Foreign Capital Inflows, Exchange Rates, and Government Stability

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Abstract

In theory, changes in a host country exchange rate can be a cause or consequence of changes in its level of foreign direct investment (FDI), and recent incidences suggest that government stability may have sizable implications for the interactions between FDI and the exchange rate. This paper uses a semiparametric system of simultaneous equations to empirically characterize the relationship between FDI and the exchange rate, with each country's level of government stability serving as a moderator. The results suggest that across developed and developing economies the most prevalent type of symbiosis between FDI and the exchange rate is a positive effect of FDI on the exchange rate, but no effect of the exchange rate on FDI. This significant FDI effect is heterogeneous, with an interquartile range of 1.241. At the median, a 10 percent increase in FDI inflows relative to GDP causes approximately a 13.29 percent increase in the annual change in the exchange rate. Government stability acts as a moderator variable by strengthening the relationship between FDI and the exchange rate in some countries, but eliminates the relationship in other countries.

Keywords: Foreign direct investment; exchange rate; government stability; symbiosis; parameter heterogeneity; semiparametric system of equations model.

JEL Codes: C14; C26; E02; F21; F31; O19.

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1 Introduction

A recent spate of incidences in government instability across the globe appear to have had implications for the interactions between exchange rates and FDI flows. For example, in early 2014, reports from different sources indicated that Ukraine was on the brink of an economic disaster and that the currency plunged amid political turmoil between Russia and the European Union. Between 2013 and 2014, estimates from the World Bank database suggests that Ukraine's local currency per US dollar depreciated by 48.7%, while its FDI net inflows (as a % of GDP) decreased by 1.82 percentage points. In August 2018, according to Bloomberg, the combination of political turmoil, hyperinflation, and years of disastrous polices in Venezuela led to one of the greatest currency devaluations in history – a 95% depreciation of the Bolívar (Venezuelan dollar). Meanwhile, the World Bank database shows that FDI net inflows plunged from 2.956 billion dollars in 2015 to -68 million dollars in 2017.

Conversely, Angola represents a valuable case of a resource-rich country that experienced a protracted government instability period and recovered well. After gaining political independence from Portugal in 1975, Angola erupted into a civil war that lasted for 27 years (1975-2002). Not surprisingly, the Angolan Kwanza (AOA) was highly unstable during the civil war years. The currency became effectively worthless, and the country introduced a new currency in the late 1990s. In the year 1999, the United States Dollar ($1.00) was worth AOA 2.80, and as of 2013, it was approximately US$1.00 to AOA 97.00. However, in the first decade after the civil war, the exchange rate was relatively stable compared to the rapid depreciation between 1999 and 2003. Angola became a major FDI player in its post-war period. UNCTAD's data records that Angola's inward stock of FDI almost quadrupled from 2002 to 2011. According to UNCTAD's (2017) World Investment Report, Angola boasts other feats such as being the largest recipient of FDI inflows in Africa in 2016, with a value of 14.4 billion dollars, and in the top 20 host economy in the world of FDI inflows in 2015 and 2016. So, Angola experienced political instability for an extended period. Subsequently, it moved towards a more stable political environment and achieved rapid growth in FDI inflows and a more stable currency.[1]

Do these incidences reflect an empirical regularity that government stability matters for the interaction between a host country's exchange rate and FDI inflows? This paper investigates empirically the interaction between FDI inflows and the exchange rate as well as the effects of variation in government stability across host countries in this relationship. Conceptually, there are six theoretical foundations of the FDI-exchange rate relationship – the traded and non-traded goods model (Bruce & Purvis 1984), the portfolio model (Branson 1977), the monetary approach to balance of payments model (Ffrench-Davis 1983, Corbo 1985), the strategic behavior of international firms model (Goldberg & Kolstad 1995, Sung & Lapan 2000), the imperfect capital markets theory (Froot & Stein 1991, Klein & Rosengren 1994), and the relative labor cost theory (Cushman 1985, Cushman 1987, Culem 1988). These theories have been developed to explain different countries' experiences with FDI flows and exchange rates, possibly stemming from differences between industrialized or non-industrialized nations or whether a country maintains a fixed or floating exchange rate; we provide a more detailed summary of these foundational theories in Section 2. And though few empirical papers examine the effect of FDI flows on exchange rates, the literature is replete with empirical studies showing that the exchange rate

[1]Based on World Bank data, between 2003 and 2013, Angola's economy grew at an annual average of about 10.3% relative to all of Sub-Saharan Africa which grew by an average of approximately 5.7%.

is a determinant of FDI inflows.[2] Furthermore, the impact of government stability on the relationship between the exchange rate and FDI inflows has not been analysed. Although anecdotal evidence strongly suggests that government stability can impinge on the symbiotic relationship between a host country's exchange rate and FDI inflows (if such a relationship exists), it need not be the case that the magnitude and role of government stability is likely to be homogeneous across countries.

We maintain that government instability can undermine the ability of national authorities to, in accordance with domestic goals, efficiently and effectively use flows from FDI to impact changes in the country's exchange rate and vice versa. Angola, once again, is an appropriate illustration: according to the 2004 IMF country report for Angola (IMF 2005), "... Directors commended the authorities for the improvements in macroeconomic management since the peace agreement." Additionally, it is challenging for FDI inflows in some host countries to redound to their benefit because there is a huge disparity in bargaining power between their governments and sender countries' investors. This disparity in bargaining power may be magnified in unstable host countries. Aleksynska & Havrylchyk (2013) lend credence to this scenario in their discussion on Chinese firms' choice of overseas investment location.

Government instability can also increase the costs borne by foreign investors. These costs need not translate into lower or no FDI inflows in an unstable host country, as large corporations with high potential tax revenues may parlay their local political capital to circumvent frictions in unstable host countries. In fact, drawing on UNCTAD's (2007) report on transnational corporations, Aleksynska & Havrylchyk (2013) highlight that firms from the South are largely state-owned and are therefore less sensitive to poor institutions in host countries than large private multinationals from the North; the presence of Chinese, Indian and Malaysian firms in Sudan provides a fitting example of such phenomenon. In addition, foreign investors may shift their preference from wholly-owned firms to joint ventures with local investors in an attempt to mitigate the added risk induced by government instability. However, in the absence of such risk-mitigation mechanisms, an increase in government instability may increase (or decrease) the strength of the symbiotic effect of changes in the exchange rate on FDI inflows.

To undertake our empirical analysis, we adopt the semiparametric panel model of a system of simultaneous equations put forward by McCloud, Delgado & Kumbhakar (2018) – hereafter MDK – which allows FDI and the exchange rate to be modeled jointly *and* uses instrumental variables to identify causal effects. The semiparametric nature of the MDK model stems from the assumption that the coefficients on all regressors in all equations are unknown smooth functions of a moderating index – here, government stability – and unobserved country- and year-specific factors (fixed effects). The joint modelling of FDI inflows and exchange rates allows us to discern whether the data are most consistent with some countries experiencing, for example, (i) exchange-rate-FDI mutualism – a positive effect of FDI on the exchange rate and a positive effect of the exchange rate on FDI – or (ii) FDI-commensalism – a positive effect of FDI on the exchange rate but no effect of the exchange rate on FDI.[3] Our modelling framework can be viewed as an empirical extension of the theoretical setting in Russ (2007) who argues that FDI and exchanges rates are jointly determined by underlying macroeconomic factors, and consequently exchange

[2]See, e.g., Froot & Stein (1991), Broll & Wahl (1992), Blonigen (1997), Cushman (1985), Campa (1993), Aizenman (1992), Goldberg & Kolstad (1994), Campa & Goldberg (1995), Kiyota & Urata (2004), Russ (2007), Udomkerdmongkol, Morrissey & Gorg (2009), Yu & Walsh (2010), Alba, Wang & Park (2010).

[3]Here, we avail ourselves of the symbiosis taxonomy in the biological literature to characterize the interactions between FDI inflows and changes in exchange rates.

rates are endogenous in FDI models. Russ (2007) develops a general equilibrium framework that links demand and the bilateral exchange rate to common underlying fundamental variables, thus capturing the multinational firm's reaction to the net effect that macroeconomic shocks have on both the exchange rate and sales overseas.

We fit the MDK apparatus to a panel dataset of 115 developed and developing countries over the period 1984 to 2010. The index of government stability comes from the International Country Risk Guide published by Political Risk Services, and is defined as "the government's ability to carry out its declared program(s), and its ability to stay in office". The index is the sum of three subcomponents – Government Unity, Legislative Strength and Popular Support – each with a maximum score of 4 points and a minimum score of 0 points; a score of 4 points equates to very low risk and a score of 0 points to very high risk. Consequently, this government stability index ranges from 0 to 12, with 0 representing low government stability and 12 representing high government stability. It is important to emphasize that a government must perform well in all three categories in order to have an overall high index value of government stability. Or, a government that performs well in two categories, but poorly in the third, will not be measured to have a high level of government stability. As we show in the data section of this paper, developed countries are not guaranteed a high score in this government stability index.

We see several important empirical conclusions regarding the types of symbiotic interactions that exist between FDI and the exchange rate, and the indirect effects of government stability on such interactions. We observe that across developed and developing economies, causal, heterogeneous *mutualism* and *FDI-commensalism* are the most dominant types of interaction between FDI and the exchange rate, indicating that FDI generally has a significantly positive effect on exchange rates but the exchange rate has either a significantly positive or insignificant effect on FDI inflows in most countries. We further find that government stability is an important source of heterogeneity in the FDI-exchange rate relationship, with approximately 8 points being an important threshold level of government stability. In light of Russ (2007), our empirical findings suggest that simultaneous effects of underlying government stability on demand and the exchange rate are important, and can dominate those effects from underlying macroeconomic variables. Our contribution complements the broader literature on political-economy determinants of FDI, and of exchange rates, their regimes, and policies.[4] Our modelling framework, however, accounts for both direct and indirect effects of institutions on FDI and changes in exchange rates.

We begin in Section 2 with a review of literature. Section 3 introduces the MDK semiparametric system of simultaneous equations model, which we use to examine the relationship between exchange rate, FDI and government stability. We provide our empirical system model and a description of our data, including the instrumental variables, in Section 4. We present our empirical results in Section 5, and conclusions in Section 6. Further technical details regarding the MDK model are placed in a technical appendix.

[4] Regarding the political economy determinants of FDI, see for example Schneider & Frey (1985), Hines (1995), Wei (2000), Harms & Ursprung (2002), Egger & Winner (2005), Egger & Winner (2006), Hakkala, Norbäck & Svaleryd (2008), Kolstad & Villanger (2008), Asiedu, Jin & Nandwa (2009), Faeth (2009), Javorcik & Wei (2009), Aleksynska & Havrylchyk (2013), Sánchez-Martín, de Arce & Escribano (2014), Akhtaruzzaman, Berg & Hajzler (2017) and the references cited therein; and for exchange rates, see Bodea (2015), Beckmann, Ademmer, Belke & Schweickert (2017), Beckmann & Czudaj (2017) and the references cited therein.

2 Literature Review

2.1 The Relationship between FDI and the Exchange Rate

As noted, the theoretical literature is undecided as to the nature of the relationship between FDI and the exchange rate. There are at least six competing theoretical frameworks that seek to explain the FDI-exchange rate relationship: the traded and non-traded goods model; the portfolio model; the monetary approach to the balance of payments model; the strategic behavior of international firms model; the imperfect capital markets theory; and the relative labor cost theory.

The traded and non-traded goods model maintains that an exogenous inflow of capital will lead a country's real exchange rate to either appreciate or depreciate, depending on whether the capital inflows are used to finance domestic spending or capital accumulation (Bruce & Purvis 1984). If capital inflows are used to finance domestic consumption, then FDI raises spending power and demand for both traded and non-traded goods, leading to a real exchange rate appreciation. If, instead, capital inflows finance capital accumulation in the non-traded sector in order to increase productivity, the real exchange rate will depreciate as the prices of non-tradable goods fall. Importantly, this model more generally applies to small countries that are price takers in the world market with normally low exchange rate volatility; this model also only works with FDI inflows, not net FDI inflows. The model was particularly popular among economists studying southern European countries in the late 1980s as characterized by large capital inflows and real exchange rate appreciation.

The portfolio model suggests that an excess liquidity of capital due to foreign investment pushes the domestic price level up, thereby increasing inflation that in turn leads to an appreciation in the real exchange rate (Branson 1977). The model is based on a background of financial and capital liberalization, and generally applies to countries characterized by low exchange rate volatility or to markets with fixed exchange rate regimes. Empirical effort using this framework includes Harberger (1985), who investigates massive capital inflows and exchange rate volatility in Chile.

The monetary approach to the balance of payments model, the strategic behavior of international firms model, the imperfect capital markets theory, and the relative labor cost theory, focus on the effect of the exchange rate on FDI, generally describing countries characterized by relatively high exchange rate volatility or with freely floating currencies. The monetary approach to the balance of payments framework holds that a real exchange rate appreciation associated with a current account deficit leads to foreign capital inflows, assuming that the exchange rate is the main instrument of monetary policy, the international capital market is liquid, and there are no barriers to capital inflows. The strategic behavior of international firms model suggests that a domestic exchange rate appreciation results in a large current account deficit. Under the fear of follow-up protectionism, such as an increase in tariffs, risk-averse international firms abroad are more likely to invest in these markets with capital instead of goods. In this case, an appreciation in the real exchange rate causes an increase in net FDI inflows. Different from the these two theories, the imperfect capital markets model and the relative labor cost model predict that a depreciation in the real exchange rate causes an increase in net FDI inflows. Froot & Stein (1991) connect the exchange rate with FDI in the context of capital market imperfections that cause external financing to be more expensive than internal financing, such that changes in wealth translate into changes in the demand for direct investment. By developing a model characterized by capital market imperfections, they find that a depreciation in the domestic currency (that causes the wealth of firms to fall) increases firms' demand for foreign capital. The relative labor cost theory focuses on the value of the currency during the floating exchange rate period among industrialized countries, such as US, Germany, or the UK. A depreciation of the domestic exchange rate is associated with relatively cheaper labor, in turn attracting more FDI.

Efforts have been made to empirically test the above theories and provide supporting evidence. Consistent with the theory of traded and non-traded goods, Giavazzi & Spaventa (1990) find that large foreign capital inflows have led to the real exchange rate appreciation in the southern European countries; and consistent with the portfolio model, evidence shows that FDI inflows cause a real exchange rate appreciation in financially liberalized countries, such as Spain (De Grauwe, Danthine, Katseli & Thygesen 1991), Chile (Harberger 1985) and Argentina (Edwards 1985). In terms of the exchange rate effect on FDI, Corbo (1985) finds that real exchange rate appreciation explains the huge foreign capital inflows into Chile during the 1977-1982 period, which is consistent with the monetary approach. In line with the strategic behavior model, Kogut & Chang (1996) find that Japanese multinational firms switch from support FDI outflows to inflows following an appreciation in the domestic real exchange rate. Finally, Klein & Rosengren (1994) provide empirical support of the imperfect capital markets model and Cushman (1985) provide evidence of the relative labor cost model, both of which suggest a domestic exchange rate depreciation leads to an increase in FDI among industrialized countries. This empirical backdrop provides a footing for us to explore these different theoretical links more broadly across a large sample of developed and developing countries, with government stability as a moderator.

