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Does multilateral lending aid capital accumulation? Role of intellectual capital and institutional quality

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ABSTRACT

This paper investigates whether multilateral lending is more effective in accumulating capital in countries with a higher level of innovation. Specifically, we examine the role of the World Bank or IMF financing on capital stock using data from 175 countries over the period 1970–2017, while considering different types of long-term external flows namely FDI and debt. We find that FDI as a long-term inflow influences domestic capital stock positively, but non-G7 countries, even with a higher level of innovation, are unable to benefit from greater FDI flows in boosting their capital stock, which we explain considering institutional quality differences across countries. With regard to foreign debt flows, the multilateral lending only benefits a borrowing country if it has greater level of intellectual capital or if those funds are used in financing innovative activities. Unlike short-term IMF loans, as World Bank lending tends to be directed more towards long-term development goals, they help boost productive capital. Exploiting a policy intervention with TRIPs agreement, the paper further uncovers that countries with better institutional quality and greater innovation benefit from multilateral lending in generating higher level of capital stock following TRIPs implementation.

1. Introduction

It is already established in the literature that long-term external capital can flow into countries in the form of foreign direct investment or external debt, contributing to the productive capacity of a country (see for example Bournakis et al., 2018; Mallick and Moore, 2008). Earlier studies looked at the link between foreign direct investment (FDI) and intellectual property rights (IPR) relationship in capacity building (See Furukawa, 2010; Akiyama and Furukawa, 2009; Kwan and Lai, 2003). But, if countries are financially constrained, raising the required capital domestically would become challenging. Many developing and emerging economies continue to have rigidity in terms of their capital account transactions, with capital controls at elevated levels (see Pasricha et al., 2018), implying that those countries would rely on official sources of debt financing. Many low-income countries by dismantling capital controls allow long-term FDI flows, but better access to the overseas debt market can further drive outward orientation by better-performing and credit-constrained firms. FDI inflows

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usually come to countries where there is low cost of labour, and which allow technology transfer, boosting a country's productive capacity. Besides, developed and developing countries have different motivations for holding capital reserves and attracting external inflows, because they face different economic realities, especially in the aftermath of the global financial crisis (see Aizenman et al., 2015). Recent challenges brought by the financial crises have led to structural and institutional changes in those developing countries. Also, they have different economic strengths (i.e. East Asian countries are more technology-intensive whereas Latin American countries are commodity-intensive), making their motivations to attract capital differ due to institutional and structural differences in those economies.

On the other hand, a country's ability to innovate is also an important factor in wealth-creation, including foreign trade and investment. Many developing countries, however, remain financially constrained and therefore, those governments mainly rely on official sources of financing. Foreign currency financing is required to meet the much-needed funding for import of capital goods, setting up of new foreign projects, and modernization or expansion of existing units. Therefore, overseas debt financing can be more effective in countries with a higher level of innovation. Financing is also important in countries with limited innovation capacity and the need to get the necessary raw materials or adopt new technology. Countries with limited access to the private capital market need to use official loans such as IMF credits and World Bank loans. Although we consider total external debt, we do make a distinction between different types of multilateral lending which can have differential effects given the level of intellectual capital and the quality of institutions in a country. In the era of financial globalization, enabling outward orientation via access to international capital markets can improve a country's performance.

The role of multilateral lending on economic growth has widely been established in the literature (see Abbott et al., 2010; Agostino, 2008; Dreher, 2009, 2004; Dreher et al., 2009; Marchesi, 2003; Santiso, 2001; Bird, 2001). The common view is that both IMF and World Bank loans actually do not help growth. In fact, conditional lending is found to reduce growth (see Dreher and Walter, 2010; Barro and Lee, 2005; Dreher, 2006; Easterly, 2005), as those are meant for short-term debt obligations rather than boosting capital growth. However, countries with better innovation and institutional quality can derive a different outcome from such external borrowing. Furthermore, the impact of IPRs and institutional quality in driving the external debt-capital accumulation relationship has received little attention in the literature – a research gap that we address in this paper.

The role of innovation activities in wealth creation has been widely discussed in the earlier literature (see Furukawa, 2010, 2007) and yet it still remains a puzzle as innovation does not contribute to capacity building equally across countries. Therefore, it needs further investigation as to why the role of innovation in capital accumulation varies across countries. Earlier literature focused on different channels to explain the welfare differences between developed and developing countries, including the non-linear relation between IPR and economic development. Earlier studies such as Chen and Puttitanun (2005), Yang and Maskus (2009), and Lorenczik and Newiak (2012) find that stronger IPRs in developing countries can stimulate innovation and impact economic development of those countries. Papageorgiadis and Sharma (2016) empirically investigated the non-linearities, following Furukawa (2010), and find that the levels of enforcement of IPR, as well as non-linearities, are significant drivers in IPR and innovation relationship. However, the effect of IPR on economic development has a U-shaped relation. Below the threshold, strengthening of IPR fails to promote innovation and thus has a negative effect on overall world growth (see also Borota (2012)). However, above the threshold, stronger IPRs for developing countries can benefit both parties by stimulating innovation in developing countries and therefore can attract financial inflows. Yang and Maskus (2009) find that stronger IPR enhances technology and increases exporting from the South. Excessively strong IPRs can reduce welfare; however, adding FDI maintains the IPR-technology transfer relationship. More recent studies such as Sweet and Eterovic Maggio (2015) attempt to uncover the reason for this U-shaped relationship, by investigating the threshold effect. They find that only the countries that have an economic development level above average can benefit from stronger IPR enforcement. Hudson and Minea (2013) find that the non-linearity in this relation is more complex which depends on the initial level of IPR and economic development. Kemeny (2010) finds that the role of financial inflows in driving technology upgrading is conditional on an economy's social capability. Li et al. (2016) find that the impact of FDI tends to be moderated by factors such as absorptive capacity, foreign presence, and competition intensity in the domestic market. In addition, Kim et al. (2012) find that patentable innovations contribute to economic growth in developed countries, but not in developing ones. So, in addition to the financial inflows, the strength of IPRs and the appropriate type of IPRs are also crucial for higher economic development. Hu and Png, (2013) found that stronger patent rights stimulate growth through factor accumulation and technological progress (i.e. innovation). They find a robust relationship between patents and growth by using Fraser Index which is one of the measures used for legal system and property rights. Chu et al. (2012) find that the stronger property rights and patents lead to a reduction in growth volatility in the US.

