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Abstract

In this paper we study the relationship between the strength of intellectual property (IP) protection that less developed countries provide and foreign direct investment (FDI) flows into these countries, in the post-TRIPs period 2004-2015. Our sample period is highly appropriate insofar as it comes after the ten year period that the developing countries were allowed for implementing IP reforms in accordance with the Trade-Related Intellectual Property Rights ($TRIPs$) agreement. Further, it is long enough to permit the modelling of a delayed FDI response to the IP reform stimulus. Our modelling strategy attempts to capture the heterogeneity of the impact of the IP reform on the FDI inflows by estimating a conditional difference-in-differences specification. Thus, we allow for the fact that the impact of IP reform can vary significantly across countries depending on the magnitude of intellectual property that they own for which they seek such protection, for that would indicate the importance that they attach to IP protection. Estimating a varying coefficient model, our results do not provide evidence of a statistically significant effect of IP reform on FDI inflows into less developed countries, nor do we find that the effect of such reform is significantly stronger for countries that own relatively larger amounts of intellectual property. These results hold contemporaneously as well as with lags. Instead, FDI inflows appear to be driven by market size and domestic investment climate variables. Disaggregating our sample into the sub-groups of developing countries and least developed countries, we find that our overall results for less developed countries are driven by the sub-group of developing countries.

Keywords: Foreign direct investment, Intellectual property protection

JEL Codes: O34, O24, O11

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1. Introduction

A characterizing feature of less developed economies has been noted to be the shortage of reproducible tangible capital, as is evident from earlier growth models which emphasized the centrality of physical investment in the process of economic growth. Even with the advent of endogenous growth models asserting the importance of knowledge capital, the importance of physical investment remained (see, for instance, Basu 2003, chapter 3). The significance of foreign direct investment (FDI) in the context of developing economies then becomes self-evident, as this investment from abroad serves to ease the domestic resource constraint and/or the foreign exchange constraint on physical capital (McKinnon 1964). This significance of FDI for the growth prospects of recipient nations is further enhanced if the inflow of capital also facilitates the import of relatively advanced technology embodied in the physical capital, as with advanced machinery.

In addition to this direct technology transfer that may piggyback on inward FDI flows, there are also a number of indirect channels through which the host nation may benefit technologically in the longer run (Clark et al. 2011). Thus, greater proficiency from emulating the production, management and marketing practices of (affiliates of) multinational firms may enhance the productivity of the existing technology of host country firms. Further, competition for survival in the domestic market may coerce the host nation firms to step-up innovation themselves. This process of induced technological innovation may be further facilitated by the transfer of skilled workers from the multinational affiliates located in the host country to domestic firms. Furthermore, domestic firms supplying intermediate inputs to the multinational affiliates may benefit from technical assistance and training provided by the latter.

Given the importance of foreign direct investment in a resource-constrained milieu such as that in the less developed economies, instruments that potentially augment this flow become relevant to outcomes in those economies. One such instrument is supposedly the strength of intellectual property protection that nations provide. On the supposition that the sole interest of the source country firm is profit, whether that accrues from arms-length exports or FDI or from licensing technology to the destination country, studies argue that progressive strengthening of intellectual property rights (IPR) in the destination country is likely to initially induce a switch from exports to FDI, and then a switch from FDI to licensing, by the source country firm. By this argument, 'stronger' IPR in the destination country would be associated with *increased* FDI into that country, and 'still stronger' IPR with *decreased* FDI into that country.

However, the strength of intellectual property protection provided by the (potential) host country would be relevant in our context only if the foreign direct investment involves the transfer of proprietary intellectual property and/or involves the subsequent generation of proprietary intellectual property in the host country. By implication, if the foreign direct investment does not involve the transfer or subsequent generation of technology, and constitutes merely a transfer of resources that augment the domestic capital stock of the receiving economy, then the strength of intellectual property rights should not be a matter of concern to the foreign investors.[1]

A caveat, though, may be in order here. Markusen (1995) asks rhetorically "What then is being traded when we observe multinational production?", and proceeds to suggest that these could be firm-specific assets such as management and engineering services (in addition to any intellectual property such as patents, trademarks and design rights). To the extent that firms are protective of even non-technological intellectual property, the strength of intellectual property protection in the host nation may serve to signal the ease with which these can be copied. Therefore, even when no technology transfer occurs with the FDI inflow, intellectual property protection in recipient nations could be relevant in its signaling role when knowledge-based assets are involved. By implication, when knowledge-based assets, technological or non-technological, are *not* involved, IPR considerations should not matter to the potential foreign investor.

The upshot of this discussion is, that theoretically, stronger IPR in the destination country may be associated with a positive response, no response, or even an inverted-U shaped response of FDI into that country; and the empirical studies appear to be at least in partial consonance with these possibilities. Thus, Lee and Mansfield (1996), Seyoum (1996), Primo Braga and Fink (1997), Maskus (1998), Smith (2001), and Awokuse and Yin (2009), all find a strong positive association between FDI and IPR. Park and Lippoldt (2003) further show that the strength of this positive association is stronger for developing countries than for developed countries, because the former have not yet reached the strongest levels of protection. They also find that in industries in which the reverse engineering of technology is difficult (such as metals, machinery and transportation) FDI is not responsive to IPR, whereas in industries in which technology imitation is easy (such as computer services and chemicals) IPR matter significantly for FDI. In similar vein, Javorcik (2004) shows that weak IPR deter FDI in manufacturing and R&D, and divert it to sales and distribution. On the other hand, Ferrantino (1993), Mansfield (1993), Maskus and Konan (1994), Kondo (1995), and Seyoum (1996) for developing countries, do not find any statistically significant relationship between FDI and IPR.

Despite these informative studies, it is unclear to what extent the earlier results ought to be acceptable today, insofar as the IP variable(s) used therein may not have been exogenous. In the present paper, therefore, we facilitate identification by restricting our study to less developed countries in the post-TRIPs period, so that one can plausibly exploit the exogeneity of the IP variable(s) as brought out by several authors in other (though related) contexts (Kanwar 2012, Ivus 2010, Qian 2007). The lone exception in the received literature in this respect, is Park and Lippoldt (2003); who, however, consider the response of FDI 'stocks' that are not properly computed, insofar as the stock in a given year has been computed by simply adding up the stocks of earlier years without any discounting. Second, unlike the extant studies, we attempt to pick up any lagged relationship that may exist between FDI and IPR. Third, our sample period starts after the expiry of the ten year period designated for the implementation of the TRIPs agreement by developing countries, which have been the overwhelming beneficiaries of FDI inflows into the group of less developed countries as a whole. Moreover, our sample period 2004-2015 is long enough to permit the modeling of a delayed response to the stimulus of stronger intellectual property laws adopted by the less developed countries.

Our modelling strategy attempts to capture the heterogeneity of the impact of the IP reform on the FDI inflows by estimating a conditional difference-in-differences or variable coefficient specification. Thus, we allow for the fact that the impact of IP reform can vary significantly across countries depending on the magnitude of intellectual property that they own for which they seek such protection, for that would indicate the importance that they attach to IP protection. Studies that do not correct for such heterogeneity likely suffer from inconsistent estimates. Our results do not provide evidence of a statistically significant effect of IP reform on FDI inflows into less developed countries, nor do we find that the effect of such reform is significantly stronger for countries that own relatively larger amounts of intellectual property. Both these results hold vis-à-vis contemporaneous IP variables as well as vis-à-vis lagged IP variables. Instead, FDI inflows appear to be driven by market size and domestic investment climate variables. Disaggregating our sample into the sub-groups of developing countries and least developed countries, we find that our overall results for less developed countries are driven by the sub-group of developing countries.