2.2 Government Stability and Symbiotic Effects

Most researchers have focused on assessing the relationship between the exchange rate and FDI unidirectionally (in one direction or the other). Empirical work focusing on the bidirectional relationship between FDI and the exchange rate is limited, and most papers are either descriptive or are limited by taking a regional focus.[5] It is clear from the FDI-exchange rate literature that the relationship between the two is heterogeneous and complex, depending on a variety of factors, and in the introduction we have provided ample anecdotal evidence that government stability may serve as a moderating feature in this relationship. Additionally, our intuition for considering government stability as a factor governing the effect of FDI on the exchange rate can be motivated by the portfolio model and several theoretical and empirical monetary studies. According to Aisen & Veiga (2006), government stability is generally associated with price stability. In a more politically-stable economy, the domestic aggregate price level in the short-run tends to slowly adjust (or not adjust) in response to macroeconomic shocks. This in turn strengthens any effect of an FDI shock on real household balances and therefore increases the scope of such a shock in terms of the development of real effects on either domestic consumption or the real exchange rate. This hypothesis also resonates with several studies in the field of international economics; for example, Hau

[5]For instance, Kosteletou & Liargovas (2000) empirically examine causality between the exchange rate and FDI for 12 EU countries using a simultaneous linear equation model where FDI and the exchange rate are jointly determined. They find that in large countries with freely floating currencies causality runs from the exchange rate to FDI, but that causality runs both ways in small countries with fixed or "quasi" fixed currencies. While we also focus on bidirectional links between the exchange rate and FDI, in contrast to Kosteletou & Liargovas (2000), we do not restrict our attention to either a limited sample of countries or to a linear regression setup.

(2002) finds that the effect of trade openness on exchange rate volatility depends on a country's degree of government stability.

When it comes to FDI, a recent perception is that FDI is not only driven by macroeconomic stability (which includes inflation and the exchange rate), but also government stability in host countries. Empirical evidence on the effect of government stability on FDI has been mixed: for example, using cross-country data, Busse & Hefeker (2007), Asiedu (2006) and Wei (2000) find that government stability is a strong, positive determinant of FDI, though in a study of foreign investment in U.S. firms, Wheeler & Mody (1992) fail to find a significant link between these two factors. Therefore, it is important to account for government stability in our study of FDI, and more importantly, to treat it as a moderator via the coefficient functions rather than an additional regressor. Such a specification might provide a new explanation to these mixed findings of FDI.

3 The Semiparametric System of Simultaneous Equations Modelling Framework

We use the very general semiparametric simultaneous system of equations model put forward by MDK to extract empirical evidence on the types of symbiosis between exchange rate and FDI, and the extent to which government stability moderates this relationship. MDK develop a novel class of semiparametric estimators suited for obtaining consistent estimates from different formulations of the semiparametric simultaneous system of equations model. Details on the MDK estimators are included in the technical appendix. In what follows, we use the term *vector* to mean a *column* vector, unless otherwise stated.

To begin, consider in general form a bivariate semiparametric system of simultaneous equations

$$\begin{aligned} y_{1,it} &= Y'_{-1,it}\lambda_1(Z_{1,it}) + X'_{1,it}\gamma_1(Z_{1,it}) + \epsilon_{1,it} \\ y_{2,it} &= Y'_{-2,it}\lambda_2(Z_{2,it}) + X'_{2,it}\gamma_2(Z_{2,it}) + \epsilon_{2,it} \end{aligned} \tag{3.1}$$

for $i = 1, \ldots, N$, and $t = 1, \ldots, T$. In equation $j = 1, 2$, for cross-sectional unit i in time period t, $y_{j,it}$ is a scalar response variable, $Y_{-j,it}$ is a p_j-dimensional vector of endogenous variables that includes at least one $y_{j_1,it}$ with $j_1 \neq j$; hence, the presence of $Y_{j,it}$ in each equation renders the system non-triangular. In addition, $X_{j,it}$ is a k_j-dimensional vector of exogenous variables in which the first entry is equal to 1, $Z_{j,it} \in \mathbb{R}^{d_j}$ is a vector of exogenous variables, $\lambda_j(\cdot)$ and $\gamma_j(\cdot)$ are unknown Borel measurable functions of conformable dimensions, and $\epsilon_{j,it}$ is the idiosyncratic error term. Notice that, for the general derivation, we assume that the elements of $Z_{j,it}$ are continuously distributed; in practice, this assumption is easily relaxed to accommodate mixed categorical and continuous data using the important tools developed by Racine & Li (2004).

The maintained conditional moment assumptions for model 3.1 are that

$$E[\epsilon_{it}|Z_{it}] = 0,\ E[\epsilon_{it}|\widetilde{X}_{it}] \neq 0 \text{ and } E[\epsilon_{j,it}\epsilon_{k,it}|Z'_{it}, \widetilde{X}'_{it}] \neq 0, \tag{3.2}$$

where $\epsilon_{it} = (\epsilon_{1,it}, \epsilon_{2,it})'$, $Z_{it} = (Z'_{1,it}, Z'_{2,it})'$, and $\widetilde{X}_{it} = (\widetilde{X}'_{1,it}, \widetilde{X}'_{2,it})'$.

Our main interest is in the set of unknown coefficient functions $\{\lambda_j(\cdot)\}$, which clearly captures the types of interactions between the pairs y_j and y_{j_1} with $j_1 \neq j$. To characterize all interactions between any pair y_j and y_{j_1} with $j_1 \neq j$, we therefore follow MDK and borrow the ensuing taxonomy from the biological literature:

Definition 3.1. Let $l_j \in \{1,2\}$ and $\lambda_j(\cdot) = \{\lambda_{j,l_j}(\cdot) : \mathbb{R}^{d_j} \to \mathbb{R},\ l_j \neq j\}$. Assume that for cross-sectional unit i in time period t the effect of y_j and y_{j_1} with $j_1 \neq j$ can be *positive*, *negative* or *zero*, and *vice versa.* Between the pair of variables $(y_{j,it}, y_{j_1,it})$ we say there exists:

(a) *mutualism* if $\lambda_{j,j_1}(\cdot), \lambda_{j_1,j}(\cdot) > 0$;

(b) $y_{j_1,it}$-*commensalism* if $\lambda_{j,j_1}(\cdot) > 0$ and $\lambda_{j_1,j}(\cdot) = 0$;

(c) *synnercrosis* if $\lambda_{j,j_1}(\cdot), \lambda_{j_1,j}(\cdot) < 0$;

(d) $y_{j_1,it}$-*antagonistic symbiosis* if $\lambda_{j,j_1}(\cdot) > 0$ and $\lambda_{j_1,j}(\cdot) < 0$;

(e) $y_{j,it}$-*ammensalism* if $\lambda_{j,j_1}(\cdot) < 0$ and $\lambda_{j_1,j}(\cdot) = 0$;

(f) *non-symbiosis* if $\lambda_{j,j_1}(\cdot) = \lambda_{j_1,j}(\cdot) = 0$.

As mentioned in the preamble of this paper, plausible theoretical predictions are that the effect of FDI on the exchange rate *and* the effect of the exchange rate on FDI can be *positive*, *negative*, or *zero*. Moreover, within a country there can be *mutualism* between FDI and exchange rate in one time period, but *exchange rate-commensalism* in another time period as a result of, say, certain country-specific policies. Thus, this general taxonomy seems quite fitting for characterizing all possible theoretical interactions between FDI and exchange rate.

4 Empirical Model and the Data

4.1 An Empirical Simultaneous Model of Exchange Rate and FDI

We let $i = 1, 2, \ldots, N$ denote country index, and $t = 1, 2, \ldots, T$ denote the time period. Our empirical bivariate semiparametric system of equations model allows for the change in exchange rate, ΔEX_{it}, and FDI inflows, FDI_{it}, to be modeled simultaneously in the following way:

$$\Delta EX_{it} = \Delta EX_{i,t-1}\lambda_{0,1}(Z_{it}) + FDI_{it}\lambda_1(Z_{it}) + X'_{1,it}\gamma_1(Z_{it}) + \epsilon_{1,it} \quad (4.1)$$

$$FDI_{it} = \Delta EX_{it}\lambda_2(Z_{it}) + X'_{2,it}\gamma_2(Z_{it}) + \epsilon_{2,it}. \quad (4.2)$$

We use ΔEX_{it} rather than the level of the exchange rate, EX_{it}, as foreign investors are more concerned with fluctuations in the value of the host-country currency than with its level. In our empirical model (equations (4.1) and (4.2)), $X_{j,it}$ is a k_j-dimensioned vector of control variables for equations $j = 1, 2$, such that the first entry in the vector is equal to one; $X_{j,it}$ may share common elements across j. $\gamma_j(\cdot)$ and $\lambda_j(\cdot)$ are unknown smooth coefficient functions of conformable dimensions. We presume that Z_{it} is a d-dimensioned vector that may include a mix of continuous and discrete regressors (Racine & Li 2004, Li & Racine 2010); this vector includes our moderator as well as country- and year-specific categorical variables. We assume that Z_{it} is constant across both equations and across each of the m_j coefficient functions. That is, we maintain the hypothesis of the same sources of parameter heterogeneities in the exchange rate and FDI equations. As in our general model in Section 3, the errors $\epsilon_{j,it}$ are assumed to be mean zero disturbances that are correlated across equations, and all other model assumptions are assumed to be satisfied.

4.2 Data Overview

We garner most of our data from the 2012 World Development Indicators (WDI) database published by the World Bank. Our sample is an unbalanced panel of 115 developed and developing countries over the period 1984-2010. We average the data into a 3-year panel. A 3-year averaged panel, in lieu of an annual panel, should capture relationships between FDI and the exchange rate over longer horizons, and using time-averaged rather than contemporaneous panels reduces the serial correlation within the data, thereby smoothing the effects of outliers induced by business cycles and other annual fluctuations on our results. Averaging the panel over 3-year periods provides a sample size of 727 observations. The effective sample size used for each regression, however, is further reduced because of data limitations for different sets of control variables. Our use of a wild bootstrap to compute the standard errors mitigates, among other things, the lack of precision of the estimates that is usually a by-product of small sample estimation.

4.3 Explanatory Variables in the Exchange Rate Equation

The dependent variable in this equation is the 3-year average of the annual change in the exchange rate, where the exchange rate is the domestic currency per US Dollar. The main explanatory variable, FDI inflows, is defined as the net inflows of FDI as a percentage of GDP. Our supplementary explanatory variables control for additional factors that are correlated with both FDI and the exchange rate, and in so doing mitigate against omitted variable bias in the estimated effects of FDI. We consequently draw on the literature on exchange rate determination, which is well established. Specifically, we consider openness to trade and GDP growth as control variables (see, e.g., Branson 1981, Hacche 1983, Pearce 1983). Trade openness or high GDP growth could mean higher exports, and by extension larger foreign currency earnings, which in turn diminish the chance of an exchange rate depreciation. This aligns with the traditional balance of payments approach (see Branson 1981). We also include the one-period lag of the change in the exchange rate to capture inertia. These variables constitute the explanatory variables in the benchmark exchange rate equation, where FDI inflows affect the exchange rate directly. To echo other theories in the literature (see Section 2) where FDI inflows affects the exchange rate indirectly, we add additional regressors in the two alternative exchange rate equations. Specifically, in light of the traded and non-traded goods model, we include the CPI in one alternative model, where FDI inflows affects the exchange rate through consumer prices. As this theory applies primarily to the case of a small, price-taking country, we include GDP as an additional control when empirically assessing this model. In light of the portfolio model, we add the net foreign investment (FDI inflows minus outflows) and the inflation rate as additional regressors. With them, we are able to test whether FDI inflows affects changes in the exchange rate indirectly through the channel of foreign investment and inflation. See Table 1 for the description of the regressors.

Table 1: List of data and definitions.

Variable	Definition
Outcomes	
Exchange Rate	Exchange rate (domestic currency per US$)
FDI	Net FDI inflows as a percentage of GDP in constant 2002 dollars. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.
Controls in Exchange Rate Equation	
Lag Exchange Rate	Exchange rate in the previous period
Trade Openness	Ratio of exports plus imports as % of GDP
Growth Rate	Growth rate of real GDP per capita
CPI	Consumer price index
GDP	Logarithm of GDP (constant 2000 US$)
Net Foreign Investment	Net FDI inflows minus net FDI outflows (% of GDP)
Inflation Rate	Inflation, consumer prices (annual %)
Controls in FDI Equation	
Lag FDI	Net FDI inflows as a % of GDP in constant 2002 dollars, in the previous period
Trade Openness	Ratio of exports plus imports as a % of GDP
Growth Rate	Growth rate of real GDP per capita
Inflation Rate	Inflation, consumer prices (annual %)
Interest Rate	Interest rate of lending
Current Account	Current account balance (% of GDP)
OECD	Dummy, one for OECD countries and zero otherwise
Market Capitalization	Market capitalization of listed domestic companies (% of GDP)
Coefficient Variable	
Government Stability	12 point index of government stability which is defined as " the government's ability to carry out its declared program(s), and its ability to stay in office". The index is the sum of three subcomponents - Government Unity, Legislative Strength and Popular Support - each with a maximum score of 4 points and a minimum score of 0 points; a score of 4 points equates to very low risk and a score of 0 points to very high risk

Note: All variables, except government stability, come from the WDI 2012. Government stability comes from the International Country Risk Guide database.

4.4 Explanatory Variables in the FDI Equation

Various theories on the correlates of FDI have been developed and empirically analysed; see, for example, Blonigen (2005), Russ (2007), Faeth (2009), Blonigen & Piger (2014), Sánchez-Martín et al. (2014) for in-depth reviews. Foreign investors are guided by, among other things, profitability, complementarity with investors' global strategy, and host country environment. Given the aggregate nature of our hypothesis, we focus on the latter of these factors. Of the variables which have been associated with FDI inflows, the exchange rate is our primary variable of interest. For the control set, we choose trade openness and the economic growth rate as well. Trade openness likely has a direct impact on FDI flows as a country that is more integrated into the world economy through trade is more likely to be an attractive place for FDI. Economic growth, of course, is generally regarded as having a positive impact on FDI inflows (see Borensztein, Gregorio & Lee 1998), as a faster growing economy is more attractive to an investor than one that grows more slowly.

The exchange rate, trade openness, and the growth rate of real GDP make up the set of benchmark regressors in the FDI model, where the exchange rate has a direct effect on FDI inflows. Meanwhile, we set up three alternative FDI equations with additional regressors to examine indirect effects. First, in light of the monetary approach to the balance of payments theory, we include the inflation rate and the interest rate as additional regressors. When the exchange rate is the main monetary instrument of stabilization, an exchange rate appreciation can lead to a higher domestic inflation rate and a higher interest rate. Widening gaps between domestic inflation or interest, relative to worldwide levels, could increase the demand of foreign borrowing or financing and therefore increase FDI inflows. By including the inflation rate and the interest rate as additional regressors in the FDI model, we are able to test the above mechanism wherein the exchange rate has an indirect influence on FDI. Second, in light of the theory of strategic behavior of international firms, we consider the current account as a means through which the exchange rate affects FDI inflows. Third, in light of the theories of imperfect capital markets and relative labor cost, we consider the indirect effect of the exchange rate on FDI through the channel of firms' wealth by including the market capitalization of listed firms. The theories particularly apply for the industrialized countries, thus we include a dummy variable that equals one if a country is a member of the OECD and zero otherwise.