In light of these findings, it could be argued that not just the financial flows or the intellectual capital itself but also features such as countries' legal protection system, regulatory quality, institutional mechanisms are important factors in explaining the gap between developed and developing countries in capital accumulation. These features as key institutions of a county are broadly defined as the set of rules and constraints that shape economic behaviour and incentives, acting as a key determinant of economic development (see Challe et al., 2019). More recently it has been shown that countries with better institutional quality tend to enhance the country's willingness to pay its debts, and thus reduce the likelihood of default (see Chen and Chen, 2018). In the specific context of open economies, the importance of having appropriate economic institutions domestically is often seen as a precondition for capital inflows to lead to balanced economic activity and stable long-run growth.

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On the other hand, the impact of capital inflows on local economic institutions has recently been investigated by Challe et al., (2019) who interestingly found that capital inflows are followed by a decline in the quality of domestic economic institutions due to government's inability to stop financing inefficient projects by entrepreneurs as a result of "soft budget constraint". With particular attention to the four Euro area countries (Spain, Portugal, Italy and Greece), high amount of capital inflows to those countries in the 1990s resulted in poorer institutional quality that led to Sovereign Debt Crisis in 2010 (see Challe et al., 2019). Therefore, it could be argued that not just the financial flows but how those flows are utilised within an economy can have implications for generating high value-added output. Thus, countries' with higher rate of innovation could benefit more from such financial flows in accumulating capital.

Global growth slowdown and heightened political and policy uncertainties in the aftermath of the Global Financial Crises of 2007–2009 have attracted more attention to growth and adjustment issues. Middle-income countries are integrated into the world economy but, unlike advanced countries, they often lack well-established policies and institutions to cope with shocks. Therefore, middle-income countries usually have higher vulnerability to crisis. Aizenman et al. (2018) compare the role of institutions and fundamentals on the adjustment of growth and volatility to shocks in the pre- and post-crisis periods and find that, countries can cope with shocks better in the short to medium term by appropriately using flexible policy tools and having good long-term fundamentals. As weak institutions can hamper adjustment to shocks, rather than resorting to short-term measures to respond to shocks, countries can develop institutions that enable them to withstand shocks to the economy, should they occur. For instance, the quality of workforce matters because more skilled workers are expected to adapt better to changing economic conditions, and thus boosting higher education helps reduce growth volatility. Countries with less political polarization, and hence likely less policy uncertainty, stand to benefit from reduced volatility of economic growth.

In addition, there are ongoing global attempts to harmonize the legal system in the developed and developing countries to fully benefit from trade relation and thus enhance global wealth. In 1995, the World Trade Organisation (WTO) introduced Trade-Related Aspects of Intellectual Property Rights (TRIPs hereinafter) agreement, which aims to harmonize the intellectual property rights and regulate international trade relations. And thus, some developing countries which were less able to attract international capital flows will be able to benefit through international trade or even attract greater foreign investment. The signatories to this agreement include over 164 countries that jointly contribute to more than 90 per cent of world trade. The agreement has had an implementation period of 1 year for industrialised countries and up to 11 years for developing and transition economies. The harmonization of national legal systems and its impact on law enforcement in practice gained attention in the recent international business literature. Studies such as (Papageorgiadis et al., 2014) develop an index to measure this, while (Papageorgiadis and McDonald, 2019) present the various measures generated in the literature on how to measure the strength of intellectual property rights. In our analysis, we also investigate whether the implementation of the TRIPs agreement brought any benefit to the developing nations in terms of generating higher capital stocks in the post-TRIPs period.

