10^{-6}	-1.20×10^{-3}**	6.89
	(6.57×10^{-6})	(4.64×10^{-4})	
83:1-89:1	-3.23×10^{-6}	-9.00×10^{-4}**	1.15
	(2.36×10^{-6})	(1.47×10^{-4})	

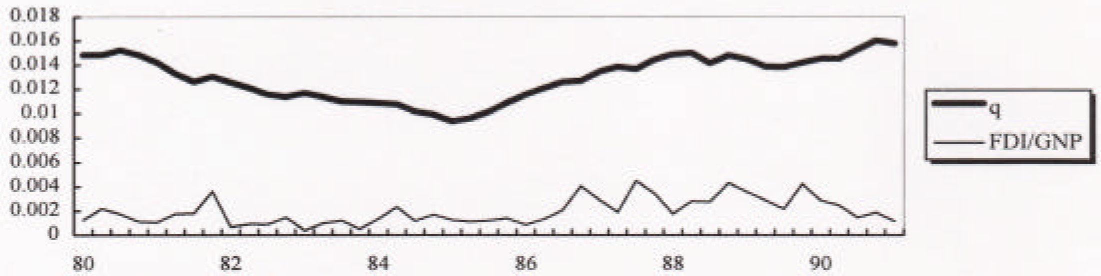
Fixed-Effect Regression and Stability Results for HP-Type Detrended Data
(excluding relative wage regressor)

	q	*nw/nw**	*Chow*
80:1-91:1	3.06×10^{-6}	-3.31×10^{-4}*	
	(2.88×10^{-6})	(1.35×10^{-4})	
83:1-91:1	1.25×10^{-7}	-1.77×10^{-4}	3.01
	(2.23×10^{-6})	(9.42×10^{-5})	
80:1-84:4	-1.96×10^{-5}*	-1.12×10^{-3}**	7.74*
	(9.75×10^{-6})	(2.56×10^{-4})	
85:1-91:1	3.75×10^{-6}	-4.72×10^{-3}**	3.20
	(3.31×10^{-5})	(1.53×10^{-4})	
83:1-89:1	1.24×10^{-6}	5.02×10^{-5}	8.50*
	(2.13×10^{-6})	(1.26×10^{-5})	

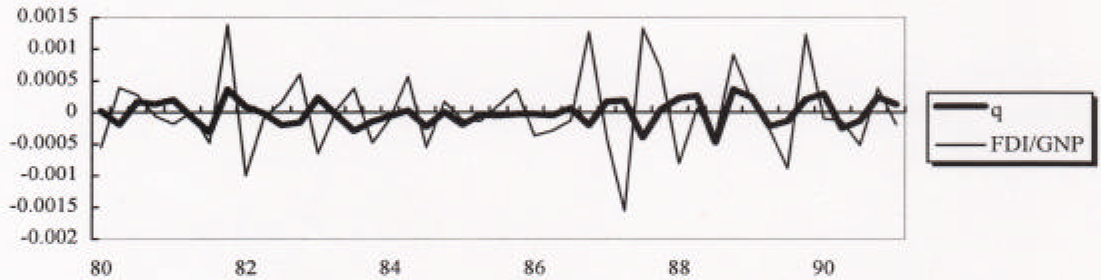
NOTES:
1) White (1980) heteroskedasticity-corrected Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level
4) All Chow tests are performed by introducing a set of dummies and interactive dummies for the subperiods in question into the original equation. Joint significance of these new coefficients was then tested.
5) All stability tests are performed relative to the full sample, 1980:1-1991:1.