4.5 Coefficient Variables

Recall that the coefficient variables, Z_{it}, are introduced as sources of heterogeneity in the effects of all the explanatory variables on the outcome variable. Our maintained assumption is that government stability and unobservable country and time effects are important factors in the relationship between the exchange rate and FDI inflows. The index of government stability comes from the International Country Risk Guide published by Political Risk Services, and is defined as "the government's ability to carry out its declared program(s), and its ability to stay in office". The index is the sum of three subcomponents – Government Unity, Legislative Strength and Popular Support – each with a maximum score of 4 points and a minimum score of 0 points; a score of 4 points equates to very low risk and a score of 0 points to very high risk.[6] Consequently, this government stability index ranges from 0 to 12, with 0 representing low government stability and 12 representing high government stability. See Table 8 for a granular description of countries in the government-stability distribution.

Our model (Equations 4.1 and 4.2) also allows for government stability to exert direct influences on both FDI and the exchange rate via the intercept coefficient functions. Indeed, empirical evidence suggests that changes in government stability are directly associated with changes in the foreign exchange

[6]This government stability index is available for 1984 and onwards, which inevitably fixes the beginning year of our dataset.

or currency market (see, e.g., Cosset & Rianderie 1985, Fielding & Shortland 2005). Empirical evidence of a direct association between government instability and FDI inflows can be inferred from, for example, Schneider & Frey (1985), Asiedu (2006), Busse & Hefeker (2007), and Sánchez-Martín et al. (2014).[7]

We use an unordered categorical country variable and ordered categorical year variable to control for unobserved country- and time-specific heterogeneity in *all* the coefficient functions. Thus, in contrast to the orthodox case of a homogeneous coefficient fixed effects panel specification, we do not assume that the country and year effects have a *neutral* effect on the model by influencing the intercept only.[8] That is, we control for country and time-varying effects – i.e., fixed effects – in a non-neutral fashion. Our country and year indicators are therefore capable of capturing *any* country and time-varying factors that induce heterogeneity in the intercept *and* slope coefficients across countries and time.[9] Consequently, innumerable time-invariant measures of country-specific government policies are subsumed in our fixed effects in Z_{it}.[10]

5 Empirical Results

We now turn to the results from applying our semiparametric instrumental variables systems estimator to our novel empirical model of the exchange rate and FDI in (4.1) and (4.2).[11] We note that our underlying sample excludes the United States. We first discuss our estimated coefficient functions for our bivariate exchange rate-FDI system, and then analyze the marginal effects on these coefficients from an increase in government stability. Since our semiparametric systems estimator provides observation-specific estimates and standard errors, we summarize these estimates using kernel density plots and 45 degree gradient plots that are depicted by Figure 1, and the 25th, 50th (median), and 75th percentiles that are in Table 2. The 45 degree gradient plots found in the lower panels of the figures show the observation specific function estimates plotted on the 45 degree line, with 95 percent observation specific confidence intervals plotted above and below each point estimate. If the horizontal dotted line at zero lies outside of each observation specific confidence interval, then that point estimate is statistically significant.

5.1 Benchmark Model Estimates

We first present the coefficient function estimates from the benchmark model, where the control sets for equations (4.1) and (4.2) are $X'_{1,it} := (Openness'_{it}, Growth'_{it})$ and $X'_{2,it} := (Openness'_{it}, Growth'_{it})$, respectively.

[7]Barro (1991) and Brunetti & Weder (1998) find empirical evidence that government instability is significantly related to cross-country differences in private investment.

[8]Moreover, the Racine & Li (2004) kernels allow for interaction of unknown form between both fixed effects and variables that vary both across country and over time, so that our control of country- and year-specific effects is not restricted to additively separable effects.

[9]With exception of the country and year indicators, we require the variables in Z_{it} to vary across both i and t, thus allowing our country and year indicators to absorb all country or time-varying factors that may lead to heterogeneity in the coefficient functions.

[10]Our use of *non-neutral* fixed effects – in lieu of their neutral counterparts - circumvents the need to remove the fixed effects via some type of weighting or first difference transformation prior to estimation, to avoid biased and inconsistent estimates of, in particular, the marginal effects. Further, our use of generalized product kernels (Racine & Li 2004) allows us to avoid the incidental parameters problem associated with many parametric panel models that include dummy variables to account for unobserved effects.

[11]We consider estimates of (A.9) that use first stage estimates of A as our weighting matrix.

Exchange Rate Equation The top-left panel of Figure 1 presents the kernel density of the FDI coefficient estimates. It is clear from the kernel density that the effect of FDI on the exchange rate is heterogeneous, though largely positive. The corresponding 45 degree gradient plot (bottom-left of Figure 1) shows that the majority of these estimates are statistically significant at the 5 percent level; this is evident from the clustering of estimates in the first quadrant with point-wise confidence bounds that exclude zero.

In Table 2, we find that the effect of FDI on the exchange rate (see the exchange rate equation) are unanimously positive across the 25th, 50th and 75th percentiles. Evidently, the effect is heterogeneous, which has an interquartile range of 1.241, with a median effect of 1.329. Our point estimates at the quartiles are statistically significant at all three reported quartiles suggesting that for most countries, FDI has a significantly positive, heterogeneous, and causal effect on the exchange rate. At the median, a 10 percent increase in FDI inflows relative to GDP causes approximately a 13.29 percent increase in the annual change in the exchange rate.

Table 2 also reports summaries of the estimates of the other coefficients in the exchange rate equation. The reported quartiles for the lagged exchange rate coefficient are all significantly positive, and satisfy the stability condition for the exchange rate equation (a coefficient estimate less than one in absolute value). Trade openness has a negative and significant effect at the lower quartile, and economic growth has a negative and significant effect on the exchange rate at the lower and median quartiles. Thus, an increase in trade openness reduces the annual change in the exchange rate in a few countries, and an increase in the economic growth rate reduces the annual change in the exchange rate in many countries. For trade openness and growth, there is a clear absence of statistical parity among the corresponding quartiles of estimates. These results therefore complement the existing exchange rate literature by providing added evidence of sizable heterogeneities in the effects of each of these variables on the annual change in the exchange rate across countries.

Table 2: Summary of system NPGMM coefficient estimates: benchmark model

	ΔExchange Model				FDI Model		
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	0.534***	1.329***	1.775***	ΔExchange	0.002**	0.003***	0.006***
	0.213	0.328	0.529		0.001	0.002	0.002
Lag ΔExchange	0.112**	0.513***	0.803***	Growth	0.131***	0.277***	0.391***
	0.050	0.076	0.144		0.049	0.088	0.141
Openness	−0.081**	−0.001	0.105	Openness	−0.003	0.020***	0.030***
	0.041	0.066	0.085		0.005	0.008	0.011
Growth	−4.900***	−1.864**	−0.196				
	0.494	1.020	2.067				
Intercept	0.016	0.124**	0.242**	Intercept	−0.008**	−0.001	0.013
	0.033	0.068	0.117		0.004	0.007	0.010

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1$;$^{**}p < 0.05$;$^{***}p < 0.01$. The dependent variables are first difference of the exchange rate and FDI inflows. See Table 1 for definitions of other variables.

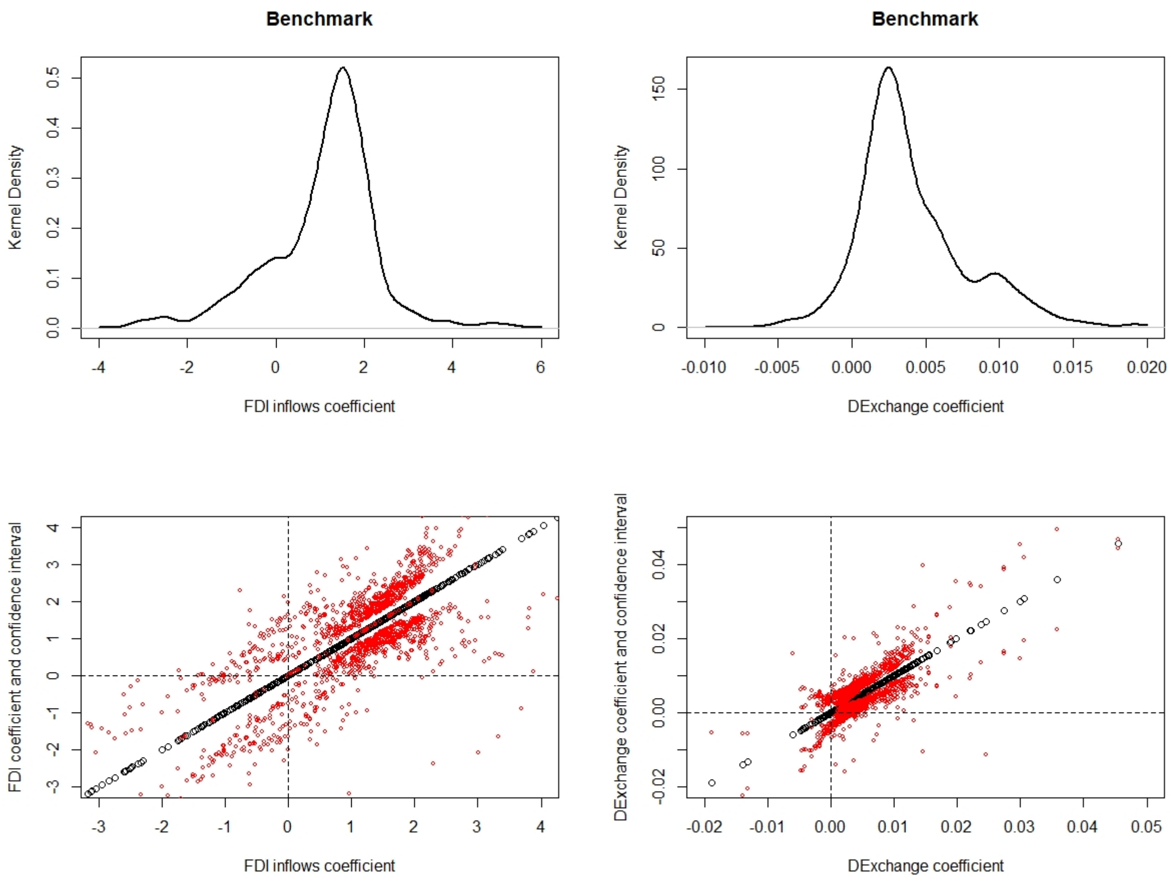


Figure 1: Coefficient estimates-benchmark model.

FDI Equation The top-right panel of Figure 1 reveals that the distribution of the exchange rate coefficient estimates is generally positive, and the corresponding 45 degree plot (bottom right of Figure 1) reveals that most of these positive estimates are statistically significant. In Table 2, we see that the change in the exchange rate has a statistically significant causal effect on FDI inflows at each reported quartile. These coefficients have an interquartile range of 0.004 with a median effect of 0.003. These estimates imply that at the median, a 10 percent increase in ΔExchange causes about a 0.03 percent increase in the ratio of FDI inflows to GDP. Overall, we find strong evidence that for most countries the change in the exchange rate has a significantly positive, heterogeneous, and causal effect on FDI. This empirical evidence of heterogeneity in the effect of exchange rate on FDI represents a salient distinction between our work and the existing FDI literature. Considering the effects of other control variables in the FDI equation, we see from Table 2 that economic growth has a statistically significant positive effect at all quartiles and with a large interquartile range. Trade openness has a positive and significant effect on FDI inflows at the median and upper quartiles, but an insignificant effect at the lower quartile. These findings mark important empirical results for research investigating factors related to macroeconomic drivers of FDI inflows. In particular, the nature of the heterogeneous effects in the FDI equation partially explains why the previous results from linear models were unable to unearth statistically robust correlates of FDI inflows.

Government Stability In all, we interpret these significant effects in both equations to be robust evidence that our model is flexible enough to significantly capture heterogeneity across countries that might arise because of nonlinearities from interactions of these variables with respect to government stability or unobserved country and time effects. Looking at the kernel density plots in Figure 2, it is clear that the FDI-exchange rate interaction is stronger for OECD countries as the distribution of FDI inflows coefficients (or DExchange coefficients) is to the right of that for the non-OECD countries. Testing for density equality via the Li, Maasoumi & Racine (2009) nonparametric test confirms our visual inspection: we reject the null hypothesis of density equality between the OECD and non-OECD sets for the FDI inflows and DExchange coefficients at the 1% significance level. Our data shows that, on average, OECD countries have better government stability as the index average is 8.10 compared with the 7.79 for the non-OECD countries, though the average difference is not particularly stark. Figure 2 indirectly suggests an increase in government stability may strengthen the effect of FDI on the change in the exchange rate and vice versa.

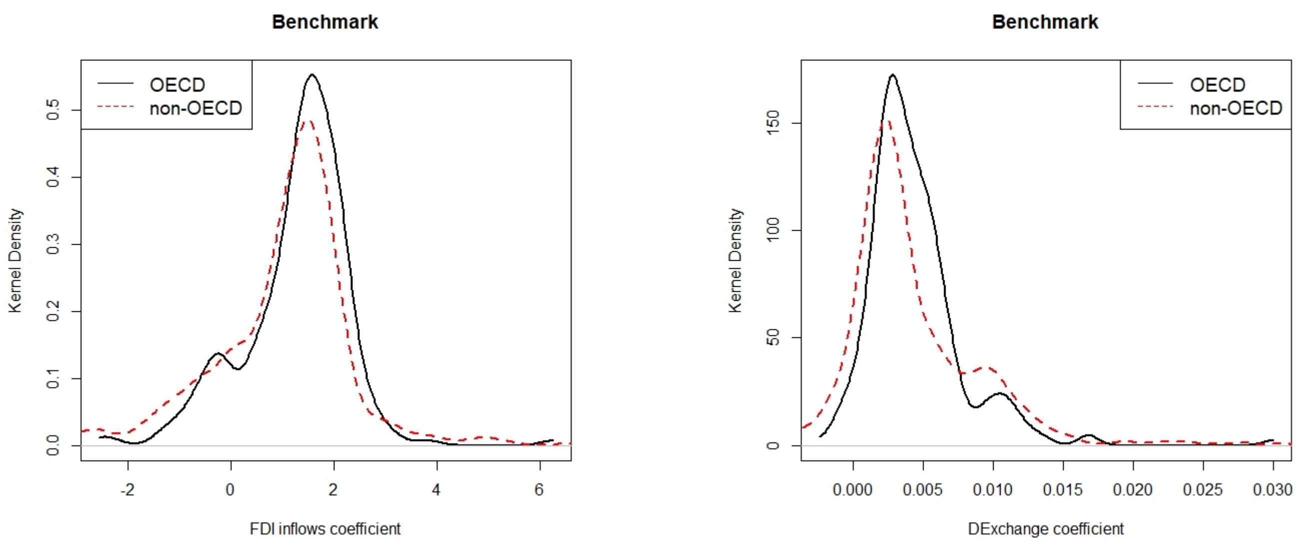


Figure 2: Kernel densities of the estimated FDI inflows coefficients and exchange rate coefficients across OECD and non-OECD country delineations.