Considering the above, this paper investigates two sources of long-term capital flows: FDI and debt, and their impact on capital accumulation in countries with a higher level of innovative ability. This relationship has received little attention in the previous literature. Therefore, the empirical literature on capital stock examining the role of external flows like FDI and debt in countries with a higher level of IPR is limited, although there are studies on FDI-growth relation or innovation-growth relation, as well as FDI and institutions. For instance, one of the important findings in the recent literature is that when credit constraints are nonbinding, strengthening patent protection stimulates R&D, and the overall effect of patent protection on innovation follows an inverted-U pattern (Chu et al., 2019). Furthermore, patent protection is more likely to have a positive effect on innovation under a higher level of financial development as parallel to the discussions about the impact of the level of regulatory quality on capacity building. Moreover, recent literature on FDI such as Papageorgiadis et al., (2020, 2019, 2013) finds that countries with stronger institutions in IP law enforcements attract more FDI. Alexiou et al., (2016) find that stronger levels of patent enforcement have a significant positive effect on economic growth of both developed and developing countries. Importantly, inward FDI flows have been found to have a mediating role in positively boosting this effect for all countries and particularly for developed countries (Alexiou et al., 2016). Besides the empirical literature discussed above, the theoretical literature only focuses on IPR as the strength of IPR enforcements across-countries, whereas we investigate the relationship considering innovation ability of a country by looking at innovation output in terms of patent and trademark applications which are elements of intellectual assets that proxy for the innovativeness of a country. The countries with a higher level of innovation tend to produce a high amount of IPR (i.e. patents and trademarks) applications. Thus, we examine the contribution of external financial flows on capital accumulation while considering the innovation capability of countries to uncover a clear channel showing the context in which external capital flows can be beneficial. Besides, we bring in the role of institutional quality as an additional channel by using World Governance Indicators (WGI) and try to explore the relationship further by adding the institutional quality dimension as an indirect mechanism for capital flows to be more effective even in the presence of greater innovation capability. We thus find that countries with better institutional quality and stronger innovation capability tend to benefit positively from financial flows in accumulating capital.

By identifying the gaps in the literature, we addressed three main issues in this paper using data from 1970 to 2017 for 175 countries. The first issue is whether multilateral lending is beneficial for capital accumulation and whether and how innovation matters in this relationship. The second insight relates to whether the implementation of the TRIPs agreement by developing nations created any difference in capital accumulation among innovation-intensive countries. The third rela-

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tion connects whether countries with better institutional quality and greater innovation benefit positively from FDI inflows and external debt. In addition, we examine the joint impact of different lending mechanisms and innovation on cross-country capital accumulation in pre and post-global financial crisis periods. Benchmark estimations are conducted using Fixed Effects while the rest of the paper uses dynamic System GMM and Difference-in-Differences estimations. This paper is structured as follows: In Section 2, we explore the relevant literature; In Section 3, we describe our data and methodology. The 4th Section discusses empirical results, explores channels and conducts robustness checks. Finally, Section 5 concludes the paper.

2. Literature Review and Hypotheses Development

2.1. The impact of IPR and FDI on cross-country capital stock

Earlier literature on innovation and external flows has focused on two main strands. The first one is FDI and IPR relation and the second one is the role of institutional quality in growth. However, the literature on the role of FDI-IPR relationship in capital accumulation has received little attention. Therefore, we aim to introduce indirect effects such as institutional quality through which FDI and IPR relationship is driven. Nunennkamp and Spatz, (2004) aimed to overcome some downsides of earlier studies such as Yang and Maskus, (2001), regarding the indirect role of IPR in FDI-growth relationship. They argue that stronger IPR raises the quality and quantity of FDI flows. IPR was found to have a significant impact on FDI depending on industry and country characteristics, meaning that FDI tends to be replaced by licensing in the advanced economies where IPR is stronger. A similar approach could also be seen in the form of North-South modelling (see Grossman and Lai, 2004; Dinopoulos and Segerstrom, 2010). Those studies argue that if IPR is strengthened in developing countries, this leads to higher industrial productivity and production shift towards the developing countries (South). According to the literature, IPR reforms influence productivities through the FDI channel. Grossman and Lai (2004), studied intellectual property rights in the global economy by extending Lai and Qiu (2003). Dinopoulos and Segerstrom (2010); Branstetter et al. (2007) and Grossman and Lai (2004) find that stronger IPR in the South leads to more FDI, more innovation, and a lower North-South wage gap.

Empirical evidence in Kashcheeva (2013); Branstetter et al. (2011, 2007, 2006) and Hu and Png (2013), explores the channels through which more solid IPR influences production. Overall, they argue that stronger IPR stimulates industrial development. Branstetter et al. (2011, 2007, 2006) use firm-level data for US MNCs and analyse shifts in IPR regimes of developing countries, and find that IPR reform leads to higher production by MNCs, and the production shifts towards the IPR reforming countries. Hu and Png (2013), use the Ginarte-Park (GP) index in cross-country level analysis and show that more patent-intensive industries grow faster than less-patent intensive ones in countries with stronger IPRs. Kashcheeva (2013) estimates the global effect of FDI inflows jointly with IPR reforms on economic development. As per the empirical evidence, both greater FDI and stronger IPR directly lead to higher growth; however stronger IPR mitigates the growth effect of FDI in developing economies, and at the highest levels of FDI, it appears that less strict IPR can even increase the growth rate. Empirical findings are consistent with theory by pointing out the importance of the level of FDI in a developing country to determine the total welfare effect of IPR reform (see Kashcheeva, 2013).[1] Lai (2007) analyses the global IPR system and finds that the South is likely to be disadvantaged by harmonisation of IP laws. This is similar to Lai (1998) but highlights the importance of the imitation channel for the South. Lai (2007) also argues that the gains of the North outweigh the losses of the South, and thus increases the global welfare. Both Branstetter et al. (2007) and Kashcheeva (2013) focus on cross-regional heterogeneity and found that there is a threshold to benefit from stronger IPR in attracting higher FDI inflows for cross-country capital accumulation and above that level, the impact diminishes. The major conclusion from these models is that developed economies are likely to benefit from stronger global IPR. FDI represents an important channel of technology transfer to emerging countries. However, apparently, the mitigating effect of the joint effects of IPR and FDI prevails in developing countries alone. Therefore, parallel to Sweet and Eterovic Maggio (2015), it could be concluded that countries should be above a certain level of economic development in order to benefit from stronger IPR.