United Nations Conference on Trade and Development data (UNCTAD 2019) for the year 2000 reveal that FDI net inflows for the world as a whole totaled some \$1.38 trillion, of which more than 86% or \$1.18 trillion went to the developed (or high income economies), a smaller but significant \$188 billion or a little more than 13% to developing (or low and middle income) economies, while a mere \$3.2 billion or about 0.2% went to the least developed countries. By 2005, the year which marked the end of the implementation period for the Trade Related Intellectual Property Rights (TRIPs) agreement for developing countries, the developing country share in world FDI net inflows had more than doubled to a little more than 34% (\$330 billion), mostly at the expense of the high income countries whose share had declined to a little more than 65% (\$620 billion), whereas that of the least developed countries still stood at a trivial 0.4% (\$3.6 billion). Data reveal that this trend has continued through 2017, with the developing country share rising steadily to about 40% (\$609 billion) of the world total (\$1.51 trillion), eating into the high income country share which declined further to a little in excess of 58% ($879 billion), with the least developed countries accounting for a small 1.3% ($20 billion). Of course, from these figures and changing shares over time, one cannot gauge which factor(s) best explain the phenomenon of foreign direct investment inflows into recipient countries, and for that we must turn to the formal analysis below.

Section 2 outlines our modelling strategy and estimation equation. Section 3 briefly discusses the dataset, and construction of the variables employed. Section 4 analyses the empirical results, and section 5 presents the resulting conclusions.

2. Modelling Strategy and Estimation Equation

It is normally recognized that the post-1994 strengthening of intellectual property rights in less developed countries was largely externally driven (Kanwar 2012; Ivus 2010; Qian 2007). Less developed countries, evidence shows, were coerced into strengthening their protection of intellectual property as per the Trade-Related Intellectual Property rights (TRIPs) agreement of 1994, which they signed under pressure from certain developed countries. We utilize this exogeneity to determine the effect of IPR reform on foreign direct investment into the less developed economies. We represent the influence of intellectual property protection in terms of a variable based on the Ginarte-Park index of patent rights (Ginarte and Park 1997; Park 2008), modified suitably to buttress the implementation aspect of these rights (Yu 2010). The procedure employed for computing this variable is described in section 3 below.

The dependent variable in our study is real foreign direct investment inflows into country *i* in year *t*, which we denote by $RFDI\_INF_{it}$. The factor whose impact on the dependent variable we intend to test for is the intellectual property regime in country *i* in year t, measured by the modified Ginarte-Park index $MODGPI_{it}$. We model the impact via a conditional difference in differences technique, using a fixed effects panel data model. Given the exogeneity of the IP reforms, the average effect of the reforms may be directly identified as the average impact of an unknown function, say *m*, in the panel regression

$$RFDI\_INF_{it} = M_{it}(MODGPI_{it}) = m(MODGPI_{it}) + \alpha_i + \gamma_t + \varepsilon_{it}, \quad (1)$$

where *M* and m are unknown functions in which the former may even change over country and time. The first equality is rather general, whereas the second conjectures that there is a systematic impact of the property rights measured by $MODGPI_{it}$ that can be additively separated from fixed deviations by country and time (country fixed effects α_i, year fixed effects γ_t), and a mean-independent additive deviation ε_{it}. Typically, people specify *m* as linear, being equal over time and space, i.e. setting $m(MODGPI_{it}) = \beta\, MODGPI_{it}$. However, it is improbable that the strengthening of intellectual property protection has an identical impact on all countries in all years. This can be made explicit using the alternative expression $RFDI\_INF_{it} = \beta\, MODGPI_{it} + (\beta_{it} - \beta)\, MODGPI_{it} + \gamma_t + \alpha_i + \varepsilon_{it}$, which is equivalent to (1) but highlights the implications of a standard linear specification; for we see that although our indicator variable is exogenous in the classical sense, it is not necessarily so if one omits the second term which would then merge with the error term ε_{it}. This is problematic in the sense of rendering our indicator endogenous, if the deviation from the average effect or $(\beta_{it} - \beta)\, MODGPI_{it}$ is not independent of $MODGPI_{it}$. Note that a random coefficient approach for capturing the heterogeneity of the treatment effect leads to exactly the same endogeneity problem. This problem cannot be rectified by instrumental variable estimation, because that would require an instrument for $MODGPI_{it}$ that is not only correlated with $MODGPI_{it}$ but also independent of $(\beta_{it} - \beta)\, MODGPI_{it}$, which is a tall order. In addition, it might even be of interest to explore the heterogeneity of treatment effects. Therefore, a preferable alternative is to model β_{it} suitably, for instance via so-called varying coefficient models.[2] In other words, instead of searching for much more complex estimation procedures whose functioning strongly depends on non-testable, difficult to understand, and thus hardly justifiable assumptions for obtaining a rough idea of the average effect, we propose to use a slightly more flexible model with a standard estimator under weaker assumptions, but one that is more informative about the impact of $MODGPI$ on *FDI*.

To be precise, we could capture such heterogeneity by modelling β_{it} as a function of country-specific drivers of the likely benefit from strengthening intellectual property rights. A self-evident (treatment) effect driver for this is the extent to which countries value intellectual property, and this country-specific valuation may vary over time, so that we can write it as X_{it} for country i in year t. Since this variable could possibly be related to other factors relevant for the dependent variable $RFDI\_INF_{it}$, we must control for those other factors as well. Denoting these country-specific time varying confounders (such as market size, political stability, ease of doing business, etc.) as Z_{it}, and any other country-specific but time 'constant' variables (such as distance from trading partners, language, historical relationship with trading partners, etc.) as α_i, the preferred specification would be:

$$RFDI\_INF_{it} = \beta(X_{it})\, MODGPI_{it} + \delta\, Z_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \quad (2)$$

where $\beta(X_{it})$ indicates that β is a function of the extent to which a country values intellectual property (indicated by X_{it}), and this importance may vary over time and space. Given our data, driver X_{it} should be represented reasonably well by the total patents of a given country in a given year registered at the United States Patent and Trademark Office ($USPAT_{it}$). There are several advantages to using this measure. While the patent statutes and patent grant efficiency probably vary significantly across less developed countries, those of the United States Patent and Trademark Office ($USPTO$) would (supposedly) be the same for all applicants from the LDCs, serving as a common denominator. Further, this common benchmark of the $USPTO$ is exogenous to all the less developed countries, whereas their own patent regimes may or may not be exogenous to their patenting activities. Furthermore, the US market is probably the largest and the most sought after by entrepreneurs wishing to benefit from their innovations. As a result, the more important innovations in countries across the world tend to be registered for patent protection at the $USPTO$ (USPTO 2019). Given these observations, the more patents a country owns at the $USPTO$, the stronger its likely valuation of intellectual property.