To examine the direct impact of government stability on the FDI-exchange rate interaction, we use nonparametric methods to regress the government stability index on the estimated FDI inflows coefficients and the estimated exchange rate coefficients. We use nonparametric methods so as to avoid any specification concerns; given that these are univariate regressions, we can plot the estimated regression functions and confidence bands. We present plots of these estimated regression functions in Figure 3. From the left side of the panel, we see a positive relationship between government stability and the effect of FDI inflows on the exchange rate (i.e., the estimated FDI inflows coefficients), particularly at higher levels of government stability (roughly above 6 on the 0-12 scale). This suggests that for many countries, particularly those with more stable governments, an increase in government stability strengthens the effect of FDI on the exchange rate. The finding is consistent with our hypothesis that government stability can enhance the ability of national authorities to efficiently and effectively use FDI inflows to impact changes in the exchange rate. From the right side of the panel of Figure 3, we find there is a non-monotonic relationship between government stability and the exchange rate coefficients. For relatively unstable countries with a stability index value less than 8, an increase in government stability is generally associated with a weakening of the impact of the exchange rate on FDI inflows. This finding is expected, as an increase in government stability may undermine foreign firms' political capital and therefore reduce the sensitivity of FDI to the exchange rate. For countries that have relatively stable governments (stability index value greater than 8), an increase in government stability is generally associated with a strengthening of the impact of the exchange rate on FDI inflows. For those countries that already have relatively strong institutions, a further increase in government stability reduces political/market risk and therefore increases the effect of a change in the exchange rate on FDI inflows. Overall, our results from Figure 3 suggest that government stability is an important source of parameter heterogeneity in both the exchange rate and FDI equations.

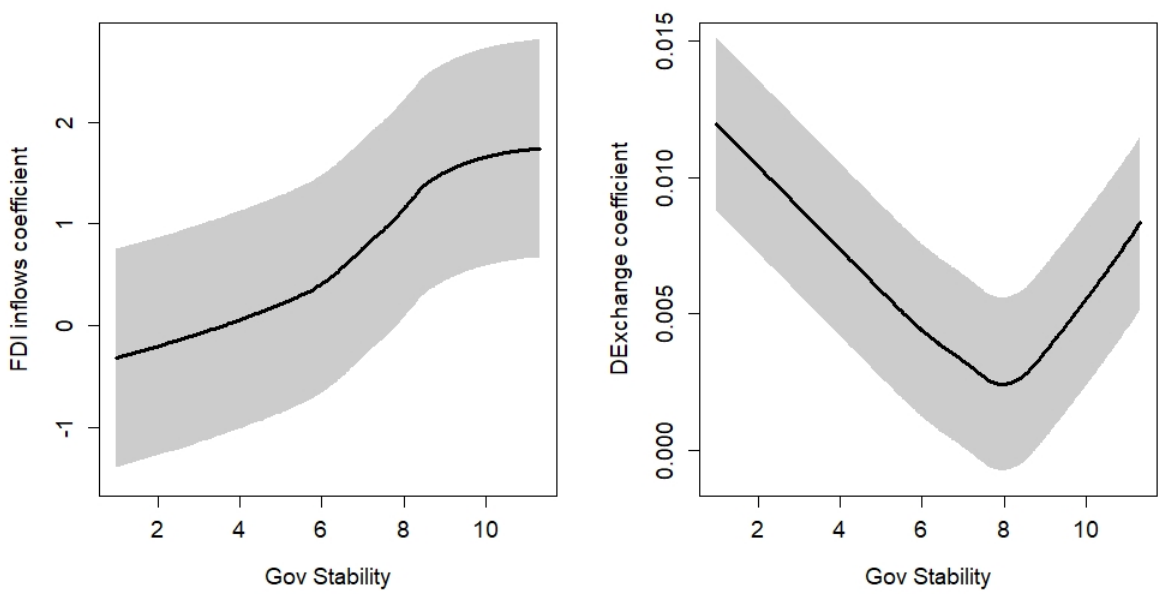


Figure 3: Plots from nonparametric regressions of estimated FDI and exchange rate coefficients on the index of government stability.

5.2 Alternative Theories: Building on the Benchmark Model

We empirically investigate the salience of each of the six theories described previously via systematically augmenting the benchmark model to incorporate the tenets of each theory. An important advantage of our nonparametric approach is that we can directly assess the relevance of each particular theory for each country specifically; that is, the heterogeneity garnered from our empirical approach allows us to determine which theories are salient for different countries or subsets of countries, rather than the all-or-nothing assumption explicit in traditional models that assume parameter homogeneity. This extension not only allows us to relate the conventional theory about FDI-exchange rate interactions, but also to enhance our understandings about the mechanism of FDI's influence on the exchange rate and the exchange rate's influence on FDI.

The Traded and Non-Traded Goods Theory The first two theories, the traded and non-traded goods and portfolio theories, suggest that capital inflows lead to changes in the exchange rate. In light of the traded and non-traded goods theory, we include CPI and GDP as additional regressors in the exchange rate equation. Thus, the control sets of equation (4.1) is $X'_{1,it} := (Openness'_{it}, Growth'_{it}, CPI'_{it}, GDP'_{it})$. Equation (4.2) is unchanged that $X'_{2,it} := (Openness'_{it}, Growth'_{it})$ because the theory focuses on the effect of FDI on the exchange rate. Figure 4 shows the density and 45 degree plots for the FDI and exchange rate coefficient estimates, and Table 3 reports the estimates of coefficients in the 25th, 50th and 75th percentiles. We see in the figure that for both FDI inflows (the exchange rate equation) and exchange rate coefficients (the FDI equation), there is a large proportion of estimates that are positive and statistically significant. These estimates appear fairly similar to the estimates from the baseline model. Table 3 shows that these similarities are generally borne out, though the FDI coefficient in the exchange rate equation is no longer significant at the 25th percentile. Further, the coefficients at the median and upper quartiles, while still significant, have smaller magnitudes compared to those in Table 2. Clearly the significance of CPI and GDP, particularly at the lower quartiles, have accounted for part of the significance of FDI on changes in the exchange rate as found in the baseline model, lending some credence to the traded and non-traded goods theory.

Table 3: Summary of system NPGMM coefficient estimates: traded and non-traded goods theory

	ΔExchange Model				FDI Model		
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	-0.027	0.562^{**}	1.052^{**}	ΔExchange	0.002^{**}	0.003^{**}	0.006^{***}
	0.042	0.291	0.547		0.001	0.002	0.002
Lag ΔExchange	0.086^{**}	0.480^{***}	0.801^{***}	Growth	0.131^{***}	0.276^{***}	0.390^{***}
	0.037	0.063	0.121		0.048	0.088	0.140
Openness	-0.073^{**}	0.061	0.219^{**}	Openness	-0.003	0.020^{***}	0.030^{***}
	0.031	0.065	0.129		0.005	0.008	0.011
Growth	-5.518^{***}	-2.331^{***}	-0.110				
	0.042	0.866	1.609				
CPI	-0.011^{***}	-0.002^{**}	0.000				
	0.001	0.001	0.004				
GDP	-0.037^{***}	-0.011	0.057^{*}				
	0.007	0.015	0.036				
Intercept	-0.669^{***}	0.463	1.179^{*}	Intercept	-0.008^{**}	-0.001	0.013
	0.043	0.369	0.795		0.004	0.007	0.010

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1;^{**} p < 0.05;^{***} p < 0.01$. The dependent variables are first difference of exchange rate and FDI inflows. See Table 1 for definitions of other variables.

The Portfolio Theory In line with the portfolio theory, we include net foreign investment and inflation as additional regressors in the exchange rate equation. Figure 5 and Table 4 report estimation summaries. The distributions of coefficient estimates are still generally positive, though we can see from the 45 degree

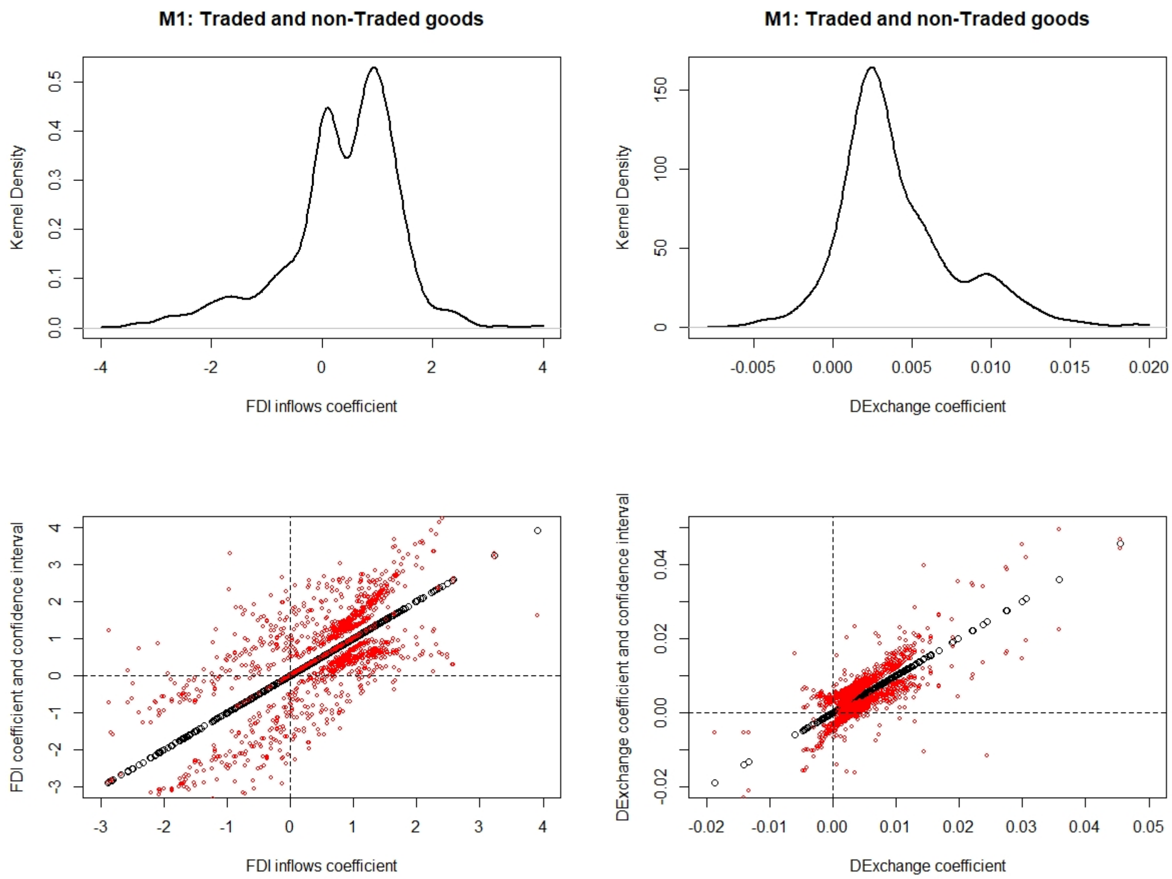


Figure 4: Coefficient estimates for M1: traded and non-traded goods theory

plot of the FDI inflows coefficient estimates that there is no longer a large and significant cluster of positive coefficients. As expected, we still see the positive and significant clustering of estimates in the FDI equation for the exchange rate coefficient estimates. Table 4 shows that at the 25th, 50th, and 75th percentiles, the FDI inflows coefficient estimates are no longer significant and instead net foreign investment (at the 25th percentile) and the inflation rate (at all reported percentiles) are significant. These results bear out the portfolio theory: FDI inflows create excessive liquidity in the domestic economy, which then pushes up the domestic price level and worsens the current account deficit that leads to a depreciation of the nominal exchange rate. Another interpretation of our results is that the FDI effect on the exchange rate identified in the baseline model operates through the inflation rate.

Monetary Approach to the Balance of Payments Theory Next, we link our model with the monetary approach to the balance of payments by including the inflation and interest rates as additional regressors in the FDI equation. The control set of equation (4.1) reverts back to the baseline specification while that of equation (4.2) becomes $X'_{2,it} := (Openness'_{it}, Growth'_{it}, Inflation'_{it}, Interest'_{it})$. The estimates are presented in Figure 6 and Table 5. At first glance, the kernel densities of the estimates reveal that a large portion of the estimated coefficients are positive, though the 45 degree plots reveal less statistical significance of these estimates compared to the baseline model. Table 5 confirms this observation:

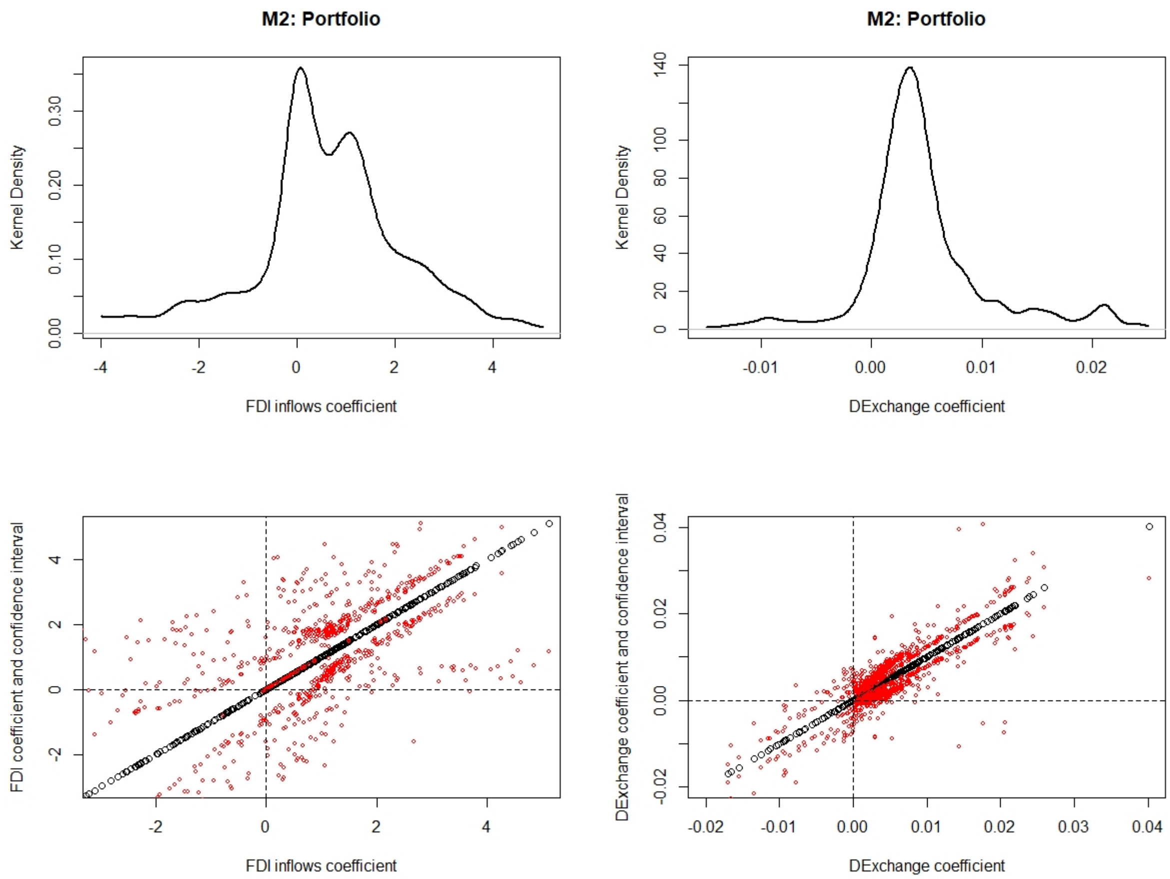


Figure 5: Coefficient estimates for M2: portfolio theory

the exchange rate becomes largely insignificant in the FDI equation, except at the 75th percentile and at the 10 percent significance level, while other control variables are largely significant. And, although there is no change in the exchange rate model specification, the coefficients on FDI are smaller and even become insignificant at the lower quartile. This finding suggests that there are systematic interactions between FDI and the exchange rate, which further validates our approach in estimating these models simultaneously instead of separately. Thus, as suggested by the monetary approach theory, when the exchange rate is the main monetary instrument of stabilization, a rise in the domestic interest rate leads to an increase in demand for foreign capital.