Keller (2004) addresses the extent of technology diffusion and whether the countries' incomes converge over time. International trade, FDI, human capital, and R&D are all the key channels for technology diffusion across countries. Fink et al. (2005) question the existence of income-related biases in international trade. Income-related biases indicate the likelihood that wealthier countries trade with each other rather than trading with poorer countries. International trade and greater openness help developing countries to move towards a technology frontier via imports or foreign investments (see Henry et al., 2009) and play a significant role in explaining R&D-led total factor productivity (TFP) differences across economies. Additionally, the institutional mechanisms such as income levels and socioeconomic conditions have a positive influence on productivity, while higher macroeconomic instability and higher private credits to domestic markets have a dampening effect on TFP (Bravo-Ortega and García Marín, 2011). Therefore, it is worth investigating how performance is affected by the institutional environment and property rights at a cross-country level. Hudson and Minea (2013) find that the non-linearities

[1] In fact, an earlier study by Lai (1998) predicts that strong IPR encourages FDI, and suggests that stronger IPR increases the cost of acquiring knowledge from attracted FDI. Hence, if a developing country were able to attract a significant FDI without appealing to the IPR policy tool, relaxed IPR may even increase total production in that economy.

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in this relation depend on the initial level of IPR and economic development. Yasar et al. (2011) find that a better legal system in a country is the key to better firm performance across countries. Also, Ang (2014) investigates the role of financial sector policies, services, and institutions of innovation and finds that interest rate restraints help to generate ideas and thus innovation. Therefore some financial reforms help economic growth via stimulating production of innovation while some do not. Although trade and multinational activities by firms can improve productivity at the industry level, Bournakis et al. (2018) suggest that these gains are bigger if there is an appropriate institutional environment in the host country. By using the high-income OECD countries, where protection of intellectual property rights is already strong, as an empirical evidence, they suggest the policy focus must be on simplifying the procedures for doing business. Policy reforms along this direction can yield substantial FDI-related gains. This is parallel to the literature suggesting that better regulatory environment can boost productivity growth across countries.

Therefore, by considering the previous findings, the pattern of the FDI-IPR relationship in driving capital accumulation could be argued as non-linear. So, it is not just the innovation itself but also features such as countries legal system, regulatory quality, institutional mechanisms are also important factors in explaining the gap between developed and developing countries in capital accumulation. Those features can be classified as the foundations of institutional quality of a county. Institutions are a key determinant of economic development (see Challe et al., 2019). More recently, it has been shown that better institutional quality tend to enhance the country's willingness to pay its debts and thus reduce the likelihood of default (see Chen and Chen, 2018). In open economies, the importance of having appropriate economic institutions domestically is often seen as a precondition for capital inflows, leading to balanced economic activity and stable long-run growth. For instance, Alexiou et al. (2016) find that stronger levels of patent enforcement have a significant positive effect on economic growth of both developed and developing countries. Importantly, inward FDI flows have been found to have a mediating role in positively boosting this effect for all countries and particularly for developed countries (Alexiou et al., 2016). In addition, Papageorgiadis et al. (2020) argue that informal institutions impact the behaviour of agents involved in enforcing legal rights. They also argue that the behaviour influences how IP law is implemented in legal arenas and thereby impacts the efficacy of IPR regimes to help secure economic rights from the use of IP assets. Using data on outward FDI from the USA to 42 host countries, Papageorgiadis et al. (2020) find that the strength of informal institutions connected to the enforcement of IP in a country directly affects the outcomes and positively moderates the effect of formal legal aspects of IP law on FDI flows. Therefore, in light of the related literature discussed above, our first hypothesis is formulated as follows:

Hypothesis 1a. The direct impacts of innovation and FDI on cross-country accumulation are positive while their joint indirect effect is negative in accumulating capital in non-G7 countries.

Hypothesis 1b. The impact of FDI and innovation on accumulating capital is positive for countries with better institutional quality.

2.2. The impact of IMF credits and World Bank loans on cross-country capital accumulation

IMF aims to lend to countries facing severe macroeconomic imbalances. In theory, IMF can influence economic growth in borrowing countries through several channels via its conditionality imposed under its programs. With several crises in the last forty years, such as 1970s oil crises, 1980s international debt crisis, and 1990s Asian crises, IMF focused on providing macroeconomic stability in those countries along with currency devaluation as an intermediate target to promote growth. At the same time, the IMF aimed to impose crucial institutional reforms within the borrowing countries. These are referred to as IMF conditionality, and in the literature, the impact of those conditionalities has been discussed extensively (Dreher, 2009; Marchesi, 2003; Marchesi and Sabani, 2007; Marchesi and Thomas, 1999).