Therefore, the varying coefficient β_{it}, i.e. function $\beta(X_{it})$, is modelled in our study as a function of the total patents of a given country at the US Patent and Trademark Office ($USPAT_{it}$). What this function does is to explore the heterogeneity of the causal effect of *MODGPI* on *RFDI_INF*; it is not (necessarily) about the causal effect of *USPAT* on *RFDI_INF*. Therefore, we do not discuss a potential endogeneity of *USPAT*, and we prefer not to call it 'interaction'; rather, one estimates for each given value of *USPAT* the average causal effect of *MODGPI* on *RFDI_INF.* An additional factor that could provide information about the value that a country attaches to intellectual property is its research and development investment, but in practice including this variable is hindered by a severe lack of data availability. In sum, our preferred specification is model (2) with *X* being *USPAT*.

Further, one could argue that legislating and implementing a certain level of intellectual property protection may have a lagged effect on foreign direct investment, on account of various reasons such as uncertainty, financial frictions, or simply mistakes, etc. It may be preferable, therefore, to tweak specification (2) and express it as:

$$RFDI\_INF_{it} = \sum_{l=0}^{L} \beta_l \left(USPAT_{i(t-l)}\right) * MODGPI_{i(t-l)} + \delta\, Z_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \qquad (3)$$

where L is the maximum lag length. In this specification we model the varying coefficients of a particular lagged *MODGPI* to be a function of USPAT of the same time lag, simply because variations of those combinations did not yield any deeper insight. A detailed discussion of the sample dataset and the control variables Z_{it} that we employ now follows.

3. Sample Dataset and Variables Employed

Given our objective of understanding whether FDI inflows into developing countries vary significantly with the intellectual property regime of these nations in the post-TRIPs period, we use country-level data for the period 2004-2015 for our analysis. Although firm-level data across all countries may have been preferable, such FDI data are presently not available for the post-$TRIP$s period.[3] Note also, that the choice of period is not only dictated by our desire to study the post-TRIPs-implementation situation, but also by data availability for the variables employed in our analysis. Dropping all records for which data are missing on one or more variables pertinent to your study, we are left with 769 observations for 71 less developed countries (Appendix 1), with an average of about 11 observations per country, spanning our sample period 2004-2015.

Foreign direct investment inflows refer to the direct investment equity inflows into the recipient economy associated with the ownership of at least 10% of the ordinary shares of voting stock of a given firm(s), and have been computed as the sum of equity capital, reinvested earnings, and other intra-firm loans (UNCTAD 2019). We deflate these current dollar figures by the country-specific GDP deflator to derive the real foreign direct investment inflows ($RFDI\_INF$).

The factors driving FDI, as well as their relative importance, need not remain fixed in time. While in earlier decades such investment decisions may have been predicated on the ‘basic’ considerations of market size, factor costs and politico-economic stability, in more recent times other complicated factors such as intellectual property protection may have become relatively important for a number of reasons. Greater competition amongst less developed nations to attract FDI (Harding and Javorcik 2011), and a greater incidence of trade in higher-value-added technology-intensive products in recent years, both imply an increasing prominence of intellectual property rights (Frischtak 1993). Accordingly, as we mentioned above, our treatment variable is the modified Ginarte-Park index of patent rights ($MODGPI$). We now explain how it is computed. The Ginarte-Park index (Ginarte and Park 1997; Park 2008) incorporates five aspects of patent protection – namely, coverage, duration, subscription to international intellectual property bodies, provisions to prevent patent revocation post-grant, and certain enforcement procedures. It ranges from 0 to 5, with larger values indicating stronger protection. Although the original Ginarte-Park index is quinquennial, the fact that it exhibits steady increase over time for the sample countries (and no fluctuations), allows us to derive the annualized series assuming proportional growth in the intervening years. We then modify this annualized index to strengthen its implementation dimension. To do so, we use the so-called ‘Area-2’ sub-index from the Economic Freedom dataset of the Fraser Institute (Economic Freedom 2018), that captures various facets of legal enforcement in a country, such as contract enforcement, judicial independence, impartiality of courts, property rights protection, impediments to property sale, and military intervention. Re-scaling this sub-index to lie between 0 and 1 (in keeping with the five components of the Ginarte-Park index), we add it to the Ginarte-Park index to derive the modified Ginarte-Park index $MODGPI$, and employ this in our empirical analysis reported below.

To flesh out the model specification, we now discuss the other variables included in our analysis. The rich extant literature suggests that foreign direct investment decisions have traditionally turned upon considerations of market size, political stability, and factor costs in the recipient nations. In addition, the 'domestic business climate' or the legal-institutional factors which determine the 'ease of doing business' also matter. We take up each of these factors in turn.

Domestic market size is represented by gross domestic product per capita measured in constant (2011) purchasing power parity units ($GDPPC$), as well as by population size (POP), both extracted from World Bank data online (World Bank 2019c and World Bank 2019d, respectively). It is preferable to use these two factors separately, than to multiply them and define market size in terms of gross domestic product alone as some studies do, for the latter would imply that countries with a larger gross domestic product have greater purchasing power, which is evidently untrue as a comparison of China and India with many smaller economies would reveal. Moreover, gross domestic product moves up and down with the business cycle without really reflecting changes in the purchasing power of the economy. Furthermore, gross domestic product tends to be a portmanteau or catch-all variable insofar as it subsumes a number of other macro-economic variables, and not just demand-side variables alone.

Evidently, the variables $GDPPC$ and POP signal the size of the domestic market at a somewhat theoretical level, and several other factors may work to determine the true business potential of an economy. One such complex of factors is the business climate. The domestic business climate comprises the legal and institutional factors that together determine the 'friction' in the system, and hence the ease with which businesses can transact. A conducive business climate is marked by lower friction and hence lower transactions costs, thereby increasing economic potential and performance. On the contrary, an adverse business climate stifles potential and performance, rendering the domestic market that much less attractive to foreign investors. We capture the domestic business climate via the ease of doing business score ($EASE$), which attempts to measure regulations that directly impinge on businesses (World Bank 2019a). It is computed as the unweighted mean of 10 sub-indices[4] pertaining to the procedures, time and cost of launching a business venture, obtaining construction permits, obtaining an electricity connection, registration of property, obtaining credit, protecting investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency (World Bank 2019b). The ease of doing business scores thus allow us to compare the business climate across economies, whereas a change in the ease of doing business score for a given country indicates the change in the regulatory environment for entrepreneurs in that country over time.

Although the market size and business climate variables discussed above provide signals about the expected return that potential foreign investors may expect in a given economic milieu, what may also be of importance to the foreign investors is the risk attaching to these expected returns on account of inadequate political stability. Although political stability can be variously defined, we prefer to define it in terms of the absence of social unrest and political violence, phenomena which pose a threat to life and property. Empirical evidence shows that lack of political stability tends to retard investment (Alesina and Perotti 1996; and the studies cited therein), and foreign investment is no exception to this. We represent this factor in terms of the political stability index ($POLSTAB$) that we derive as follows. We start off with four *in*stability sub-indices pertaining to ethnic wars (range 0 to 4), revolutionary wars (range 0 to 4), regime changes towards more autocratic rule (range 1 to 4), genocides and politicides (range 0 to 5), created by the Center for Systemic Peace, based on studies of these phenomena across countries and time (Systemic Peace 2017). Using the Center's data on terrorism-related deaths, we create a fifth sub-index (ranging from 0 to 4). Higher values of each of these five sub-indices indicate greater social unrest and violence, i.e. greater *in*stability. Therefore, subtracting the values of each sub-index from its highest possible value, yields sub-indices reflecting greater *stability* across countries and time. Adding these five transformed sub-indices, we derive our index of political stability $POLSTAB$, where higher values indicate greater political stability.