The Strategic Behavior Theory Following the strategic behavior theory, we include the current account as the additional regressor in the FDI model while keeping the exchange rate model unchanged (from the baseline). The estimation results of the nonparametric system of equations are presented in Figure 7 and Table 6. The density plots and 45 degree plots reveal a generally positive and significant set of estimated FDI inflows coefficients in the exchange rate model, and a heterogeneous (in sign and significance) set of estimates on the exchange rate coefficients in the FDI equation. Looking at the point estimates in the table, the estimates of the exchange rate coefficients in the FDI model become insignificant at the lower and median quartiles, and are significant at the 10% level at the upper quartile.

Table 4: Summary of system NPGMM coefficient estimates: portfolio theory

	ΔExchange Model			FDI Model			
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	-0.045	0.511	1.442	ΔExchange	0.002^{**}	0.004^{***}	0.006^{***}
	0.232	0.415	1.141		0.001	0.001	0.002
Lag ΔExchange	0.295^{***}	0.537^{***}	0.973^{***}	Growth	0.139^{**}	0.267^{**}	0.407^{***}
	0.055	0.103	0.221		0.064	0.104	0.162
Openness	-0.015	0.056	0.141^{**}	Openness	-0.011^{**}	0.015^{**}	0.027^{**}
	0.023	0.052	0.073		0.005	0.008	0.012
Growth	-5.254^{***}	-2.312^{***}	-0.520				
	0.217	0.830	1.394				
Net Foreign Invest	-0.006^{**}	0.002	0.013				
	0.003	0.007	0.015				
Inflation	0.090^{**}	1.112^{***}	2.420^{***}				
	0.047	0.243	0.516				
Intercept	-0.076^{***}	0.005	0.093	Intercept	-0.008^{**}	0.001	0.017^{*}
	0.021	0.045	0.096		0.004	0.007	0.011

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1;^{**}p < 0.05;^{***}p < 0.01$. The dependent variables are first difference of exchange rate and FDI inflows. See Table 1 for definitions of other variables.

Table 5: Summary of system NPGMM coefficient estimates: monetary approach to the balance of payment

	ΔExchange Model			FDI Model			
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	0.011	0.989^{***}	1.561^{**}	ΔExchange	0.000	0.002	0.003^{*}
	0.143	0.295	0.631		0.001	0.002	0.002
Lag ΔExchange	0.028	0.487^{***}	0.800^{***}	Growth	0.076^{*}	0.171^{**}	0.259^{***}
	0.046	0.080	0.152		0.048	0.080	0.106
Openness	-0.104^{***}	-0.009	0.075	Openness	0.019^{***}	0.031^{***}	0.042^{***}
	0.036	0.071	0.091		0.003	0.005	0.007
Growth	-4.792^{***}	-1.734^{*}	-0.012	Inflation	-0.014^{***}	-0.002	0.009
	0.316	1.055	2.343		0.002	0.004	0.007
				Interest	0.016^{***}	0.047^{***}	0.129^{***}
					0.007	0.012	0.025
Intercept	0.024	0.101^{**}	0.255^{**}	Intercept	-0.030^{***}	-0.015^{***}	-0.002
	0.033	0.058	0.116		0.004	0.006	0.008

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1;^{**}p < 0.05;^{***}p < 0.01$. The dependent variables are first difference of exchange rate and FDI inflows. See Table 1 for definitions of other variables.

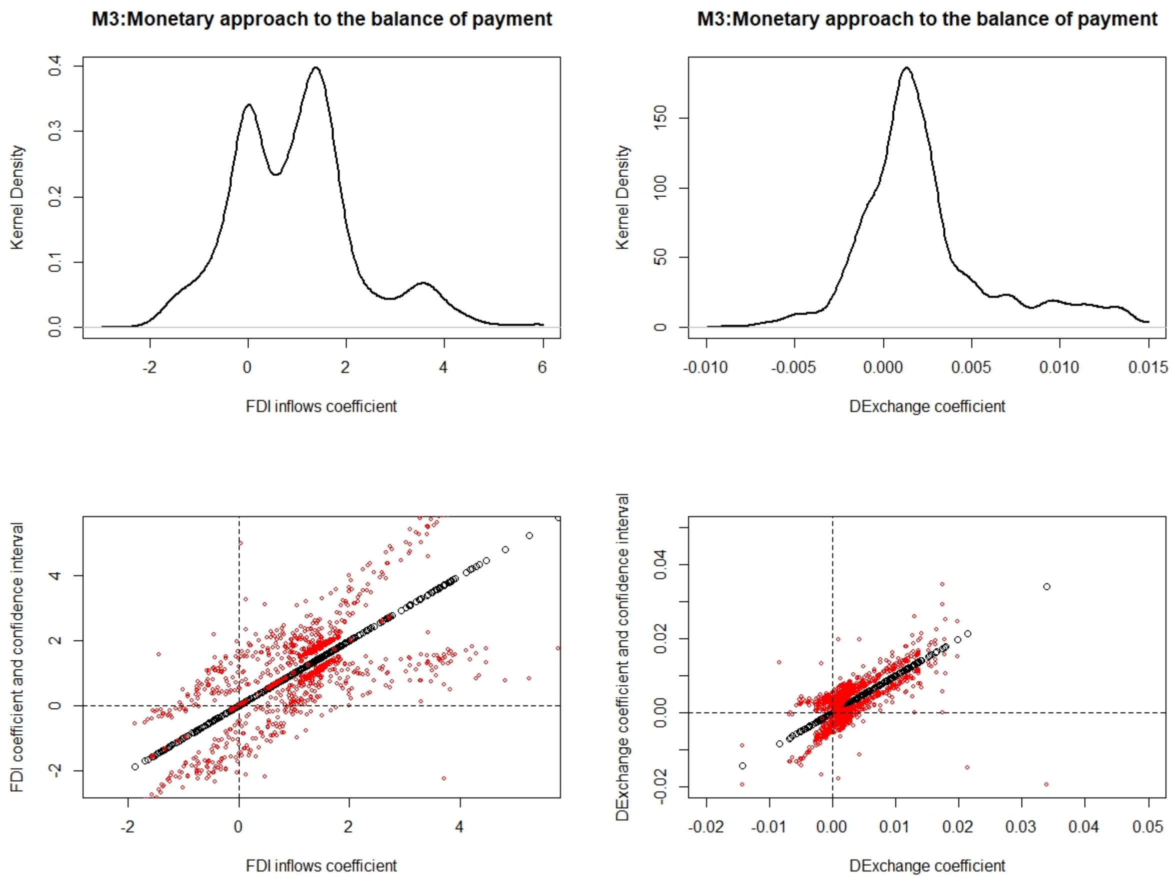


Figure 6: Coefficient estimates for M3: monetary approach to the balance of payments

Meanwhile, the newly-added current account is significant and negative at all presented quartiles. The finding is consistent with the strategic behavior of multinational firms' theory in that an appreciation of the exchange rate at home results in a large current account deficit. Under a fear of bilateral protectionism, multinational firms increase capital investment abroad, which is less sensitive to trade policy, such as tariff jumping.

Imperfect Capital Markets Theory Lastly, based on the theory of imperfect capital markets, we include an OECD dummy and market capitalization as the additional regressors in the FDI model. Results are reported in Figure 8 and Table 7. Due to the data availability of market capitalization, the new sample size for this model is only half of the original, baseline sample. In the figure, we can see generally positive and significant FDI inflows coefficients in the exchange rate model, but heterogeneous (in sign and significance) estimates of the exchange rate coefficients in the FDI model. Particularly, in the FDI model, the exchange rate coefficients become insignificant at the median quartile and become negative in the lower quartile. Meanwhile, the newly-added market capitalization is significantly negative across all quartiles. The finding is consistent with the proposed theory that a decrease in firms' value/wealth will increase the demand of foreign investment. A depreciation of the exchange rate reduces the market value of domestic firms relative to their foreign counterparts, which stimulates an increased demand of foreign

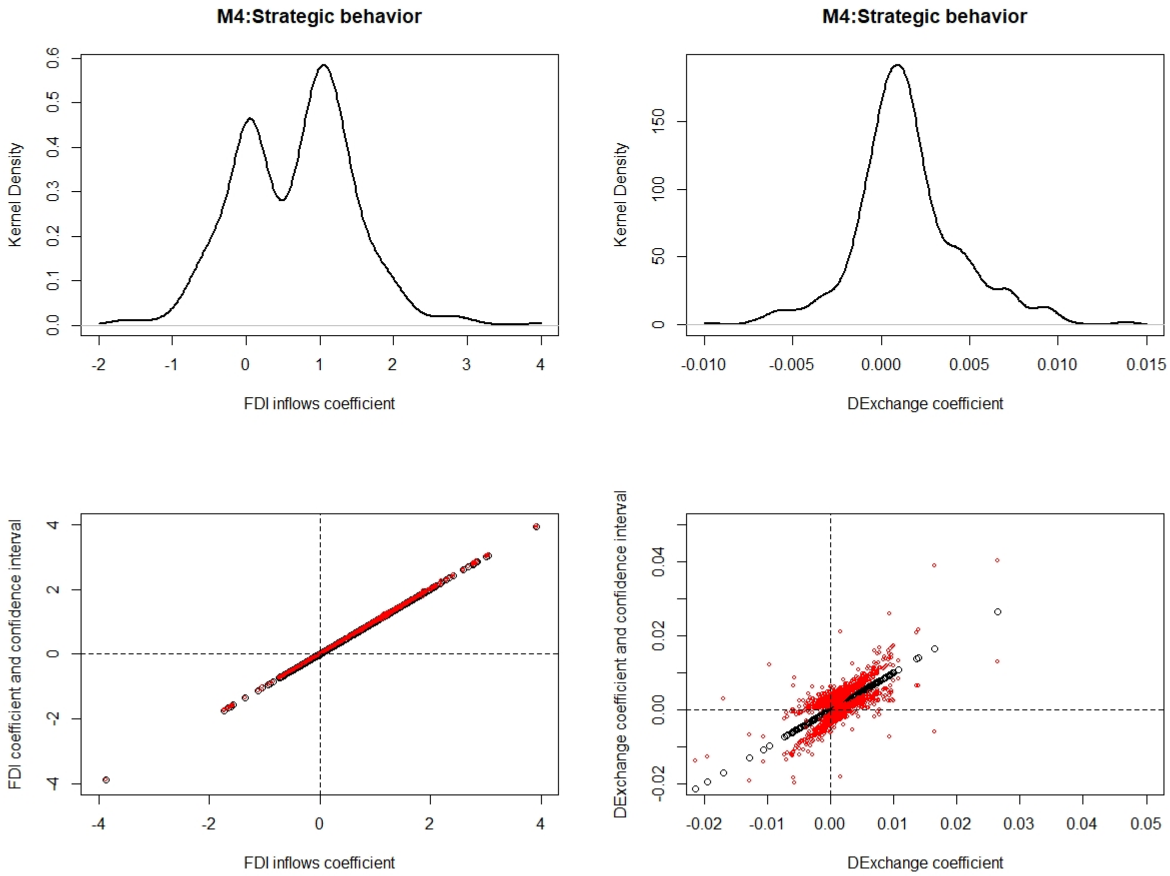


Figure 7: Coefficient estimates for M4: strategic behavior

Table 6: Summary of system NPGMM coefficient estimates: strategic behavior theory

	ΔExchange Model				FDI Model		
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	0.030***	0.815***	1.192***	ΔExchange	0.000	0.001	0.003*
	0.001	0.001	0.003		0.001	0.001	0.002
Lag ΔExchange	0.113***	0.528***	0.791***	Growth	0.136***	0.239***	0.351***
	0.022	0.062	0.089		0.045	0.067	0.102
Openness	−0.103***	−0.013	0.091***	Openness	0.003	0.024***	0.034***
	0.012	0.020	0.032		0.004	0.007	0.010
Growth	−1.175***	−0.292***	−0.017***	Current Account	−0.004***	−0.004***	−0.003***
	0.001	0.001	0.002		0.000	0.000	0.000
Intercept	0.009	0.085***	0.173***	Intercept	−0.017***	−0.009*	0.006
	0.016	0.034	0.056		0.003	0.006	0.009

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1$;$^{**}p < 0.05$;$^{***}p < 0.01$. The dependent variables are first difference of exchange rate and FDI inflows. See Table 1 for definitions of other variables.

investment to offset their losses in the capital market. In addition, the significantly negative coefficients on the OECD dummy variable indicates that the effect of the exchange rate on FDI via the channel of capital markets is stronger in non-OECD countries. In this sense, our finding extends the previous empirical work of Klein & Rosengren (1994) that uses only data on industrial countries to test the theory of imperfect capital markets.