Abbott et al. (2010) assess the IMF approach to economic reform in developing countries. With an extensive review of the related literature, Abbott et al. (2010) find that the evidence from the literature suggests that IMF program participation has little impact on cross-country growth. According to the literature, the critical question is whether countries benefit from IMF loan programs or would they be better off without adopting these programs. The essential point is to remember that IMF loans are lent with a purpose to recover from an economic crisis. Therefore, those fund-receiving countries are already in bad condition and to differentiate whether the adverse outcomes are due to pre-existing conditions or due to the adoption of IMF programs, is very important in generating unbiased estimations.

In order to address potential endogeneity in IMF programs, Dreher (2006) and Barro and Lee (2005), Dreher et al. (2009) used voting behaviours in the United Nations General Assembly, showing that developing countries obtain loans with better conditions from the IMF if they have close ties with the countries that are Fund's shareholders. Also, Marchesi and Sabani (2007) find that more extended relationship of the countries with IMF increases IMF disbursement. However, Both Dreher (2006) and Barro and Lee (2005) find that IMF programs reduce economic growth, even after controlling for countries' degree of compliance with IMF conditionality. Additionally, Dreher (2006) analyses the impact of disbursed loans and compliance with the conditionality for economic growth. Therefore, Dreher suggests that entering IMF programs reduces economic growth when countries come to the program via self-selection. However, compliance with the conditions reduces the adverse effects, and IMF loans do not robustly affect economic welfare.

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Easterly (2005) differs from other studies as the paper investigated the link between growth and policies of the countries receiving IMF funds repeatedly. The main finding is that none of the top 20 fund recipients was successful in achieving reasonable growth. Indeed, it is found that half of the recipients had severe macroeconomic distortions even with the highest amount of loans. Easterly (2005) concludes that IMF lending failed in stabilising macroeconomic conditions and providing growth because structural loans being given to same countries repeatedly signal the fact that the first loans were not successful or had limited impact in the first place. Dreher and Walter (2010) empirically analysed the impact of IMF involvement in dealing with a currency crisis and found that IMF involvement reduces the probability of a crisis. However, once in a crisis, IMF involvement increases the likelihood of currency devaluation in a particular country. Moreover, the amount of loans disbursed or compliance with the IMF conditions is found to have no significant impact.

Abbott et al. (2010), suggest that there should be changes in IMF's approach via an organisational shift in the IMF structure, as IMF acts in a risk-averse strategy towards the countries. Another point is that IMF's role as both lender and a monitor of the countries' compliance with the conditionality fails to be successful due to the reason that IMF overlooks some countries' compliance to stay as a good monitor (Marchesi and Sabani, 2007). Marchesi (2003) suggests that countries which accepted the IMF intervention via the adoption of a stabilisation programme can obtain better conditions on their loans from private creditors. This is due to the signalling feature of the IMF programme, as it shows the countries willingness to reform successfully and use the money for investment purposes rather than consumption. An earlier study by Marchesi and Thomas (1999) show that the adoption of an IMF program can be used to monitor a country's productivity. So, the main result is that both the IMF program and buy-back program can signal a country's responsiveness to a debt relief program by increasing investment and by debt repayments. IMF program can be beneficial in the situation like Asian Crises in the 1990s where IMF loan was needed for liquidity purposes. Marchesi (2003) empirically analyses the theoretical model presented in Marchesi and Thomas (1999) and finds that countries who have an arrangement with the IMF are more likely than others to obtain a rescheduling of their external debt. This is due to the reason that the IMF program could work as a signal to show the countries' willingness to repay or make necessary reforms. Marchesi, 2003 used macroeconomic indicators to analyse the relationship between adoption of IMF programme and countries' ability to receive debt rescheduling by commercial and official creditors, reporting a positive relationship. On the contrary, Bird (2001) finds that IMF lending and other capital inflows to a country via private creditors are negatively related. The reason is that usually the countries that do not have access to private credit markets seek IMF funding. So, IMF lending is a substitute for private lending. Therefore, there is a negative relationship between IMF lending and other capital inflows.

The World Bank has had some changes in the 1990s. World Bank started focusing on "good governance" as a core element of its development strategy to address the concerns over the effectiveness of aid programs. It is argued that it is necessary for the Bank to explicitly address the issues of power, politics, and democracy in order to improve good governance substantially, and explicitly state that the aid conditionality should not be a mechanism to strengthen good governance in developing countries. The introduction of management concerns signals an increased willingness to take the political dimension of development into account. It reflects a change in economic development thinking and focuses on inducing political reform in recipient countries such as the modernisation of the state, the fight against corruption, the improvement of the judiciary, the strengthening of legislatures and the decentralisation of government. Notably, the good governance ensures the legitimacy of international funding institutions as institutions of global governance (see Santiso, 2001). As Kapur and Webb (2000, p. 18) state that if governance-related conditionality is applied well, it could empower people and nations.