Another supposedly important driver of foreign direct investment into countries is factor costs; certain countries attract more FDI than others insofar as labour and capital there are cheaper than elsewhere. Unfortunately, despite efforts by the International Labour Organisation (ILO), wage data across countries and years are scanty. As a proxy, therefore, we use labour productivity ($LABPROD$) or output per worker modelled estimates of the ILO (ILO 2018). While movements in labour productivity may explain movements in wages fairly well in the long(er) run, several factors could be responsible for their divergence in the short(er) term (Van Biesebroeck 2015). In many sectors of the economy, wages constitute only a part of the total employee emoluments, and do not reflect other benefits such as stock options, pension, and employer contributions towards post-retirement payouts such as gratuity and provident fund; and movements in the wage and 'other' components need not match over time. Further, empirical evidence shows that workers are often discriminated against on the basis of gender, race, religion, etc., and given lower wages even when their productivity exceeds that of the favoured groups. Furthermore, given that labour productivity is difficult to assess, firms typically use alternative factors such as individuals' education and experience to determine their wages.

Finally, in the face of labour market imperfections in specific segments of the economy, emanating from monopsony power on the part of firms and trade union power on the part of workers, for instance, wage adjustments might lag behind productivity changes or vice versa. It is useful to be aware of these shortcomings of our productivity data, used in lieu of wages.

The second factor cost variable that we employ is the real lending rate of interest ($INTRATE$), defined as the lending rate of interest adjusted for inflation (World Bank 2019e). In addition to FDI flowing into economies with relatively inexpensive capital, Alfaro and Chauvin (2017) draw our attention to situations where the cheaper local capital actually exceeds the foreign funds that the foreign affiliates bring in. However, these interest rate data are rather patchy, and are not available for a number of sample countries for our sample time period, resulting in a significant loss of observations during estimation.

Finally, we capture the openness of the economy ($OPENNESS$) in terms of the so-named 'Area-4' sub-index available in the Economic Freedom dataset mentioned above (Economic Freedom 2018), which encompasses various aspects of the "freedom to trade internationally" such as tariffs, non-tariff barriers, black market exchange rates, restrictions on foreign ownership and investment, and capital controls. This index varies from 1 to 9, with larger values indicating greater freedom to trade internationally.

None of these variables confound the effect of the treatment variable, since they do not impinge on $MODGPI$, which was exogenously determined as we argued above. While these covariates potentially influence the dependent variable, they are not themselves associated with $MODGPI$. Thus, the domestic market size, political stability, ease of doing business, and the factor cost variables are not motivated by $MODGPI$. Table 1 reveals that the correlation between $MODGPI$ and these covariates ranges between –0.06 and 0.50 for our estimation sample. Other summary statistics for the variables are also presented in Table 1. We now proceed to investigate whether and to what extent changes in the strength of intellectual property protection drove foreign direct investment flows into less developed countries in the post-TRIPs-implementation period. Corresponding to specification (3) of the previous section, superior properties of the random error term suggest that we estimate the semi-log model:

$$Ln\ RFDI\_INF_{it} = \sum_{l=0}^{L} \beta_l\ MODGPI_{i(t-l)} + \sum_{l=0}^{L} \delta_l\ MODGPI_{i(t-l)} * USPAT_{i(t-l)} + \theta\ Z_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \qquad (4)$$

where Z_{it} comprises the control variables real per capita income ($GDPPC$), population (POP), ease-of-doing business ($EASE$), political stability ($POLSTAB$), the real wage rate proxied by labour productivity ($LABPROD$), the real lending interest rate ($INTRATE$), and openness of the economy ($OPENNESS$).

4. Empirical Results

4.1 *Less Developed Countries*

We begin by discussing the estimation results for the group of less developed countries, presented in Table 2. In all the regressions, the country-specific effects are found to be highly correlated with the regressors (with absolute regression coefficients between 0.53 and 0.57), and the Hausman test strongly supports the fixed effects specifications estimated. Since the Wooldridge test for no serial correlation in the idiosyncratic error term is strongly rejected, we allow for clustering at the country level, which yields consistent estimates of the (robust) standard errors. Further, in all five regressions, the regressors are jointly strongly significant in explaining the dependent variable, with the p-values of the associated F-tests being 0. The coefficient of the contemporaneous intellectual property variable $MODGPI_{it}$ is essentially zero, and statistically insignificant. So also is the coefficient of the contemporaneous interaction term $MODGPI * USPAT_{it}$, indicating that the effect of a unit change in the intellectual property index on foreign direct investment inflows is no greater for countries with relatively greater amounts of intellectual property. These results remain the same, even as we add lagged terms of these two variables across columns (2) to (5); and the lagged variables themselves are insignificant as well. It appears that stronger intellectual property protection in less developed countries does not induce greater inflows of foreign direct investment, even after a lag of several years, and this effect is no different between countries with greater and lesser amounts of intellectual property as measured by patents owned at the USPTO.

The market size and domestic investment climate, on the contrary, turn out to be strongly significant in explaining FDI inflows. Thus, real per capita income ($GDPPC$), political stability ($POLSTAB$), and ease of doing business ($EASE$), all exert a strong positive influence on the dependent variable. The factor cost variables also have the expected signs, and are statistically significant. A higher wage rate, proxied by labour productivity ($LABPROD$), as well as a higher real lending rate of interest ($INTRATE$), both significantly reduce FDI inflows into less developed countries. Finally, more open economies ($OPENNESS$) imply a greater inflow of foreign direct investment. Interestingly, the coefficient magnitudes of all these regressors remain quite stable across regressions (1) to (5).

It is well-understood that even a seemingly homogeneous group such as the less developed countries hides in its folds considerable heterogeneity. Therefore, we dis-aggregate our sample of Less Developed Countries ($LDCs$) into Developing Countries (DCs) and Least Developed Countries ($LEDCs$), and repeat the above empirical analysis for the two sub-groups (see Appendix 1 for the list of countries). The results are discussed in sections 4.2 and 4.3, respectively.

4.2 *Developing Countries*

The empirical results for the group of Developing Countries are reported in Table 3. Once again we find that the joint hypothesis that all regressors are uniformly zero in explaining the regressand is strongly rejected, the p-values of the associated Wald tests being 0 in all five regressions. The coefficients of the contemporaneous intellectual property variable $MODGPI_{it}$ and the interaction term $MODGPI * USPAT_{it}$ are both statistically insignificant, with the latter implying that there is no differential impact of a unit change in the intellectual property index on foreign direct investment inflows into developing countries with relatively more intellectual property. The addition of lagged terms of these IP variables does not change these results, as is evident from columns (2) to (5); and the lagged IP variables are also insignificant.

On the other hand, both market size variables, per capita income ($GDPPC$) as well as population (POP), and political stability ($POLSTAB$), exercise a statistically significant effect on foreign direct investment inflows into developing countries. Of the factor cost variables, both labour productivity ($LABPROD$) and the real lending interest rate ($INTRATE$) have a strong significant negative effect on FDI inflows. Finally, relatively open economies ($OPENNESS$) lead to higher inflows of foreign direct investment. All these results are broadly in line with those that we observed for the group of less developed countries as a whole.