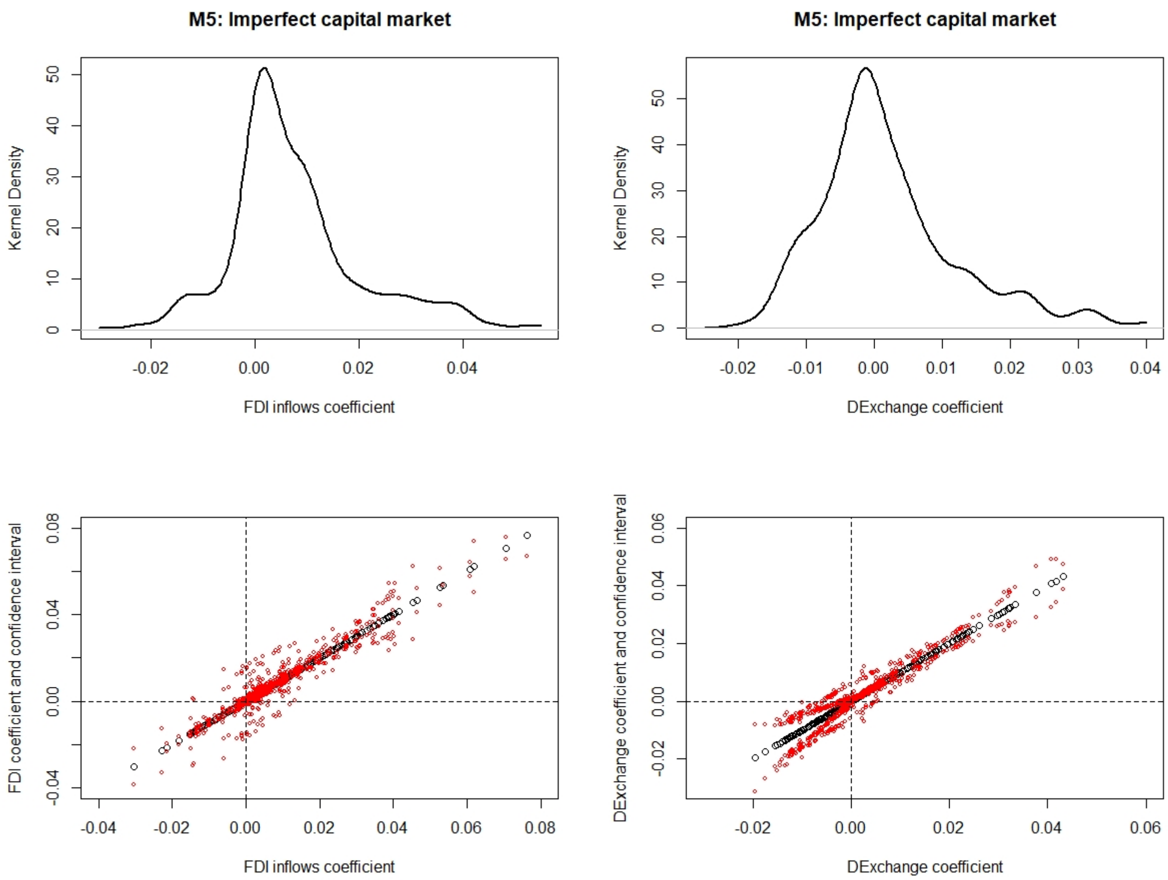


Figure 8: Coefficient estimates for M5: imperfect capital market theory

Table 7: Summary of system NPGMM coefficient estimates: imperfect capital market theory

	ΔExchange Model				FDI Model		
	Q1	Q2	Q3		Q1	Q2	Q3
FDI	0.001^{*}	0.005^{***}	0.013^{***}	DExchange	-0.004^{***}	0.000	0.006^{***}
	0.000	0.001	0.002		0.000	0.001	0.002
LDExchange	0.019^{***}	0.068^{***}	0.547^{***}	Growth	0.128^{***}	0.261^{***}	0.401^{***}
	0.003	0.011	0.028		0.038	0.055	0.077
Openness	-0.029^{***}	0.012	0.049^{**}	Openness	-0.019^{***}	0.014^{**}	0.025^{***}
	0.005	0.011	0.022		0.004	0.006	0.008
Growth	0.000	0.001^{**}	0.004^{***}	OECD	-0.052^{***}	-0.031^{***}	-0.020^{***}
	0.000	0.001	0.002		0.004	0.005	0.007
				Mkt Cap	-0.0003^{***}	-0.0002^{***}	-0.0002^{***}
					0.000	0.000	0.000
Intercept	-0.008	0.035^{**}	0.109^{***}	Intercept	0.017^{***}	0.029^{***}	0.055^{***}
	0.008	0.016	0.035		0.004	0.006	0.010

Note: Q1, Q2, Q3 refer to percentiles in the distribution of coefficient estimates. Estimate specific standard errors are obtained via wild bootstrap and are reported below each estimate. The level of statistical significance of estimates are denoted by $^{*}p < 0.1;^{**}p < 0.05;^{***}p < 0.01$. The dependent variables are first difference of exchange rate and FDI inflows. See Table 1 for definitions of other variables.

5.3 An Increase in Government Stability

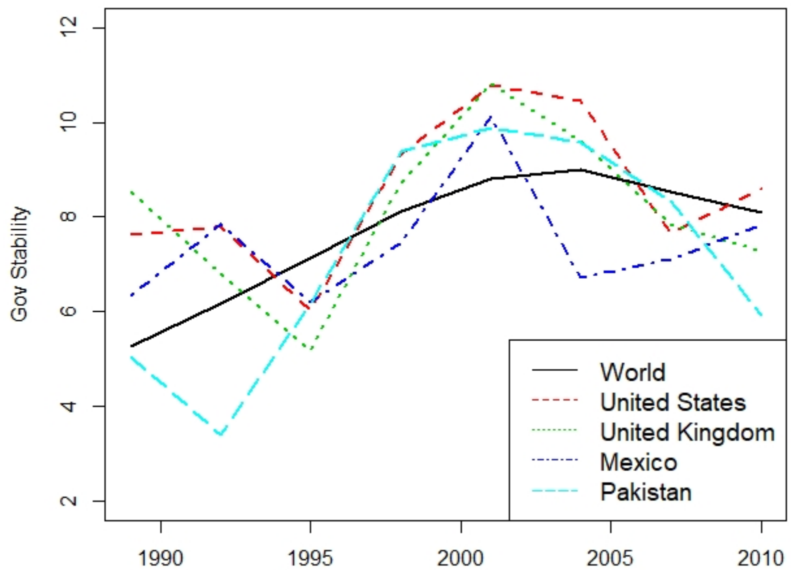
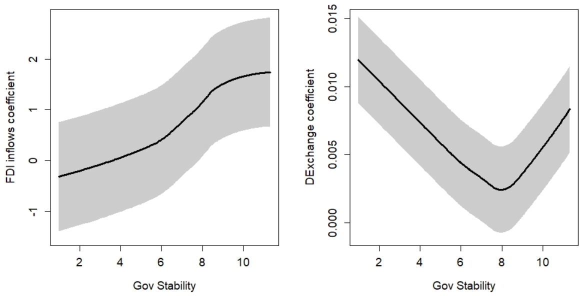
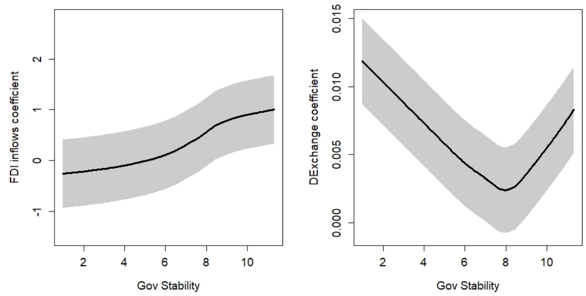


Figure 9: Index of government stability

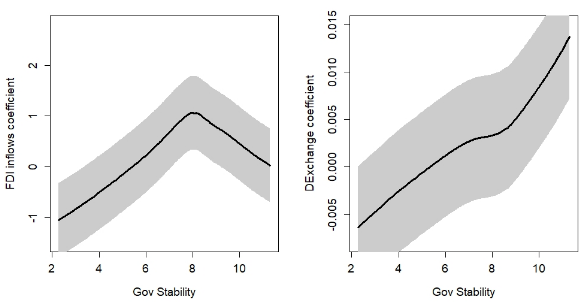
We now turn towards taking a deeper look into the estimated FDI-exchange rate relationship by investigating the extent to which our estimates depend on government stability. Recall that the index of government stability ranges from 0 to 12, and is made up of three subcomponents: government unity, legislative strength, and popular support. Looking deeper into the index, we find a maximum of government stability at 12 points coming from China in the year 2000 and Kazakhstan in the year 1999. For the United States, the minimum index value is 5.6 in the year 1995 and the maximum value is 10.8 in the year 2000. To provide a slightly broader perspective, in Figure 9 we plot the time series of the government stability index for the entire world (averaged), the United States, the United Kingdom, Mexico and Pakistan jointly. This sampling of countries is ad hoc; we merely select both developed and developing countries as a means of comparing their indices over time. We see from the figure that these countries – and the world as an average – follow a similar time path. Perhaps more importantly, we see that developed nations do not have a particular advantage in government stability over developing countries. This is divergent from other common measures of institutional strength, e.g., corruption, in which there is a marked advantage of developed nations over developing nations. Yet, in thinking about the government stability index components, it is sensible that developed nations must also actively work to promote improved government stability. For instance, a country might have strong legislative strength through well guarded legal institutions, but have relatively little popular support. It is also not clear that democratic governments necessarily have a better chance at a higher level of government stability, as evidenced by China in 2000.



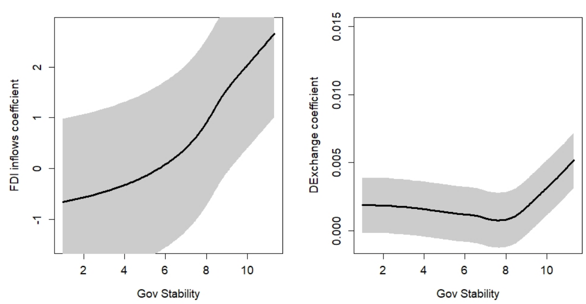
(a) Benchmark model



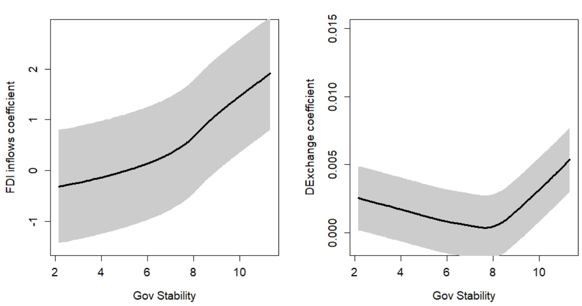
(b) M1: traded and non-traded goods theory



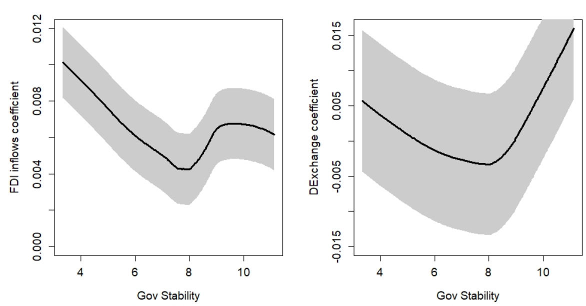
(c) M2: portfolio theory



(d) M3: monetary approach to the balance of payments



(e) M4: strategic behavior



(f) M5: imperfect capital market theory

Figure 10: Nonparametric regressions of government stability on FDI and exchange rate coefficients

To investigate the effect of a marginal change in the government stability index on the FDI and ΔExchange coefficients, we once again use nonparametric methods to regress the FDI and ΔExchange rate coefficients on the index of government stability (separately). These plots are shown in Figure 10. It is clear from the figure that across most of the estimated models, government stability has a significantly positive relationship with the FDI inflows coefficients, indicating that the effect of FDI inflows on the exchange rate is stronger at higher levels of government stability. It is also clear that there is a kind of threshold effect in this relationship given that the relationship between government stability and the FDI inflows coefficient is not significant at relatively low levels of government stability. In other words, there seems to be a level of government stability – at approximately 8 points on the 12 point scale – above which increases in government stability strengthens the FDI inflows effect on changes in the exchange rates. It is worth noting that the upward trend in the government stability-FDI coefficient relationship turns downwards in the portfolio theory model, and is downward trending at low levels and flat at high levels in the imperfect capital market theory model (recall that this last model has a substantially smaller sample size).

Looking at the effect of government stability on the ΔExchange rate coefficients, we find a generally V-shaped relationship, with the only exception being the portfolio theory model. According to the majority of these models, an increase in government stability weakens the exchange rate effect on FDI when the existing level of government stability is low, but strengthens this relationship when the existing level of government stability is above (approximately) 8 points. In the portfolio theory model, government stability does not significantly influence the effect of the exchange rate on FDI flows at low levels of stability, but has a significantly positive effect at higher levels (again, above approximately 8 points).

Returning to the empirical reality that all governments – in both developed and developing nations – appear to struggle in maintaining a relatively high level of government stability, it is apparent that over recent decades most governments in the world have experienced periods of interaction between government stability, FDI, and exchange rates, as well as periods of non-interaction. Further, our estimates provide clear understanding of the approximate levels of government stability necessary for facilitating the bivariate FDI-exchange rate relationship, regardless of which particular channel through these bivariate relationships occur (i.e., the six theories we consider beyond our baseline model). Moreover, from Figure 9, the average nation's level of government stability fluctuates over time around 8 points on the stability index – the exact "threshold" that emerges from our empirical estimates; clearly, small changes in government stability can have dramatic effects on these important variables in the macroeconomy.

5.4 Characterizing the Relationship Between FDI and the Exchange Rate

We can now turn towards characterization of our bi-directional FDI-exchange rate effects via the mutualism classifications presented in Section 3. For each of our semiparametric models, including the baseline specification, we classify each country according to its modal (across years) estimate. Take as a simple example, a country with 5 time series observations. If in a majority of the 5 years the country has a significantly positive FDI coefficient but insignificant exchange rate coefficient, this country will be classified as FDI-commensalism, meaning that for this country FDI significantly affects the exchange rate but the exchange rate does not affect FDI. In some cases, a country does not have a unique modal classification, and so the country is listed multiple times in the table; we mark these countries in the table. We report classification matrices listing each country's placement in Tables 9 – 14.

It is clear from the classification of the baseline model in Table 9 that the majority of countries are classified mutualism, meaning that both FDI and the exchange rate have a significantly positive effect on each other. A relatively small number of countries are classified as FDI-commensalism, meaning that FDI positively affects the exchange rate, but the exchange rate does not affect FDI inflows. Only a handful of other countries exhibit other classifications. Looking across the classification matrices corresponding to the auxiliary models, it is clear that many country's FDI-exchange rate relationships are contingent on the set of control variables included in each specification. For instance, moving from the benchmark model classifications in Table 9 to the traded and non-traded goods theory classification, Table 10, the predominant classification switches from mutualism to FDI-commensalism and FDI-antagonistic symbiosis (positive FDI effect on the exchange rate but negative exchange rate effect on FDI). Taking a close second look across all classification tables, it is clear that the predominant classifications – regardless of model specification or sample size – is either mutualism or FDI-commensalism, with certain models (particularly traded and non-traded goods, Table 10, and imperfect capital markets, Table 14) showing a relative large number of countries classified as FDI-antagonistic symbiosis.

From these classifications, we gather that (i) these different theories generally reflect significant channels through which FDI and the exchange rate interact, at least for particular countries according to each theory, and (ii) overall, FDI has a significantly positive effect on the exchange rate but that the exchange rate has a more sensitive effect on FDI flows.