Dreher (2004) explains IMF and World Bank lending and conditionality, stressing changes in the relative bargaining power of different stakeholders. Accounting for economic and political factors, regional, country and year effects, Dreher et al. (2009) find that there is a robust positive relationship between UN Security Council membership, and the number of World Bank projects a country receives. This contributes to the arguments that multilateral lending institutions have been employed as a foreign policy tool by their major shareholders. According to Easterly (2005) the World Bank often subsidises inefficient policies and corrupt governments, and thus long-run economic prosperity suffers. Therefore, the reason for the failure of the World Bank lending may be that its loans could not promote development. Additionally, Dreher (2004) also mentions the point that the World Bank mainly lends to the countries that have access to private capital whereas it should have lent to those countries most in need. The International Bank for Reconstruction and Development (IBRD) raises funds on international financial markets, while the International Development Association (IDA) relies mainly on the major shareholder's resources. Increased reliance on shareholder resources could make the Bank even more trapped into their short-term political goals unless other reforms are also taken.

Kilby (2009) presents empirical evidence that macroeconomic performance is a less binding constraint in getting World Bank loans in countries closer to the United States. For countries that do not make concessions to the U.S. position in crucial UN votes, there appears to be a substantial degree of enforcement. When these countries have active World Bank structural adjustment loans, the weak macroeconomic policy is associated with lower disbursements, and the effect can be substantial. For countries that are friendly with the U.S., there is little evidence of enforced conditionality. For this second group, there is no significant link between macroeconomic policy and disbursements. These results highlight the donor pressure as an essential alternative explanation for the failure of conditionality.

World Bank conditional loans might affect private investment in recipient countries by both through the funds they provide and by the policy conditions they include and the transfer of knowledge they imply. Agostino (2008) investigates the impact of these channels on private investment, considering conditionality and countries' commitment to reform. The main finding shows that the formal obligations to reform with World Bank structural loans seem to be associated with lower

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investment ratios in the short-run in recipient countries. Such a harmful effect is likely to add to other short-run adverse effects, which usually characterise an adjustment period after which the economy is stabilised, and investors respond positively. In fact, when a longer-run perspective is adopted, by considering all variables as five-year averages, none of the mentioned channels appear to be relevant or to affect the aggregate investment positively. Adversely, there is evidence of the negative impact of those funds. This is also parallel to our findings that the World Bank loans can have a negative impact on capital accumulation in a country.

There are many studies on the impact of the IMF and World Bank lendings. However, due to data limitations on World Bank conditionalities on each country, the empirical analyses have usually focused on the IMF, and thus Dreher (2004) points out that this might be a promising area for future research, and this is the gap which we address in our analysis. Furthermore, after an extensive review of the literature, we find that the impact of different lending mechanisms and innovation has not been explored yet. Also, cross-country differences in institutional mechanisms may affect how the country benefits from those loans. Therefore, we aim to contribute to those unexplored sides of the literature. Following our review of the literature of IMF and World Bank lending mechanisms, it can be inferred that the IMF and World Bank borrowings do not necessarily help all types of countries. Developing countries use that mechanism to maintain economic stability. However, there is no evidence whether they might contribute to capital accumulation to help future growth.

The literature has stated that World Bank and IMF lending do not contribute towards growth as they were created to provide long-term stability per se. However, the literature does not look at the lending mechanisms from an innovation-led growth perspective. We argue that, if the borrowings from IMF, World Bank and countries' total external borrowings are used for the financing of innovation activities or by the countries with higher intellectual properties namely patents and trademarks, then countries may attract their inward capital flows and thus increase their stock of capital. In addition, it is arguable that the countries with better governance or in other words, better institutional quality can benefit from those loans differently. Therefore, we aim to investigate the joint impact of IMF, World Bank and external debt variables with IPR variable to estimate the joint impact on capital stock while introducing a temporal variation with TRIPs intervention.

Hypothesis 2a. Borrowing from international lending institutions and other external debts have an adverse impact on cross-country capital stock; however, if these loans are used to finance innovation activities, then the effect on capital stock becomes positive.

Hypothesis 2b. Multilateral lending has an adverse impact on cross-country capital accumulation; however, the impact is positive for countries with better institutional quality, following TRIPs intervention.

3. Data and methodology

3.1. Description of the data

Data is taken from the World Bank's World Development Indicators, covering the years 1960–2017 for 186 countries. We aim to investigate the impact of external financial flows on capital stock, considering innovativeness and institutional quality differences across countries and over time. The dependent variable is capital stock (as % of GDP), in other words, the capital-output ratio which is formed by accumulating the annual investment flows using the perpetual inventory method. The capital stock variable is given as a percentage of GDP to control for size differences across economies. We refer to this as capital accumulation, or capital stock or capital-output ratio throughout the paper. The variable was obtained from the 'Penn World Tables' database. This dataset uses various discount rates across countries for each year (for 186 countries between 1960 and 2017). We believe that this provides a more accurate calculation of capital stock than calculating the capital accumulation variable manually.

Intellectual property rights are measured by total patent applications and total trademark applications. For this variable, we use the acronym IPR and use the terms "innovation", knowledge capital and intellectual capital interchangeably throughout the paper. We also have an R&D activity variable which is another proxy for innovation. This variable has been taken from Word Development Indicators (WDI) and shows R&D expenses as % of GDP at the country level. This is used in exploring channels through which innovation adds to capital accumulation. Foreign direct investment (FDI) is another variable we use in our estimations, measured by net FDI inflows as a percentage of GDP. Mostly, the previous literature looked at either TFP or factor accumulation- via GDP growth. However, in this paper, we look at the impact of FDI and IPR on capital accumulation which has received limited attention in the previous literature.