4.3 *Least Developed Countries*

The empirical results for the Least Developed Countries are presented in Table 4. For all five regressions, we find that the set of regressors is jointly strongly significant in explaining variations in the dependent variable, with the p-values of the associated tests equal to 0. The coefficients of the contemporaneous intellectual property variable $MODGPI_{it}$ and the interaction term $MODGPI * USPAT_{it}$ are statistically insignificant, with large standard errors, and the successive addition of lagged terms of these two variables does not change the picture. Additionally, the lagged variables are insignificant as well, as is clear from the results of columns (2) to (5), with the exception of the third and fourth lags of $MODGPI$ which, however, switch signs. It is evident, that both the IP variables are not well-estimated in this sub-sample, and lags of these variables are best avoided. Of the control variables, the 'domestic investment climate' variable ease of doing business ($EASE$) has a strong positive influence on FDI inflows, while political stability is weakly significant. Of the factor cost variables, the proxy variable $LABPROD$ exerts a mild negative effect on the dependent variable. Finally, more open economies ($OPENNESS$) attract more foreign capital.

From the empirical evidence presented in Tables 2 to 4 and the discussion above, it is evident that the results for the group of less developed countries as a whole are driven by those for the sub-group of developing countries. Intellectual property considerations do not appear to be at the heart of FDI inflows into less developed countries, whether contemporaneously or with a lag. Nor is it the case that differences in ownership of intellectual property across less developed countries make for differential inflows of foreign direct investment across these countries. What matters, on the contrary, is the domestic market, domestic investment climate, and factor cost considerations.

4.4 *A Robustness Check: Redefining the lagged IP variables using Principal Components*

The empirical results presented in the previous three sub-sections are coloured by the fact that there is a lot of persistence in the lagged IP variables, because intellectual property laws are slow to change over time. Thus, the correlation between the contemporaneous and lagged $MODGPI$ terms ranges above 0.94, and that between the contemporaneous and lagged interaction terms $MODGPI * USPAT$ ranges above 0.98. We attempt to circumvent this difficulty by combining the lagged terms of these two variables via the principal components (correlation) technique, and use the first principal component in each case.

The first principal component combining the lagged terms of variable $MODGPI$ yields the composite variable $MODGPI_{i(t-\tau)}^{PC1}$ = $0.498 * MODGPI_{i(t-1)}$ + $0.502 * MODGPI_{i(t-2)}$ + $0.502 * MODGPI_{i(t-3)}$ + $0.498 * MODGPI_{i(t-4)}$, where superscript 'PC1' indicates the first principal component, and subscript $i(t-\tau)$ indicates that this composite variable is of a lagged nature. The Kaiser-Meyer-Olkin measure of overall sampling adequacy equals 0.69, implying a 'mediocre' to 'middling' basis for principal components estimation, with the first principal component explaining 98.9% of the total variation. Similarly, the first principal component combining the lagged terms of variable $MODGPI * USPAT$ yields the composite variable $MODGPI * USPAT_{i(t-\tau)}^{PC1}$ = $0.500 * MODGPI * USPAT_{i(t-1)}$ + $0.500 * MODGPI * USPAT_{i(t-2)}$ + $0.500 * MODGPI * USPAT_{i(t-3)}$ + $0.499 * MODGPI * USPAT_{i(t-4)}$. The Kaiser-Meyer-Olkin measure of overall sampling adequacy equals 0.86, implying a so-called 'meritorious' basis for principal components estimation, with the first principal component explaining 99.6% of the total variation.

After computing these two composite variables, we re-estimate specification (4), and the results are presented in Table 5. For brevity, suffice it to say that the estimates for all three groups of countries are in line with those presented in Tables 2 to 4 and discussed in sub-sections 4.1 to 4.3 above. More importantly for the objective of this robustness exercise, both composite IP variables are found to be statistically insignificant in all three regressions, underlining our findings in sub-sections 4.1 to 4.3 about the insignificance of the lagged IP terms. In other words, intellectual property concerns do not seem to be relevant to FDI inflows into less developed countries, either contemporaneously or with a lag. Nor do cross-country differences in ownership of intellectual property underlie differential inflows of foreign direct investment across these countries. As before, variations in domestic market size, domestic investment climate, and factor cost, underpin variations in FDI inflows across less developed countries.

4.5 *Economic Significance*

Given the diverse distributions of the variables in our dataset, comparing their relative importance vis-à-vis FDI inflows would be facilitated by standardized or so-called beta coefficients. Accordingly, we re-estimate our specification using standardized data, and the results are reported in Table 6. In these regressions, we include only the contemporaneous terms for the intellectual property variables $MODGPI\ and\ MODGPI * USPAT$, i.e. we estimate the standardized equivalents of the specifications in column (1) of Tables 2 to 4. This is motivated by the fact that the addition of the lagged terms individually, as in sections 4.1 to 4.3, does not add anything to our model. For the group of Less Developed Countries as well as the sub-group of Developing Countries, these lagged terms are all insignificant, and the other statistics such as the Akaike Information Criterion (AIC), the Bayes Information Criterion (BIC), the Coefficient of determination, and the error properties (not mentioned in Tables 2 to 4 for brevity), all support the column (1) specification. For the sub-group of Least Developed Countries (Table 4), although there appears to be some ambiguity on this count, the error properties of the various specifications estimated indicate the superiority of the column (1) specification. A similar conclusion holds when the lagged IP terms are included as composite terms, computed as the first principal component (Table 5), and therefore we prefer to drop the lagged IP terms in estimating the standardized model.

The results in Table 6 reveal, that although relatively open economies and economies characterized by a greater ease of doing business attract more foreign direct investment, the two important variables to focus on are market size and labour cost. Thus, a one standard deviation increase in the openness index is associated with higher FDI inflows of 0.17 standard deviations for less developed countries overall, 0.14 standard deviations for developing countries, and 0.13 standard deviations for least developed countries. Again, a one standard deviation increase in the ease of doing business index is associated with higher FDI inflows of 0.18 standard deviations for less developed countries overall, 0.13 standard deviations for developing countries, and 0.17 standard deviations for least developed countries. So these two factors are certainly useful in encouraging capital inflows; economies that impose lower tariff and non-tariff barriers on trade and capital flows, and those that ensure bureaucracy is minimized in establishing businesses, are also the economies that attract more foreign direct investment. While these factors function as 'necessary' conditions for inflows, they are not quite 'sufficient' in ensuring those flows. The latter role is played by the market size and factor cost variables. Thus, a one standard deviation increase in real per capita income is associated with a 0.59 standard deviations increase in FDI inflows into less developed countries overall, 1.2 standard deviations for developing countries, and 0.29 standard deviations for least developed countries. Similarly, a one standard deviation increase in the wage cost proxy is associated with lower FDI inflows to the extent of about 1 standard deviation in less developed countries, 1.3 standard deviations in developing countries, and 0.55 standard deviations in least developed countries. Aggregating all these results, we see that domestic market size and domestic labour costs in the (potential) recipient economy are likely the more important drivers of FDI inflows in the post-TRIPs-implementation period, subject to the 'necessary conditions' of a relatively open economy and one which facilitates the establishment and running of a business.