5.5 Model Assessment

One important way we glean additional insight from our model about the nature of parameter heterogeneity is to examine the cross-validated bandwidths used for regression estimation. It is widely accepted (e.g., Li & Racine 2007) that if a continuous regressor's cross-validated bandwidth does not exceed its upper bound in a local linear regression, then that variable is chosen by the cross-validation procedure to enter nonlinearly into the regression model. For discrete variables, a less than unitary bandwidth implies nonlinear, nontrivial interactions in the regression. An examination of the cross-validated bandwidths in our model shows that government stability has nonlinear interactive effects. That is, we find that our government stability bandwidths are less than their upper bounds, which is a signal that the data do not justify any ad-hoc parametric linear restriction. Further, the existence of nonlinear interactions does not provide insight into the correct parametric specification. Hence, our bandwidth analysis signals that parametric restrictions on the functional form of heterogeneity within our model should be carefully considered and supported by appropriate model specification tests. Also, the country and year fixed-effects enter the FDI model in a nonlinear manner. We finally note that since the degree of smoothing varies across equations for each regressor, we conclude that the nature of these nontrivial interactions differs across equations as well.

6 Conclusion

In theory, FDI inflows can have positive, negative, or no effect on the exchange rate, and vice versa. If, for example, within a country FDI has a positive effect on the exchange rate *and* the exchange rate has a positive effect on FDI – our concept of *mutualism* – then FDI-promoting strategies for stabilizing changes in the exchange rate have added and direct multiplier benefits. Further, recent incidences suggest that government stability may have sizable implications for the interactions between FDI inflows and exchange rates. To date, however, no study has analyzed empirically the types of interactions between the exchange rate and FDI that may exist within and across countries *and* the effect of government stability on such interactions.

In this paper, we characterize empirically the types of interactions between FDI and the exchange rate, guided by the theoretical literature that provides six specific predictions about the FDI-exchange rate relationship. We also analyze the effect of government stability on the FDI-exchange rate interactions. To do so, we use a recently developed semiparametric system of simultaneous equations model that accommodates the exchange rate and FDI as a bivariate response. This simultaneous equations model allows us to coalesce several important aspects of the empirical and theoretical exchange rate and FDI literatures, including (i) the joint determination of the exchange rate and FDI, (ii) nonlinear and nontrivial interactions of government stability with each of the conditioning variables, (iii) an instrumental variables approach for identification, (iv) unobserved heterogeneity (country- and time-specific effects) of unknown and non-neutral form, and (v) correlations in errors across equations. Only a few existing papers have explored even a *subset* of these important model structures.

We find several important interactions in the exchange rate-FDI-government stability nexus that have not been documented by germane existing literatures. Specifically, our proposed semiparametric system of equations model, and associated specification tools, suggests that across developed and developing economies, causal, heterogeneous *mutualism* and *FDI-commensalism* are the most dominant types of interactions between FDI and the exchange rate; this suggests that in most countries, FDI has a significantly positive effect on the exchange rate, and in some countries the exchange rate has a significantly positive effect on FDI while in others the exchange rate does not effect FDI inflows. We find that government stability is an important source of heterogeneity in these effects, particularly with approximately 6-8 points being an important government stability threshold for which (i) above this threshold the FDI effect on exchange rates substantially increases, and (ii) an inflection point in the exchange rate effect on FDI such that the negative effect at low levels of government stability switches to become positive. We note that the average world economy fluctuates right around this important threshold – including both developed and developing nations – indicating that small changes in government stability can have dramatic effects on relationships in the macroeconomy.

These findings are strong evidence in support of research advocating a more tailored, country-specific set of macroeconomic policies for the relationship between the exchange rate and FDI. It is well-known that neglected heterogeneity can lead to misleading inferences on the parameters of interest. Thus, our findings underscore the importance of accounting for different sources of heterogeneities in a flexible – rather than the traditionally *ad hoc* parametric – manner to obtain consistent and generally reliable results. Our semiparametric system of simultaneous equations model coupled with its instrument-based estimator seems appropriate for assessing empirically the types of interactions between the exchange rate and FDI.

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Technical Appendix

A.1 Estimation and Identification

To understand the estimation technique, let us first rewrite each equation j in (3.1) as

$$y_{j,it} = \widetilde{X}'_{j,it} g_j(Z_{j,it}) + \epsilon_{j,it}, \tag{A.1}$$

where $\widetilde{X}'_{j,it} := (Y'_{-j,it}, X'_{j,it})$ and $g_j(Z_{j,it}) := (\lambda'_j(Z_{j,it}), \gamma'_j(Z_{j,it}))'$ and $m_j := p_j + k_j$.[12] Given the general unspecified form of our coefficient functions $g_j(\cdot)$ in (A.1) and the absence of a distributional assumption on $\epsilon_{j,it}$, MDK choose the generalized method of moments (GMM) approach to estimate the system of equations. Heuristically, MDK first linearize the $g_j(\cdot)$ in each equation using local-linear approximation (Fan & Gijbels 1996); MDK apply this method to the system of equations as follows. Assume each g_j is sufficiently smooth and consider a first-order Taylor series expansion of $g_j(Z_{j,it})$ around a fixed point z_j in a neighborhood of $\{Z_{j,it}\}$, so that the s^{th} component of this expansion is

$$g_j^s(Z_{j,it}) \approx a_j^s + (b_j^s)'(Z_{j,it} - z_j), \ s = 1, \ldots, m_j, \tag{A.2}$$

where $b_j^s := \partial g_j^s(z_j)/\partial z_j$, a $d_j \times 1$ vector of first-order derivatives. Note that for the j-th equation, the remainder term of the second-order Taylor series expansion of the s-th component of $g_j(Z_{j,it})$, $g_j^s(Z_{j,it})$, is

$$R_j^s(Z_{j,it}, z_j) = g_j^s(Z_{j,it}) - a_j^s - (b_j^s)'(Z_{j,it} - z_j) - \frac{1}{2}(Z_{j,it} - z_j)'\nabla^2 g_j^s(z_j)(Z_{j,it} - z_j), \tag{A.3}$$

and $R_j(Z_{j,it}, z_j) = (R_j^1(Z_{j,it}, z_j), R_j^2(Z_{j,it}, z_j), \ldots, R_j^{m_j}(Z_{j,it}, z_j))'$ is a m_j-dimensional vector. Define $\bar{R}_j^s(Z_{j,it}, z_j) := \frac{1}{2}(Z_{j,it} - z_j)'\nabla^2 g_j^s(z_j)(Z_{j,it} - z_j)$ to be the second order term in the expansion, and $\bar{R}_j(Z_{j,it}, z_j) = (\bar{R}_j^1(Z_{j,it}, z_j), \bar{R}_j^2(Z_{j,it}, z_j), \ldots, \bar{R}_j^{m_j}(Z_{j,it}, z_j))'$.

Combining (A.1) and the first-order approximation in (A.2) we obtain

$$y_{j,it} \approx U'_{j,it}\alpha_j + \epsilon_{j,it}, \tag{A.4}$$

where $U_{j,it} := \begin{pmatrix} \widetilde{X}_{j,it} \\ \widetilde{X}_{j,it} \otimes (Z_{j,it} - z_j) \end{pmatrix}$ is a vector of dimension $m_j(d_j + 1)$, $\otimes$ is the Kronecker product operator, and the corresponding coefficient vector is $\alpha_j := (a_j^1, \ldots, a_j^{m_j}, (b_j^1)', \ldots, (b_j^{m_j})')'$. Now stacking observations by T, then by N, and then by J gives the compact system formulation

$$y \approx U\alpha + \epsilon, \tag{A.5}$$

where $y = (y'_1, y'_2)'$, $U = block\ diag(U_1, U_2)$ so that for each j, U_j is a matrix of $NT \times m_j(d_j + 1)$ observations on all right-hand side variables, $\alpha = (\alpha'_1, \alpha'_2)'$, and $\epsilon = (\epsilon'_1, \epsilon'_2)'$ with

$$\epsilon_j = (\epsilon_{j,11}, \ldots, \epsilon_{j,1T}, \ldots, \epsilon_{j,21}, \ldots, \epsilon_{j,2T}, \ldots, \epsilon_{j,N1}, \ldots, \epsilon_{j,NT})'.$$

Assume the existence of additional information in the form of instruments, W, to ensure the identi-

[12]In general, $Z_{j,it}$ is required to be the same across $g_j(\cdot)$ for any j because of substantial econometric difficulties that arise in estimation of a semiparametric varying coefficient model in which the coefficient variables differ across coefficients.

fication of the α parameter in the system in (A.5). For the population moment conditions, let $V_{j,it} := (W'_{j,it}, Z'_{j,it})'$ and $V_{it} = (V'_{1,it}, V'_{2,it})'$. Thus,

$$E(\epsilon_{it}|V_{it}) = 0. \tag{A.6}$$

In light of the moment equality in (A.6), for any measurable function $Q(V_{it})$,

$$E(\epsilon_{it}|V_{it}) = 0 \iff E(Q(V_{it})\epsilon_{it}|V_{it}) = 0. \tag{A.7}$$

In the spirit of Cai & Li (2008), MDK choose for each equation j,

$$Q_{j,it} := Q(V_{j,it}) = \begin{pmatrix} W_{j,it} \\ W_{j,it} \otimes (Z_{j,it} - z_j)/h_j \end{pmatrix},$$

which is a low-order polynomial vector of dimension $l_j(d_j + 1)$ in $W_{j,it}$ and $Z_{j,it}$, l_j is the dimension of $W_{j,it}$, and $l_j \geq m_j$ for identification. In addition, the first entry of the vector $W_{j,it}$ is equal to one.

For ease of exposition, let $Q = block\ diag(Q_1, Q_2)$ so that for each j, Q_j is a matrix of $NT \times l_j(d_j+1)$ observations on the variables in $Q_{j,it}$. Also, let the system kernel matrix $K = block\ diag(K_1, K_2)$ where $K_j = diag(K_{h_j}(Z_{j,11} - z_j), \ldots, K_{h_j}(Z_{j,NT} - z_j))$ with $K_{h_j}(\cdot) := h_j^{-d_j} K_j(\cdot/h_j)$, a kernel function in $\mathbb{R}^{d_j}$ for equation j. Define $\tilde{m}_j := m_j(d_j + 1)$, $\tilde{m} := \tilde{m}_1 + \tilde{m}_2$, and similarly, $\tilde{l}_j := l_j(d_j + 1)$, $\tilde{l} := \tilde{l}_1 + \tilde{l}_2$.

One specific local-linear GMM system MDK estimator that is relevant to our system analysis assumes $Z_{1,it} = Z_{2,it} = Z_{it}$, $h_1 = h_2 = h$, and $K_1 = K_2 = K$. This MDK local-linear GMM system estimator, $\widehat{\alpha}_{GMM}$, is defined as

$$\widehat{\alpha}_{GMM} = \arg\min_{\alpha}\ (y - U\alpha)'\widetilde{K}Q\Gamma^{-1}Q'\widetilde{K}(y - U\alpha), \tag{A.8}$$

where $\widetilde{K} = K \otimes I_J$, and Q and U are as previously defined but with Z_{it} in lieu of $Z_{j,it}, \forall\ j$, and Γ^{-1} is a known $\tilde{l} \times \tilde{l}$ positive definite weighting matrix. Then

$$\widehat{\alpha}_{GMM} = \Big[U'\widetilde{K}Q\Gamma^{-1}Q'\widetilde{K}U\Big]^{-1}\Big[U'\widetilde{K}Q\Gamma^{-1}Q'\widetilde{K}y\Big]. \tag{A.9}$$

The MDK estimator $\widehat{\alpha}_{GMM}$ is very easy to implement. Under the assumptions enumerated in MDK, $\widehat{\alpha}_{GMM}$ is consistent and asymptotically normal – which renders easy statistical inference. We, however, obtain standard errors for our estimate of α using a wild-bootstrap predicated on 399 replications.

A.2 Selection and Interpretation of Bandwidth

As in Delgado, McCloud & Kumbhakar (2014), we select the optimal smoothing parameters, $\{h_c, \lambda_u, \lambda_o\}$ using the method of least squares cross validation. The method of least squares cross validation selects $\{h_c, \lambda_u, \lambda_o\}$ by minimizing the following criterion function

$$\min_{\{h_c,\lambda_u,\lambda_o\}} (nTJ)^{-1} \sum_{j=1}^{J}\sum_{i=1}^{n}\sum_{t=1}^{T} \Big[y_{j,it} - \widetilde{X}'_{-j,it}\widehat{g}_j(Z_{-it})\Big]^2, \tag{A.10}$$

in which $\widetilde{X}'_{-j,it}\widehat{g}_j(Z_{-it})$ is the leave-one-out nonparametric GMM estimate of $\widetilde{X}'_{j,it}g_j(Z_{it})$. It is common to employ a cross validation procedure to select bandwidths in applied research as regression estimates are typically sensitive to choice of bandwidth parameter. Further, the least squares cross validation procedure has been shown to asymptotically select the optimal bandwidth, and has been shown to have impressive finite sample performance that includes the ability to detect nonlinearities in the data (Li & Racine 2007).

In the local-linear least squares approach, a continuous nonparametric variable that has nonlinear interactions with other variables is assigned a relatively small bandwidth when chosen with the least squares cross validation criterion. Li & Racine (2004) and Hall, Li & Racine (2007) show that an effective finite sample threshold for interpretation of nonlinear effects is approximately two standard deviations of the data. Variables whose cross validated bandwidth exceeds this threshold are interpreted to have linear interactions with the other nonparametric variables. Hence, examination of the cross validated bandwidths yields important insight into the data driven specification of heterogeneity within the model. Formal statistical tests can be used to choose between linear parametric and potentially nonlinear semiparametric models.

Table 8: List of countries grouped by percentile according to time-averaged government stability

Below 25th	25th to Below 50th	50th to Below 75th	75th and Above
$\overline{G} < 7.225$	$7.225 \leq \overline{G} < 7.924$	$7.924 \leq \overline{G} < 8.512$	$\overline{G} \geq 8.512$
Argentina	Albania	Angola	Algeria
Bangladesh	Bolivia	Armenia	Australia
Colombia	Brazil	Austria	Azerbaijan
Costa Rica	Bulgaria	Bahrain	Belarus
Czech Republic	Dominican Republic	Belgium	Botswana
Ecuador	Gabon	Burkina Faso	China
El Salvador	Greece	Cameroon	Cyprus
Guatemala	Guinea	Canada	Estonia
Haiti	Guinea-Bissau	Chile	Finland
Honduras	Guyana	Croatia	Iceland
Iraq	Hungary	Denmark	Ireland
Israel	India	Ethiopia	Jordan
Italy	Indonesia	France	Kuwait
Kenya	Jamaica	Germany	Libya
Liberia	Japan	Ghana	Luxembourg
Malawi	Lebanon	Latvia	Malta
Nicaragua	Madagascar	Lithuania	Moldova
Niger	Mali	Malaysia	Morocco
Nigeria	Mexico	Mongolia	Namibia
Pakistan	New Zealand	Mozambique	Oman
Papua New Guinea	Norway	Netherlands	Saudi Arabia
Paraguay	Panama	Portugal	Singapore
Peru	Romania	Senegal	Slovenia
Philippines	Sierra Leone	South Africa	Switzerland
Poland	Thailand	Spain	Tanzania
Sri Lanka	Togo	Sudan	Tunisia
Suriname	Turkey	Sweden	Uganda
Zambia	Ukraine	United Kingdom	United States
Zimbabwe		Uruguay	Vietnam

Note: The index of government stability comes from the International Country Risk Guide published by Political Risk Services, and is defined as "the government's ability to carry out its declared program(s), and its ability to stay in office". The index is the sum of three subcomponents – government unity, legislative strength and popular support – each with a maximum score of 4 points and a minimum score of 0 points; a score of 4 points equates to very low risk and a score of 0 points to very high risk. This table indicates the groups of countries that fall into the quartile ranges of the distribution of the time-averaged level of government stability, denoted by $\overline{G}$, for the period 1984 to 2010.