Figure 1:
FDI/GDP and Real Exchange Rate
Frequency Band Components

Raw Data Correlation = +0.41



Irregular Correlation = -0.02



Trend Correlation = +0.74

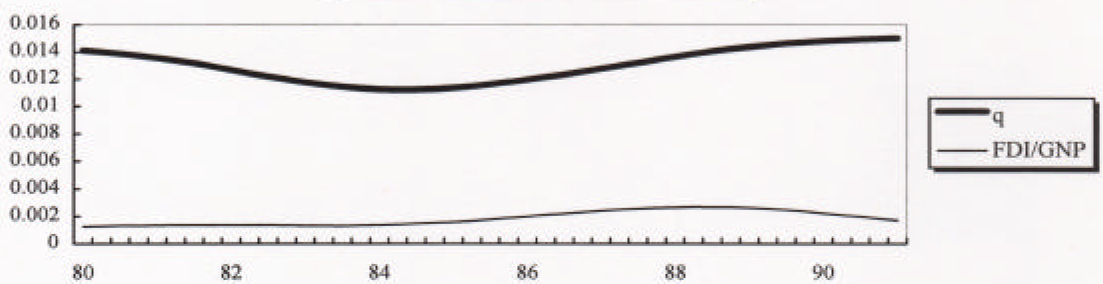
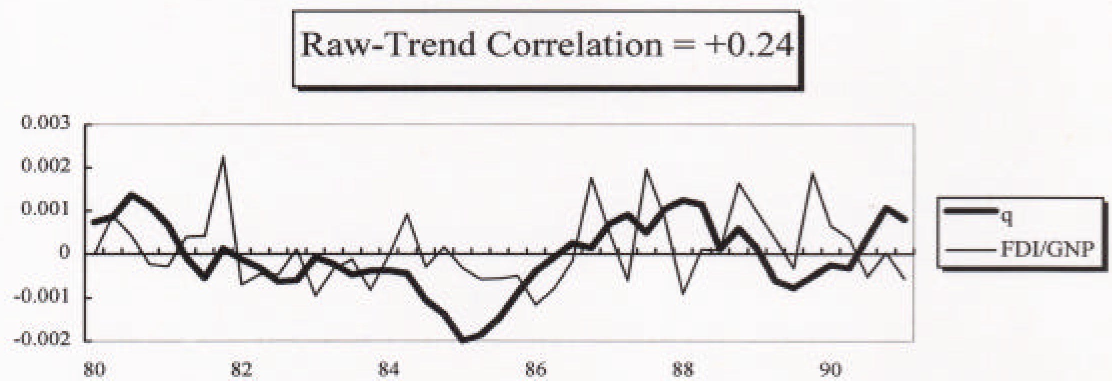


Figure 2:
Detrended FDI/GDP and Real Exchange Rate



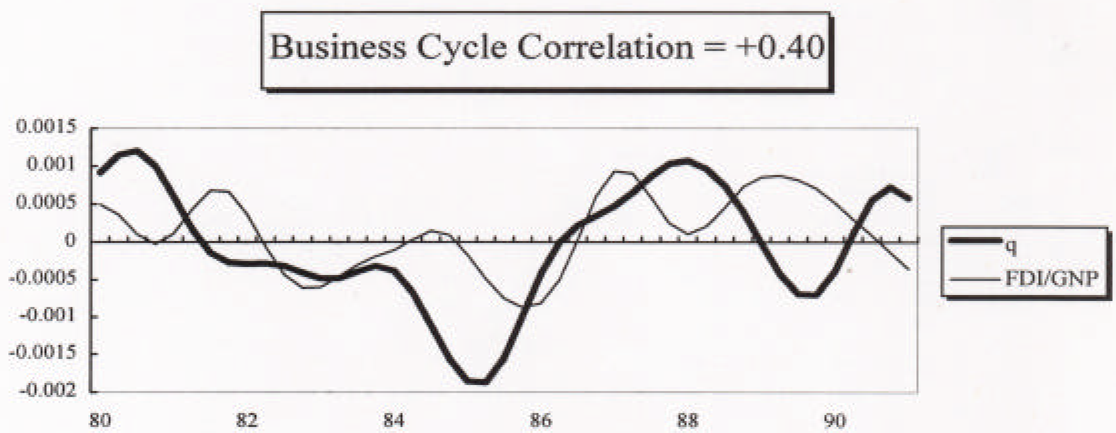


Figure 3:
Cross Correlogram of FDI/GDP and Real Exchange Rate at Business Cycle Frequencies