Macroeconomic indicators can also impact capital accumulation. In the literature, inflation or macroeconomic instability were used as one of the macroeconomic controls in TFP and factor accumulation models. Bravo-Ortega and García Marín (2011) use macroeconomic instability measured via inflation and found a negative relation with TFP. We included both macroeconomic instability and inflation in our estimations interchangeably. However, the coefficients and standard errors remain unchanged with the transformation of inflation to instability as described below. Therefore, we used the "instability" variable. According to the literature, trade openness is another essential macroeconomic factor that influences capital accumulation and TFP (see studies by Papageorgiadis and Sharma, 2016; Sweet and Eterovic Maggio, 2015; Hudson and Minea,

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2013; Henry et al., 2009, and Chen and Puttitanun, 2005). Trade openness is measured by the sum of total exports and imports for the individual country *i*, as a share of GDP. When this ratio is higher, it means the country is more open to trade. Dikova et al. (2016) also evaluate the impact of export strategy and FDI on TFP of firms in a transitional economy over the period 1995–2010. It is important to control whether countries that are more open to trade can have greater capital accumulation. Another factor influencing capital accumulation is the real effective exchange rate index (REER), calculated taking the year 2010 as 100. The data is taken from WDI.

Financial development is also a factor that can impact capital accumulation (see studies such as Beck and Levine, 2004; Claessens and Laeven, 2003; Demirguc-Kunt and Levine, 2009; Laeven et al., 2015). Earlier studies incorporate financial development in two dimensions: bank development and stock market development. Beck and Levine (2004) control whether bank development and stock market development enter the growth regression simultaneously. Their results suggest a link between growth and both stock market liquidity (turnover) and bank development (bank credit). Therefore, we encounter the impact of both stock market and bank development on capital accumulation. We measure stock market development by stock market capitalisation of domestic listed companies as a share of GDP, and we measure financial development as broad money (M3) as a share of GDP.

Demirguc-Kunt et al., 2011 suggest that both financial institutions and stock markets have a positive impact on economic growth. However, there is an optimal combination of these two, to prevent any institutional and policy regulations' adverse impact on economic activity in growing markets. On the other hand, Mattana and Panetti (2014) find that at a low level of economic development, households are unable to participate in the securities markets for investments, and therefore, pushed towards banks. However, when the level of development is higher, the households can access securities markets, and therefore leading to a drop in relative liquidity. Beck and Levine (2004) find that both stock markets and banks play an essential role in economic growth. Additionally, they control for other macroeconomic indicators such as trade openness, inflation, and government consumption. Ang and Kumar (2014) explore the determinants of economic and financial development by addressing the barriers to the diffusion of technology. They find that private credit to GDP ratio plays a highly significant and positive role in the country's per capita GDP while trade openness is found to have an adverse impact on growth.

By controlling for the impact of macroeconomic indicators and incorporating the lending mechanisms (IMF/World Bank), we investigate the effects of FDI and IPR on capital accumulation. Additionally, we check how different countries namely, developing countries and G7 are impacted by innovation in accumulating capital. One classification we used for this analysis is the region classification. We used the World Bank's classifications for placing countries into the appropriate region. The six regions are as follows: North America, Europe, Asia, Oceania, Middle East and Africa, Latin America. Then the developing regions are selected as per the literature, and the impact of external flows to those countries is analysed along with all developing countries. Furthermore, the country-income classifications which we use in the robustness checks are based on World Bank's classifications (i.e., high income, upper-middle, lower-middle, low income), and the developing countries' list is taken from the IMF database.

This paper aims to investigate the impact of lending mechanisms on cross-country capital accumulation. Therefore, we incorporated three different measures. One is total external debt, the second one is IMF credits, and the third one is World Bank loans. The literature investigates the impacts of IMF and World Bank loans on growth. The data for IMF and World Bank loans starts from 1970, which restricts our time period to start from 1970 to 2017. Many studies found that IMF and Worldbank loans have a detrimental effect on country growth (see studies such as Barro and Lee, 2005; Dreher, 2006; Easterly, 2005). Parallel to the existing view, we argue that IMF and World Bank credits (IBRD and IDA loans) impact a country's capital accumulation. The IMF and IBRD credits/IDA loans are both represented as a share of GDP.

As a third measure, we examined the impact of total external debt stocks on capital accumulation. For external debt measure, we use external debt stocks that are public and publicly guaranteed, short-term, private non-guaranteed and total external debt stock. Total external debt stock is the sum of the former three. Public and publicly guaranteed debt comprises long-term external obligations of public debtors, including the national government, political subdivisions (or an agency of either), and autonomous public bodies, and external obligations of private debtors that are guaranteed for repayment by a public entity. Short-term external debt is defined as debt that has an original maturity of up to one year. Private nonguaranteed debt is an external obligation of a private debtor that is not guaranteed for repayment by a public entity. All are represented as a ratio of GDP. Table 1 reports variable descriptions and descriptive statistics. Table 1 consists of 3 panels. The first panel describes the variables and descriptive statistics for all sample while panel 2 reports descriptive statistics for only G7 countries, and panel 3 provides descriptive statistics for low-, middle- and high-income countries. According to Table 1, low-income countries have the lowest IPR rates while middle, and high-income countries have higher average IPR rates. Also, low- and middle-income countries are same while high-income countries have higher FDI rates. This might be an indication that higher-income countries usually have higher FDI inflows and possibly countries that are economically stronger have more FDI flows between them. Also, low-income countries' capital accumulation is lower than others as one might expect. Moreover, as we can expect, higher income and G7 countries have better macroeconomic and financial structures which are shown by trade openness, market capitalisation, financial development, stability, and debt sustainability.