Table 9: Countries and their types of interactions between Δ exchange rate and FDI – benchmark model

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Algeria, Argentina*, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Botswana*, Brazil, Burkina Faso, Cameroon, Canada, China, Colombia*, Cyprus, Denmark, Dominican Republic,Ecuador, El Salvador, Estonia*, Finland, France, Gabon*, Germany, Ghana, Greece, Guinea, Haiti, Honduras, Hungary, India, Ireland, Israel^{*+}, Italy, Jamaica, Japan, Kenya, Kuwait*, Latvia, Libya, Luxembourg, Madagascar, Malaysia, Mali, Morocco, Mozambique, Namibia, Netherlands, Nicaragua, Niger*, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Saudi Arabia, Senegal*, Sierra Leone, Singapore, Slovenia, South Africa*, Spain, Sri Lanka, Sudan*, Suriname, Sweden, Switzerland, Tanzania, Thailand, Togo, Tunisia, Turkey, United Kingdom, United States, Uruguay, Vietnam, Zimbabwe	**FDI-Antagonistic Symbiosis**:	**FDI-Commensalism**: Albania, Angola, Argentina*, Armenia, Belarus, Belgium, Botswana*, Bulgaria, Chile, Colombia*, Croatia, Estonia*, Ethiopia, Gabon*, Guatemala, Guyana, Iceland, Israel^{*+}, Jordan, Kuwait*, Lebanon, Liberia^{+}, Lithuania, Malawi^{+}, Malta, Mexico, Moldova, Mongolia, New Zealand, Niger*, Nigeria, Papua New Guinea, Senegal*, South Africa*, Sudan*, Zambia^{+}
	Negative	**Δ Exchange Rate -Antagonistic Symbiosis**: Costa Rica^{+}	**Synnercrosis**:	**Δ Exchange Rate -Ammensalism**: Malawi^{+}, Paraguay
	Zero	**ΔExchange Rate - Commensalism**: Costa Rica^{+}, Israel^{*+}, Romania, Uganda	**FDI-Ammensalism**:	**non-Symbiosis**: Bolivia, Czech Republic, Guinea-Bissau, Indonesia, Iraq, Israel^{*+}, Liberia^{+}, Ukraine, Zambia^{+}

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.

Table 10: Countries and their types of interactions between Δ exchange rate and FDI – M1

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Albania, Australia, Croatia*, Cyprus, Ecuador*, Ghana, Kuwait, Latvia, Lebanon, Luxembourg, Mali*, Malta*, Nicaragua^{+}, Niger	**FDI-Antagonistic Symbiosis**: Angola, Armenia, Brazil, Cameroon*, Canada, Chile, China*, Colombia*, Croatia*, Ecuador*, El Salvador*, Estonia^{+}, Ethiopia, Guatemala^{*+}, Guinea, Guyana, Haiti*, India, Indonesia^{+}, Israel^{+}, Italy, Japan*, Kenya*, Lithuania, Mali*, Mexico^{*+}, New Zealand*, Oman, Papua New Guinea, Philippines, Poland, Sierra Leone, Singapore, Spain^{+}, Sri Lanka, Thailand^{*+}, Tunisia, Turkey*, United Kingdom*, Vietnam, Zambia	**FDI-Commensalism**: Armenia, Austria, Azerbaijan^{+}, Bahrain, Bangladesh, Belgium, Botswana, Bulgaria, Burkina Faso, Cameroon*, China*, Colombia*, Denmark^{+}, Dominican Republic,El Salvador*, Finland, Germany, Greece, Guatemala^{*+}, Haiti*, Honduras, Hungary, Ireland, Jamaica, Japan*, Kenya*, Libya, Madagascar, Malawi^{+}, Malaysia, Malta*, Mexico^{*+}, Moldova, Mongolia, Morocco, Mozambique, Namibia, Netherlands, New Zealand*, Nigeria, Peru, Portugal, Saudi Arabia, Senegal, Slovenia^{+}, Sudan, Sweden, Thailand^{*+}, Togo, Turkey*, United Kingdom*, United States, Uruguay
	Negative	**Δ Exchange Rate -Antagonistic Symbiosis**: Argentina*, Gabon, Nicaragua^{+}, Paraguay*	**Synnercrosis**: Argentina^{*+}, Costa Rica, Guatemala^{*+}, Indonesia^{+}, Israel^{+}, Mexico^{*+}, Paraguay*	**Δ Exchange Rate -Ammensalism**: Guatemala^{*+}, Iraq^{*+}, Malawi^{+}, Mexico^{*+}
	Zero	**ΔExchange Rate - Commensalism**: Algeria, Argentina^{*+}, Belarus*, Guinea-Bissau, Latvia, Slovenia*, Uganda*, Ukraine	**FDI-Ammensalism**: Argentina^{*+}, Czech Republic*, Estonia^{+}, Iceland*, Liberia*, Spain^{+}, Thailand^{*+}	**non-Symbiosis**: Azerbaijan^{+}, Belarus*, Bolivia, Czech Republic*, Denmark^{+}, France, Iceland*, Iraq^{*+}, Ireland*, Jordan, Liberia*, Romania, Slovenia^{*+}, South Africa, Thailand^{*+}, Uganda*

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.

Table 11: Countries and their types of interactions between Δ exchange rate and FDI – M2

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Albania, Angola^{+}, Argentina, Austria, Bahrain, Bangladesh, Belgium, Bolivia^{+}, Brazil*, Burkina Faso, Cameroon, Canada, China, Croatia, Denmark^{+},El Salvador, Estonia*, France, Germany, Ghana, Guatemala, Guinea, Honduras, Hungary, Iceland^{+}, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan*, Kenya, Kuwait^{+}, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malaysia^{+}, Mexico^{+}, Morocco, Mozambique, Netherlands, Niger*, Nigeria, Norway, Oman, Pakistan^{+}, Papua New Guinea, Poland, Portugal, Senegal^{+}, Sierra Leone, Singapore, Slovenia^{+}, South Africa, Spain^{+},Sri Lanka^{+}, Sudan, Sweden^{+}, Thailand, Tunisia, Turkey, United Kingdom, United States, Uruguay, Vietnam, Zambia, Zimbabwe*	**FDI-Antagonistic Symbiosis**:	**FDI-Commensalism**: Armenia, Belarus, Brazil*, Bulgaria, Colombia, Costa Rica, Estonia*, Gabon^{+}, Guinea-Bissau, Jordan*, Mali, Moldova^{+}, Mongolia^{+}, New Zealand, Niger*, Paraguay, Peru, Togo, Zimbabwe*
	Negative	**Δ Exchange Rate -Antagonistic Symbiosis**: Algeria, Angola^{+}, Australia^{+}, Kuwait^{+}, Pakistan^{+}, Slovenia^{+}, Sri Lanka^{+}	**Synnercrosis**: Haiti	**Δ Exchange Rate -Ammensalism**:
	Zero	**ΔExchange Rate - Commensalism**: Australia^{+}, Azerbaijan, Bolivia^{+}, Botswana, Cyprus, Denmark^{+}, Finland, Greece*, Iceland^{+}, Kuwait^{+}, Malaysia^{+}, Malta*, Mexico^{+}, Mozambique^{+}, Namibia, Philippines, Saudi Arabia, Senegal^{+}, Spain^{+}, Sri Lanka^{+}, Sweden^{+}, Switzerland, Uganda	**FDI-Ammensalism**: Romania	**non-Symbiosis**: Czech Republic, Gabon^{+}, Greece*, Guinea-Bissau^{+}, Malawi, Malta*, Moldova^{+}, Mongolia^{+}, Ukraine

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.

Table 12: Countries and their types of interactions between Δ exchange rate and FDI – M3

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Angola, Australia, Austria*, Azerbaijan*, Bahrain*, Burkina Faso, Cameroon^{+}, China, Colombia*, Denmark*, Finland*, France, Greece, Haiti*, Hungary, Ireland, Japan, Kenya*, Kuwait*, Libya, Malaysia*, Mali, Morocco, Netherlands*, Niger^{*+}, Oman, Peru*, Portugal, Sierra Leone, Singapore, Slovenia, Spain, Suriname, Switzerland, Tanzania, United States*, Vietnam	**FDI-Antagonistic Symbiosis**: Liberia, Niger^{*+}	**FDI-Commensalism**: Albania, Armenia, Austria*, Azerbaijan*, Bahrain*, Bangladesh, Belarus, Belgium, Botswana, Brazil, Bulgaria, Canada, Colombia*, Croatia, Cyprus, Denmark*, Dominican Republic, Ecuador, Estonia, Ethiopia, Finland*, Gabon, Germany, Guatemala, Guyana, Haiti*, Honduras, Iceland, India, Indonesia, Italy, Jamaica, Kenya*, Kuwait*, Latvia, Lebanon, Lithuania, Madagascar, Malaysia*, Malta, Mexico, Moldova, Mongolia, Mozambique, Namibia, Netherlands*, New Zealand, Nicaragua*, Nigeria, Norway, Panama, Papua New Guinea, Peru*, Philippines, South Africa, Sri Lanka, Sweden, Togo, United Kingdom, United States*, Uruguay, Zambia
	Negative	**Δ Exchange Rate -Antagonistic Symbiosis**: Costa Rica^{+}, Niger^{*+}	**Synnercrosis**: Niger^{*+}	**Δ Exchange Rate -Ammensalism**: Malawi, Nicaragua*, Paraguay
	Zero	**ΔExchange Rate - Commensalism**: Algeria, Argentina*, Cameroon^{+}, Costa Rica^{+}, Ghana, Poland, Romania, Thailand*, Tunisia, Zimbabwe	**FDI-Ammensalism**: Ukraine	**non-Symbiosis**: Argentina*, Bolivia, Botswana, Bulgaria, Czech Republic, Israel, Jordan, Romania, Senegal, Thailand*, Uganda

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.

Table 13: Countries and their types of interactions between Δ exchange rate and FDI – M4

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Algeria*, Australia, Austria*, Azerbaijan*, Bahrain, Cameroon, Canada*, China*, Colombia*, Denmark*, Finland, France*, Ghana, Greece*, Hungary, Japan, Kenya, Kuwait*, Libya, Luxembourg, Morocco*, Mozambique, Nicaragua, Oman, Pakistan, Portugal*, Saudi Arabia, Senegal*, Slovenia, Spain*, Sri Lanka*, Switzerland, Tanzania, Thailand, Togo, Tunisia, United States*, Vietnam, Zimbabwe	**FDI-Antagonistic Symbiosis**: Jordan	**FDI-Commensalism**: Albania, Algeria*, Angola, Argentina, Armenia,Austria*,Azerbaijan*,Bangladesh, Belarus, Belgium, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Canada*, Chile, China*, Colombia*, Croatia, Cyprus, Denmark*, Dominican Republic, Ecuador, El Salvador, Estonia, Ethiopia, France*, Gabon, Germany, Greece*, Guatemala, Guinea, Guyana, Haiti, Honduras, Iceland, India, Indonesia^{+}, Ireland, Israel^{+}, Italy, Jamaica, Kuwait*, Latvia, Lebanon, Liberia, Lithuania, Madagascar, Malawi, Malaysia, Mali, Malta, Mexico^{+}, Moldova, Mongolia, Morocco*, Namibia, Netherlands, New Zealand, Niger, Nigeria, Norway, Panama, Papua New Guinea, Peru^{+}, Philippines, Poland, Portugal*, Romania, Senegal*, Sierra Leone, Singapore, South Africa, Spain*, Sri Lanka*, Sudan, Suriname, Sweden, Thailand, Turkey, Uganda, United Kingdom, United States*, Uruguay
	Negative	**Δ Exchange Rate - Antagonistic Symbiosis**: Costa Rica*	**Synnercrosis**: Guinea-Bissau*, Iraq, Ukraine	**Δ Exchange Rate -Ammensalism**: Costa Rica*, Czech Republic, Guinea-Bissau*, Indonesia^{+}, Israel^{+}, Mexico^{+}, Paraguay, Peru*, Zambia
	Zero	**ΔExchange Rate - Commensalism**:	**FDI-Ammensalism**:	**non-Symbiosis**:

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.

Table 14: Countries and their types of interactions between Δ exchange rate and FDI – M5

		Δ Exchange Rate Effect		
		Positive	Negative	Zero
FDI Effect	Positive	**Mutualism**: Argentina, Australia, Bahrain, Bangladesh, Botswana*, Bulgaria*, Canada, Costa Rica*, Finland, France*, Ghana^{+}, Hungary*, Ireland^{+}, Japan,Jordan, Kenya*, Kuwait, Luxembourg, Malaysia, Malta, Namibia, New Zealand, Pakistan^{+}, Peru, Philippines, Saudi Arabia, Slovenia^{+}, Tanzania, Thailand, United Kingdom*, United States, Vietnam, Zimbabwe	**FDI-Antagonistic Symbiosis**: Bangladesh, Belgium, Botswana, Brazil, Bulgaria*, Canada, Costa Rica*, Croatia, Cyprus, Denmark, Greece, Hungary*, Italy, Malta, Mexico, Netherlands*, New Zealand, Nigeria^{+}, Norway, Papua New Guinea^{+}, Poland, Portugal, Romania^{+}, Sri Lanka, Turkey, Uruguay*, Zambia^{+}	**FDI-Commensalism**: Austria, Botswana*, Bulgaria*, Costa Rica*, Czech Republic, Ecuador, France*, Germany, Hungary*, Indonesia, Israel, Jamaica, Kenya*, Morocco, Netherlands*, Romania*, South Africa, Spain,Sweden, United Kingdom*, Uruguay*
	Negative	**Δ Exchange Rate -Antagonistic Symbiosis**: China, Ireland^{+}, Oman, Singapore, Tunisia	**Synnercrosis**: Colombia*, India, Lebanon, Nigeria^{+}, Papua New Guinea^{+}, Paraguay*, Romania^{+},Zambia^{+}	**Δ Exchange Rate -Ammensalism**: Colombia*, Romania*
	Zero	**ΔExchange Rate - Commensalism**: Algeria, Azerbaijan, Ghana^{+}, Pakistan^{+}, Panama, Slovenia^{+}, Switzerland	**FDI-Ammensalism**: Chile, Papua New Guinea^{+}, Paraguay^{+}, Ukraine	**non-Symbiosis**:

Repeated countries in the same row are marked with *. Repeated countries in the same column are marked with $^{+}$. Repeated countries across rows and columns are marked with $^{*+}$.