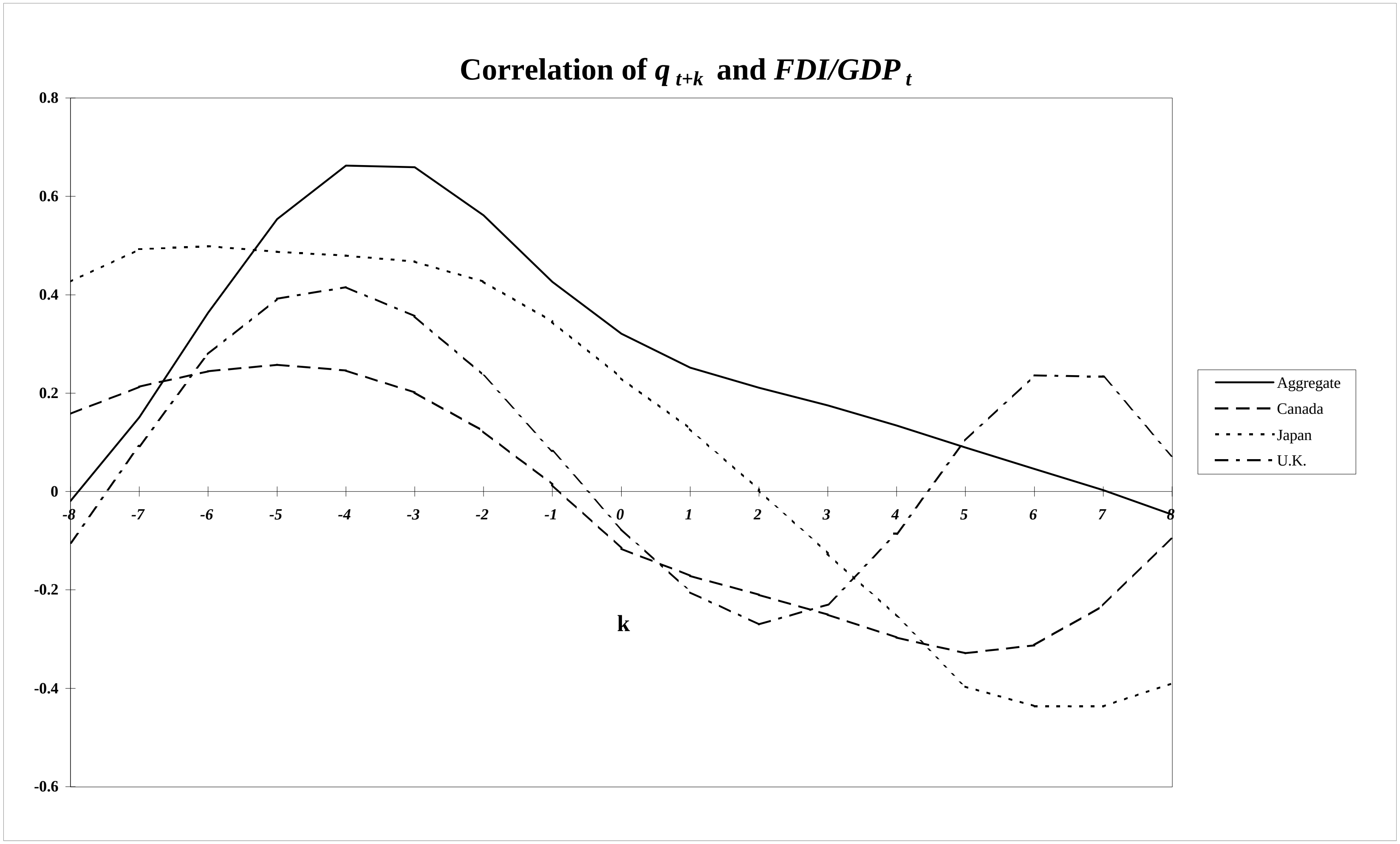


TABLE 1

Univariate Regression and Stability Results for Aggregate Data

Regression Coefficient on q_{t-1}

	Raw with Trend	*Raw*	*Irregular*	*Business Cycle*	*Trend*	*Raw-Trend*
80:1-91:1	.16**	.22**	-.81	.29**	.45**	.18
	(.07)	(.09)	(.80)	(.10)	(.07)	(.11)
83:1-91:1	.20	.31**	-.29	.34**	.56**	.28**
	(.13)	(.10)	(.36)	(.11)	(.07)	(.11)
80:1-84:4	-.14	.06	-1.29*	.29**	.34**	.01
	(.39)	(.04)	(.76)	(.08)	(.04)	(.05)
85:1-91:1	.41	.11	-.53	.12**	.63**	.04
	(.36)	(.27)	(.40)	(.05)	(.12)	(.27)
83:1-89:1	.18*	.46**	-.45	.42**	.55**	.44**
	(.11)	(.09)	(.57)	(.10)	(.07)	(.11)