However, even between these two factors of domestic market size and domestic labour costs, the former is likely to be the more important from the policy viewpoint, because one can hardly suggest the lowering of real domestic wages to attract foreign direct investment, especially when real wages in less developed countries are low to begin with. To understand the potential significance of market size as a policy instrument, note that the elasticity of real foreign direct investment with respect to real per capita income works out to 1.44 for less developed countries, 3.26 for developing countries and 1.01 for least developed countries, using the (preferred) column (1) results of Tables 2 to 4. Considering the group of less developed countries first, its elasticity implies that a 1% increase in real per capita income, ceteris paribus, is associated with a 1.44% increase in real foreign direct investment inflows. Given that real foreign direct investment inflows into less developed countries in 2010 (roughly the midyear of our sample period) were about \$4155.51 million (at constant prices), the annual real FDI inflows due to an annual 1% increase in per capita income works out to \$59.88 million. Over the entire sample period 2004-2015, real per capita income increased by about 62.83% for our sample countries, which implies an increase in real foreign direct investment inflows of \$3762.41 million over our sample period. These inflows constitute about 7.9% of the total real foreign direct investment inflows into less developed countries over our sample period. Similar exercises yield figures of 16.1% for the sub-group of developing countries, and about 20.3% for the sub-group of least developed countries. These figures are very substantial, and cogently reveal the potential of market size as a policy instrument in attracting foreign direct investment inflows into less developed countries. Note also that this factor is likely to remain important for some time, as per capita incomes in less developed countries continue to increase, even as population growth rates slow down over time.

5. Conclusions

For various reasons, foreign direct investment flows into the economy are seen to be highly desirable, and even more so for less developed countries that are short of reproducible tangible capital and 'high' technology. Of the various factors that impinge on such flows, one that appears to have become more salient over time is the strength of intellectual property protection that countries provide. Given the steep increase in FDI inflows into less developed countries in the recent past, and the exogenously imposed strengthening of intellectual property protection in these countries post-TRIPs agreement, one is naturally led to ask whether a significant relationship exists between the two. In addressing this issue, our modelling strategy attempts to capture the heterogeneity of the impact of the IP reform on the FDI inflows by estimating a conditional difference-in-differences specification. Eschewing this, one would be deprived of both consistent estimation as well as an acceptable interpretation of the empirical results. Thus, the impact can vary significantly across countries depending on the magnitude of intellectual property that they own for which they seek such protection, for that would indicate the importance that they attach to IP protection. We explicitly model this heterogeneous impact via a varying coefficient model.

Our sample period of 2004-2015 is highly appropriate insofar as it comes after the ten year period that the developing countries were allowed for implementing IP reforms in accordance with the TRIPs agreement. Further, it is long enough to permit the modelling of a delayed response to the stimulus. Our empirical results do not provide evidence of a statistically significant effect of IP reform on FDI inflows into less developed countries, nor do we find that the effect of IP reform is significantly stronger for countries that own relatively larger amounts of intellectual property; and these results hold contemporaneously as well as with lags. Instead, foreign direct investment inflows appear to be driven by market size and domestic investment climate. Disaggregating our sample into the sub-groups of developing countries and least developed countries, we find that our overall results for less developed countries are driven by the sub-group of developing countries, which is understandable in view of the fact that the predominant bulk of foreign direct investment flowed into developing countries, rather than least developed countries.

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Appendix 1: The Sample Countries

Listed below are the sub-groups of Developing Countries (DCs) and Least Developed Countries (LEDCs), which together comprise the group of Less Developed Countries (LDCs) for which data were available to us, and which were therefore included in the estimation exercises.

Developing Countries:

Algeria, Argentina, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Chile, China, Colombia, Costa Rica, Dominican Republic, Egypt, Fiji, Guatemala, Guyana, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ivory Coast, Jamaica, Jordan, Kenya, Malaysia, Mauritius, Mexico, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Russia, South Africa, Sri Lanka, Swaziland, Thailand, Trinidad Tobago, Ukraine, Uruguay, Venezuela, Vietnam, Zimbabwe.

Least Developed Countries:

Angola, Bangladesh, Benin, Burundi, Congo Dem Rep, Ethiopia, Haiti, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Niger, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, Zambia.

Table 1 Sample Statistics: Less Developed Countries 2004-2015

Regressor	Units	Mean	Standard Deviation	Minimum	Maximum
$RFDI\_INF$	US$ million	61.62	172.49	0.0003073	1356.10
$GDDPPC$	$ ‘000 PPP	8.58	7.73	0.605863	45.22
POP_{it}	Million	68.15	175.36	0.01	1000.00
$EASE_{it}$	Index	52.31	11.63	23.45	85.29
$POLSTAB_{it}$	Index	20.56	1.07	14.50	21.00
$LABPROD_{it}$	$ ‘000 PPP	23.25	21.35	1.57	112.08
$INTRATE_{it}$	Percent	9.72	51.73	–32.00	1158.03
$OPENNESS_{it}$	Index	6.76	1.02	2.06	8.71
$MODGPI_{it}$	Index	2.99	0.66	0.16	4.60
$USPAT_{it}$	‘000	0.10	0.61	0	9.00
N	769	769	769	769	769

Table 2 Effect of IP Reform Post-TRIPs-Implementation: Less Developed Countries
Dependent Variable: $Ln\ RFDI\_INF_{it}$

Regressor	(1)	(2)	(3)	(4)	(5)
$GDPPC_{it}$	0.1679**	0.1686**	0.1731**	0.1767**	0.1803**
	(0.0696)	(0.0693)	(0.0697)	(0.0713)	(0.0720)
POP_{it}	0.0011	0.0012	0.0013	0.0013	0.0014
	(0.0018)	(0.0018)	(0.0019)	(0.0019)	(0.0019)
$EASE_{it}$	0.0348***	0.0339***	0.0325***	0.0317**	0.0306**
	(0.0112)	(0.0115)	(0.0117)	(0.0120)	(0.0124)
$POLSTAB_{it}$	0.0737**	0.0721**	0.0726**	0.0723**	0.0726**
	(0.0347)	(0.0338)	(0.0343)	(0.0345)	(0.0357)
$LABPROD_{it}$	–0.1089**	–0.1074**	–0.1088**	–0.1100**	–0.1109**
	(0.0434)	(0.0427)	(0.0432)	(0.0438)	(0.0440)
$INTRATE_{it}$	–0.0009***	–0.0009***	–0.0009***	–0.0009***	–0.0010***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
$OPENNESS_{it}$	0.3647***	0.3628***	0.3645***	0.3668***	0.3635***
	(0.0916)	(0.0938)	(0.0951)	(0.0951)	(0.0970)
$MODGPI_{it}$	0.0694	–0.3699	0.6136	0.6469	0.6515
	(0.2358)	(0.7773)	(0.9555)	(0.9814)	(0.9967)
$MODGPI * USPAT_{it}$	0.0065	–0.0281	–0.0377	–0.0433	–0.0460
	(0.0097)	(0.0493)	(0.0543)	(0.0714)	(0.0837)
$MODGPI_{i(t-1)}$		0.4984	–1.5880	–1.0196	–0.9892
		(0.8736)	(1.7300)	(1.4925)	(1.5350)
$MODGPI * USPAT_{i(t-1)}$		0.00004	0.0001	0.0001	0.00004
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
$MODGPI_{i(t-2)}$			1.2105	–0.1060	–0.5807
			(1.0902)	(1,1372)	(0.9490)
$MODGPI * USPAT_{i(t-2)}$			–0.00001	–0.00001	–0.0001
			(0.0001)	(0.0001)	(0.0002)
$MODGPI_{i(t-3)}$				0.7655	–0.8219
				(0.8944)	(0.9998)
$MODGPI * USPAT_{i(t-3)}$				0.00002	0.00001
				(0.0001)	(0.0001)
$MODGPI_{i(t-4)}$					0.9294
					(0.8998)
$MODGPI * USPAT_{i(t-4)}$					0.0002
					(0.0002)
Intercept	–3.0258***	–3.1222***	–3.3578**	–3.4893**	–3.5789
	(1.3041)	(1.3160)	(1.3476)	(1.3763)	(1.4369)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.0000	0.0000	0.0000	0.0000	0.0000
P-value (all $MODGPI$ terms 0)	0.7694	0.8284	0.7430	0.8678	0.9006
P-value (all $MODGPI * USPAT$ terms 0)	0.5063	0.7131	0.8597	0.8924	0.8894
AIC	1467.979	1470.943	1472.320	1475.186	1477.089
BIC	1560.881	1573.135	1583.802	1595.958	1607.152
$\overline{R}^2$	0.0920	0.0906	0.0909	0.0896	0.0894
N	769	769	769	769	769