NOTES:
1) GMM Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level

Chow Test F-Statistics

	Raw with Trend	*Raw*	*Irregular*	*Business Cycle*	*Trend*	*Raw-Trend*
83:1-91:1	.88	8.19**	.88	.69	13.77**	8.25*
80:1-84:4	3.10	13.28**	.37	2.57	14.17**	13.25*
85:1-91:1	3.11	14.81**	.39	2.58	14.19**	13.27*
83:1-89:1	12.57**	10.88**	2.13	2.13	3.78	8.51*

NOTES:
1) All Chow tests are performed by introducing a set of dummies and interactive dummies for the subperiods in question into the original equation. Joint significance of these new coefficients was then tested.
2) All stability tests are performed relative to the full sample, 1980:1-1991:1.
3) * = significant at 95% confidence level
4) ** = significant at 99% confidence level

TABLE 2
Fixed-Effect Regression and Stability Results for Raw Data Including Trend

	q	*nw/nw**	*w/w**	*Trend*	*Chow*	*Chow (q only)*
80:1-91:1	6.34×10^{-6}*	-4.49×10^{-4}**	1.70×10^{-3}**	1.64×10^{-8}		
	(2.18×10^{-6})	(1.34×10^{-4})	(5.54×10^{-4})	(1.42×10^{-7})		
83:1-91:1	1.69×10^{-6}	-1.89×10^{-4}	9.04×10^{-4}	1.03×10^{-8}	14.61**	0.46
	(2.29×10^{-6})	(1.18×10^{-4})	(6.39×10^{-4})	(1.58×10^{-7})		
80:1-84:4	-2.07×10^{-5}**	-1.10×10^{-3}**	4.39×10^{-3}**	-2.78×10^{-8}	49.38**	13.40**
	(6.10×10^{-6})	(2.75×10^{-4})	(9.47×10^{-4})	(4.21×10^{-7})		
85:1-91:1	2.49×10^{-6}	-7.96×10^{-4}*	-1.02×10^{-3}	-3.43×10^{-8}	27.68**	4.13
	(4.28×10^{-6})	(3.39×10^{-4})	(1.66×10^{-3})	(2.65×10^{-7})		
83:1-89:1	-3.11×10^{-7}	1.23×10^{-4}	-1.14×10^{-3}	1.30×10^{-8}	17.10**	9.63**
	(2.13×10^{-6})	(1.38×10^{-4})	(8.56×10^{-4})	(1.91×10^{-7})		

Fixed-Effect Regression and Stability Results for Raw Data (excluding trend)

	q	*nw/nw**	*w/w**	*Chow*	*Chow (q only)*
80:1-91:1	6.53×10^{-6}*	-4.48×10^{-4}**	1.70×10^{-3}**		
	(2.83×10^{-6})	(1.30×10^{-4})	(5.54×10^{-4})		
83:1-91:1	1.69×10^{-6}	-1.88×10^{-4}	9.05×10^{-4}	14.42**	1.29
	(2.28×10^{-6})	(1.16×10^{-4})	(6.37×10^{-4})		
80:1-84:4	-2.07×10^{-5}**	-1.10×10^{-3}**	4.38×10^{-3}**	45.64**	41.67**
	(6.05×10^{-6})	(2.68×10^{-4})	(8.93×10^{-4})		
85:1-91:1	2.46×10^{-6}	-7.96×10^{-4}*	-1.02×10^{-3}	20.24**	2.13
	(4.17×10^{-6})	(3.36×10^{-4})	(1.66×10^{-3})		
83:1-89:1	-3.06×10^{-7}	1.24×10^{-4}	-1.14×10^{-3}	17.32**	11.78**
	(2.10×10^{-6})	(1.35×10^{-4})	(8.52×10^{-4})		

NOTES:
1) White (1980) heteroskedasticity-corrected Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level
4) All Chow tests are performed by introducing a set of dummies and interactive dummies for the subperiods in question into the original equation. Joint significance of these new coefficients was then tested.
5) All stability tests are performed relative to the full sample, 1980:1-1991:1.

TABLE 3

Fixed-Effect Regression and Stability Results for Business Cycle Frequencies

	q	*nw/nw**	*w/w**	*Chow*	*Chow (q only)*
80:1-91:1	5.21×10^{-6}**	-1.04×10^{-3}**	9.53×10^{-4}		
	(2.20×10^{-6})	(1.25×10^{-4})	(8.46×10^{-4})		
83:1-91:1	7.12×10^{-6}**	-1.13×10^{-3}**	-1.27×10^{-3}	18.36**	17.26**
	(2.66×10^{-6})	(2.06×10^{-4})	(8.95×10^{-4})		
80:1-84:4	3.54×10^{-5}**	-6.17×10^{-4}**	6.71×10^{-3}**	10.64**	5.60**
	(3.07×10^{-6})	(1.54×10^{-4})	(9.96×10^{-4})		
85:1-91:1	1.55×10^{-5}**	-1.62×10^{-3}**	-2.40×10^{-3}**	22.22**	12.09**
	(5.64×10^{-6})	(4.40×10^{-4})	(8.22×10^{-4})		
83:1-89:1	1.31×10^{-5}**	-7.65×10^{-4}**	-3.32×10^{-3}**	23.18**	7.44*
	(2.70×10^{-6})	(1.16×10^{-4})	(8.07×10^{-4})		

Fixed-Effect Regression and Stability Results for HP-Type Detrended Data

	q	*nw/nw**	*w/w**	*Chow*	*Chow (q only)*
80:1-91:1	-2.59×10^{-6}	-9.04×10^{-4}**	2.04×10^{-3}*		
	(3.33×10^{-6})	(2.02×10^{-4})	(9.22×10^{-4})		
83:1-91:1	-1.08×10^{-6}	-5.96×10^{-4}	6.56×10^{-4}	26.97**	6.28*
	(3.66×10^{-6})	(3.22×10^{-4})	(1.03×10^{-3})		
80:1-84:4	-2.63×10^{-5}**	-7.86×10^{-4}	6.55×10^{-3}**	7.13	4.44
	(8.61×10^{-6})	(3.04×10^{-4})	(1.43×10^{-3})		
85:1-91:1	9.00×10^{-6}	1.17×10^{-4}	3.53×10^{-5}	13.05**	4.54
	(1.07×10^{-5})	(5.00×10^{-4})	(1.47×10^{-3})		
83:1-89:1	1.32×10^{-6}	-6.56×10^{-4}*	-8.57×10^{-4}	4.51	0.83
	(4.58×10^{-6})	(3.40×10^{-4})	(1.42×10^{-3})		

NOTES:

1) White (1980) heteroskedasticity-corrected Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level
4) All Chow tests are performed by introducing a set of dummies and interactive dummies for the subperiods in question into the original equation. Joint significance of these new coefficients was then tested.
5) All stability tests are performed relative to the full sample, 1980:1-1991:1.

TABLE 4
Dynamic Fixed-Effect Regression Results for Business Cycle Data

Include Contemporaneous Values of Explanatory Variables

LAG	*q*	*nw/nw**	*w/w**
0	-1.15×10^{-4}**	-5.30×10^{-6}	6.71×10^{-3}
	(1.40×10^{-5})	(8.23×10^{-4})	(4.66×10^{-3})
1	2.15×10^{-4}**	-7.33×10^{-3}**	-1.86×10^{-2}
	(4.69×10^{-5})	(2.55×10^{-3})	(1.45×10^{-2})
2	-1.87×10^{-4}**	1.68×10^{-2}**	3.94×10^{-2}**
	(7.03×10^{-5})	(3.38×10^{-3})	(2.00×10^{-2})
3	1.35×10^{-4}**	-1.50×10^{-2}**	-5.02×10^{-2}**
	(5.39×10^{-5})	(2.26×10^{-3})	(1.33×10^{-2})
4	5.10×10^{-5}**	4.90×10^{-3}**	2.54×10^{-2}**
	(1.86×10^{-6})	(6.83×10^{-4})	(3.60×10^{-3})

NOTES:
1) White (1980) heteroskedasticity-corrected Standard Errors in parantheses
2) * = significant at 95% confidence level
3) ** = significant at 99% confidence level
4) Because of degrees of freedom issues, model is estimated using only
the full data sample