Note: Clustered robust standard error in parentheses below the coefficient;
***, ** and * denote significance at the 1%, 5% and 10% levels, using a two-tail test

Table 3 Effect of IP Reform Post-TRIPs-Implementation: Developing Countries
Dependent Variable: $Ln\ RFDI\_INF_{it}$

Regressor	(1)	(2)	(3)	(4)	(5)
$GDPPC_{it}$	0.2879***	0.2891***	0.2940***	0.2966***	0.2986***
	(0.0780)	(0.0784)	(0.0785)	(0.0799)	(0.0806)
POP_{it}	0.0035*	0.0036*	0.0038*	0.0038*	0.0038*
	(0.0020)	(0.0021)	(0.0021)	(0.0021)	(0.0021)
$EASE_{it}$	0.0224	0.0216	0.0199	0.0193	0.0187
	(0.0146)	(0.0147)	(0.0148)	(0.0150)	(0.0153)
$POLSTAB_{it}$	0.0856**	0.0847**	0.0857**	0.0857**	0.0857**
	(0.0354)	(0.0341)	(0.0340)	(0.0338)	(0.0346)
$LABPROD_{it}$	–0.1161***	–0.1154***	–0.1168***	–0.1176***	–0.1181***
	(0.0394)	(0.0390)	(0.0391)	(0.0395)	(0.0396)
$INTRATE_{it}$	–0.0013***	–0.0013***	–0.0014***	–0.0014***	–0.0014***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
$OPENNESS_{it}$	0.2408***	0.2379***	0.2366***	0.2364***	0.2320***
	(0.0757)	(0.0778)	(0.0796)	(0.0803)	(0.0809)
$MODGPI_{it}$	0.1557	–0.1116	0.7513	0.7626	0.7634
	(0.2447)	(0.6993)	(0.9929)	(1.0097)	(1.0159)
$MODGPI * USPAT_{it}$	0.0060	–0.0267	–0.0326	–0.0419	–0.0406
	(0.0116)	(0.0350)	(0.0388)	(0.0508)	(0.0579)
$MODGPI_{i(t-1)}$		0.3125	–1.5284	–1.2253	–1.2032
		(0.7385)	(1.6718)	(1.5918)	(1.5923)
$MODGPI * USPAT_{i(t-1)}$		0.00004	0.0001	0.0001	0.0001
		(0.00004)	(0.0001)	(0.0001)	(0.0001)
$MODGPI_{i(t-2)}$			1.0707	0.3900	0.6186
			(0.8227)	(1.1001)	(0.9612)
$MODGPI * USPAT_{i(t-2)}$			–0.00004	0.00003	–0.0001
			(0.0001)	(0.0001)	(0.0001)
$MODGPI_{i(t-3)}$				0.4021	–0.1607
				(0.6586)	(0.9211)
$MODGPI * USPAT_{i(t-3)}$				–0.00002	–0.00003
				(0.0001)	(0.0001)
$MODGPI_{i(t-4)}$					0.3343
					(0.6839)
$MODGPI * USPAT_{i(t-4)}$					0.0002
					(0.0002)
Intercept	–2.3387*	–2.4226*	–2.6375**	–2.7104**	–2.7278**
	(1.1970)	(1.2110)	(1.1808)	(1.1954)	(1.2471)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.0000	0.0000	0.0000	0.0000	0.0000
P-value (all $MODGPI$ terms 0)	0.5276	0.7301	0.4307	0.5941	0.7392
P-value (all $MODGPI * USPAT$ terms 0)	0.6099	0.6796	0.7427	0.8308	0.8767
AIC	936.2388	939.7935	941.8094	945.5041	948.9899
BIC	1022.4010	1034.572	1045.204	1057.515	1069.617
$\overline{R}^2$	0.1209	0.1179	0.1174	0.1142	0.1112
N	549	549	549	549	549

Note: Clustered robust standard error in parentheses below the coefficient;
***, ** and * denote significance at the 1%, 5% and 10% levels, using a two-tail test

Table 4 Effect of IP Reform Post-TRIPs-Implementation: Least Developed Countries Dependent Variable: $Ln\ RFDI\_INF_{it}$					
Regressor	(1)	(2)	(3)	(4)	(5)
$GDPPC_{it}$	0.5740	0.5953	0.6395	0.7722	1.1736
	(0.9425)	(0.9787)	(1.0225)	(1.0913)	(1.1247)
POP_{it}	–0.0027	–0.0026	–0.0024	–0.0028	–0.0027
	(0.0035)	(0.0034)	((0.0034)	(0.0033)	(0.0032)
$EASE_{it}$	0.0438**	0.0432**	0.0428**	0.0423**	0.0419**
	(0.0189)	(0.0183)	(0.0184)	(0.0184)	(0.0181)
$POLSTAB_{it}$	0.1089*	0.1112*	0.1136*	0.1154*	0.1027†
	(0.0565)	(0.0555)	(0.0559)	((0.0560)	(0.0639)
$LABPROD_{it}$	–0.3453†	–0.3533†	–0.3606†	–0.3776	–0.4716†
	(0.2281)	(0.2421)	(0.2676)	(0.2871)	(0.3242)
$INTRATE_{it}$	–0.0027	0.0017	–0.0006	–0.0003	0.0010
	(0.0098)	(0.0101)	(0.0101)	(0.0098)	(0.0112)
$OPENNESS_{it}$	0.3824†	0.4287†	0.4542†	0.5049*	0.5534*
	(0.2848)	(0.2961)	(0.2966)	(0.2755)	(0.2761)
$MODGPI_{it}$	0.6228	–1.0464	1.2749	1.5069	1.8087
	(0.9014)	(2.4993)	(2.8494)	(2.8415)	(2.9600)
$MODGPI * USPAT_{it}$	–33.8202	–35.7588	–39.8318	–26.1620	–34.1000
	(67.2363)	(65.8710)	(63.6209)	(62.8707)	(61.3402)
$MODGPI_{i(t-1)}$		1.6601	2.9377	–1.1861	–1.4532
		(1.9400)	(3.6974)	(3.7133)	(3.9623)
$MODGPI * USPAT_{i(t-1)}$		0.0507	0.0578	0.0553	0.0726
		(0.0600)	(0.0619)	(0.0608)	(0.0597)
$MODGPI_{i(t-2)}$			2.5149	–1.9003	1.1925
			(2.0850)	(3.0055)	(2.8514)
$MODGPI * USPAT_{i(t-2)}$			0.0438	0.0423	0.0477
			(0.0718)	(0.0756)	(0.0783)
$MODGPI_{i(t-3)}$				2.5480	–4.6959*
				(1.7405)	(2.4064)
$MODGPI * USPAT_{i(t-3)}$				0.0139	0.0058
				(0.0402)	(0.0426)
$MODGPI_{i(t-4)}$					4.2747***
					(1.4575)
$MODGPI * USPAT_{i(t-4)}$					–0.0277
					(0.0598)
Intercept	–7.3143**	–7.5979**	–8.3872***	–9.0877	–9.6271
	(2.8614)	(2.9033)	(2.8549)	(2.4412) ***	(2.3815) ***
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
P-value (all slopes 0)	0.0000	0.0000	0.0000	0.0000	0.0000
P-value (all $MODGPI$ terms 0)	0.4972	0.3127	0.3246	0.1555	0.0491
P-value (all $MODGPI * USPAT$ terms 0)	0.6202	0.3658	0.4753	0.7618	0.5567
AIC	480.5478	480.4517	477.6723	475.1641	467.6802
BIC	548.4204	551.7178	548.9385	546.4302	538.9464
$\overline{R}^2$	0.1967	0.1953	0.1962	0.1962	0.2139
N	220	220	220	220	220
Note: Clustered robust standard error in parentheses below the coefficient; ***, ** and * denote significance at the 1%, 5% and 10% levels, using a two-tail test; † denotes significance at the 10% level using a one-tail test					

Table 5 Effect of IP Reform Post-TRIPs-Implementation: Lagged IP Variables Redefined using Principal Components Dependent Variable: $Ln\ RFDI\_INF_{it}$			
	Less Developed Countries	Developing Countries	Least Developed Countries
Regressor	(1)	(2)	(3)
$GDPPC_{it}$	0.1727**	0.2933***	0.7886
	(0.0700)	(0.0791)	(1.0944)
POP_{it}	0.0013	0.0038*	–0.0027
	(0.0019)	(0.0021)	(0.0033)
$EASE_{it}$	0.0322***	0.0201†	0.0412**
	(0.0120)	(0.0150)	(0.0185)
$POLSTAB_{it}$	0.0709**	0.0842**	0.1145*
	(0.0343)	(0.0339)	(0.0576)
$LABPROD_{it}$	–0.1075**	–0.1157***	–0.3945†
	(0.0431)	(0.0390)	(0.2798)
$INTRATE_{it}$	–0.0010***	–0.0014***	0.0006
	(0.0002)	(0.0002)	(0.0099)
$OPENNESS_{it}$	0.3622***	0.2335***	0.4972†
	(0.0957)	(0.0797)	(0.2920)
$MODGPI_{it}$	–0.2044	–0.0187	–0.5585
	(0.3440)	(0.3210)	(1.4965)
$MODGPI * USPAT_{it}$	–0.0361	–0.0200	–33.4506
	(0.0473)	(0.0427)	(67.4061)
$MODGPI^{PC1}_{i(t-\tau)}$	0.4505	0.3164	1.3114†
	(0.4913)	(0.3386)	(0.9579)
$(MODGPI * USPAT)^{PC1}_{i(t-\tau)}$	0.00004	0.00003	0.0941
	(0.0001)	(0.00005)	(0.1451)
Intercept	–3.3813**	–2.6344**	–8.4898***
	(1.3606)	(1.2143)	(2.7112)
Year Fixed Effects	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes
P-value (all slopes 0)	0.0000	0.0000	0.0000
P-value (all $MODGPI$ terms 0)	0.6527	0.5104	0.0623
P-value (all $MODGPI * USPAT$ terms 0)	0.6287	0.8049	0.5330
$\overline{R^2}$	0.0935	0.1196	0.2101
N	769	549	220
Note: Clustered robust standard error in parentheses below the coefficient; ***, ** and * denote significance at the 1%, 5% and 10% levels, using a two-tail test; † denotes significance at the 10% level using a one-tail test			

Table 6 Effect of IP Reform Post-TRIPs-Implementation: Standardized Regression Coefficients
Dependent Variable: $(Ln\ RFDI\_INF)'_{it}$

	Less Developed Countries	Developing Countries	Least Developed Countries
Regressor	(1)	(2)	(3)
$GDPPC'_{it}$	0.5850**	1.1634***	0.2947
	(0.2425)	(0.3152)	(0.4839)
POP'_{it}	0.0830	0.3837*	–0.0477
	(0.1391)	(0.2207)	(0.0628)
$EASE'_{it}$	0.1826*	0.1250†	0.1727**
	(0.0587)	(0.0187)	(0.0747)
$POLSTAB'_{it}$	0.0355**	0.0519**	0.0450*
	(0.0167)	(0.0215)	(0.0234)
$LABPROD'_{it}$	–1.0480**	–1.3060***	–0.5496†
	(0.4179)	(0.4430)	(0.3631)
$INTRATE'_{it}$	–0.0219***	–0.0437***	–0.0130
	(0.0056)	(0.0073)	(0.0467)
$OPENNESS'_{it}$	0.1677	0.1356***	0.1282†
	(0.0421)	(0.0426)	(0.0955)
$MODGPI'_{it}$	0.0205	0.0497	0.1571
	(0.0697)	(0.0782)	(0.2274)
$(MODGPI * USPAT)'_{it}$	0.0075	0.0096	–0.0108
	(0.0112)	(0.0188)	(0.0215)
Year Fixed Effects	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes
N	769	549	220

Note: The prime (′) after the regressand and regressors indicates standardized variables.
Clustered robust standard error in parentheses below the coefficient;
***, ** and * denote significance at the 1%, 5% and 10% levels, using a two-tail test;
† denotes significance at the 10% level using a one-tail test

Endnotes

[1] Thus, Article 7 of the 1994 $TRIP$s agreement (WTO 1994), that "The protection and enforcement of intellectual property rights should contribute to the … transfer and dissemination of technology … ", can be claimed to relate to FDI only to the extent that the FDI involves technology transfer.

[2] Such models are decidedly superior to random coefficient models, where the response heterogeneity across countries is essentially random. Random response heterogeneity by definition does not model and, therefore, cannot explain either the factor(s) that the heterogeneity is a consequence of, or the factor(s) that it changes. All that we obtain from a random coefficient model is the distribution of the (random) treatment effects.

[3] For a study that uses pre-$TRIP$s firm-level data pertaining to the 'transition' economies of Eastern Europe, see Javorcik (2004).

[4] Alternative aggregation methods such as principal components and unobserved components methods were found to yield virtually identical results to that of simple averaging, because these alternative methods also assign roughly equal weights to the sub-indices since the pairwise correlations between the sub-indices are roughly similar (see World Bank 2019b).