Following the descriptive statistics in Table 1, scatter plots are presented in Fig. 1. Fig. 1 indicates that both IPR and FDI have a positive relation with capital accumulation while the IMF and World Bank (IBRD& IDA) borrowing and external debt have a negative relationship with capital accumulation.

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Table 1
Variable Descriptions and Summary Statistics.

Panel 1

Variable	Description	Obs.	Mean	Std.Dev.	Min	Max
Capital Stock	Accumulated capital stock (as % of GDP)	11,342	0.86	0.81	0	9.161
IPR	Total number of patent& trademarks applications (scaled by million people)	3297	0.31	0.93	0.00	19.22
FDI	(Net) Foreign Direct Investment inflows as % of GDP	6053	0.04	0.19	−1.62	7.11
Trade Openness	Trade Openness (Total Exports + Total Imports as % of GDP)	7564	0.77	0.51	0.02	5.32
Market Capitalisation	Market capitalisation of domestic listed companies as % of GDP	1932	0.55	0.84	0.00	12.54
Financial Development	Financial Development: Broad Money(M3) as % of GDP	6292	0.43	0.34	0.16	3.36
REER	Real Effective Exchange Rate index (2010 = 100)	3216	111.42	54.43	18.71	917.33
Inflation	Inflation rate (using GDP deflator)	7986	0.36	0.45	0	9.51
Instability	Inflation rate divided by (1+inflation)	7986	0.25	0.63	0	9.32
IBRD ratio	Loans by IBRD and credits by IDA as a % of GDP	4333	0.09	0.14	0	2.00
IMF ratio	Use of IMF credits as a % of GDP	4306	0.03	0.10	0	2.52
Public Debt ratio	External debt stocks, public and publicly guaranteed, as % of GDP	4252	0.48	0.62	0	8.90
ST Debt ratio	External debt stocks, short term as % of GDP	4252	0.09	0.30	0	7.27
Private Debt ratio	External debt stocks, private non-guaranteed as % of GDP	4252	0.04	0.08	0	0.92
Total Debt ratio	External debt stocks, total as % of GDP	4252	0.64	0.90	0	18.55
R&D	R&D expenses as % of GDP	1761	0.929	0.931	0.005	4.428
IQ	Institutional Quality Index (see further explanation for PCA)	3294	−0.017	2.224	−5.101	4.848

Panel 2

G7 Countries

Variable	Obs	Mean	Std Dev	Min	Max
Capital Stocks	371	1.19	0.54	0	2.001
IPR	293	1.69	1.78	0.30	7.94
FDI	292	0.21	0.72	−0.05	7.11
Trade Openness	356	0.38	0.15	0.89	0.86
Market Capitalisation	200	0.59	0.40	0.03	1.89
Financial Development	212	0.79	0.63	0.09	2.41
REER	269	105.93	14.51	61.92	166.83
Inflation	354	0.04	0.044	0	0.27
Instability	354	0.08	0.08	0	0.54

Panel 3

	low income					middle income					high income				
Variable	Obs	Mean	Std.Dev	Min	Max	Obs	Mean	Std.Dev.	Min	Max	Obs	Mean	Std.Dev	Min	Max
Capital Stock	1908	0.68	0.55	0	2.22	5457	0.95	0.78	0	3.95	3975	0.83	0.90	0	9.16
IPR	195	0.01	0.02	0.00	0.12	1553	0.20	0.88	0.00	19.22	1549	0.45	1.01	0.00	7.94
FDI	1033	0.03	0.09	−0.82	0.89	3114	0.03	0.07	−0.55	1.62	1905	0.07	0.32	−0.016	7.11
Trade Openness	1376	0.54	0.31	0.31	3.21	3803	0.76	0.40	0.02	3.75	2383	0.92	0.67	0.08	5.31
Market Capitalisation	79	0.14	0.13	0.25	0.44	834	0.39	0.58	0.04	8.90	1018	0.70	0.99	0.00	12.54
Financial Development	1242	0.24	0.17	0.162	1.51	3527	0.42	0.28	0.489	2.43	1521	0.61	0.43	0.05	3.36
REER	256	162.87	0.98	0.78	827.17	1410	113.97	0.61	18	917	1536	100.52	0.23	38.02	296.25
Inflation	1381	0.16	0.51	0	8.30	3891	0.18	0.60	0	9.87	2664	0.09	0.40	0	9.42
Instability	1387	0.28	0.66	0	9.32	3874	0.29	0.70	0	8.84	2660	0.16	0.45	0	8.28
IBRD ratio	1122	0.19	0.20	0	2.00	3045	0.06	0.08	0	0.84	165	0.02	0.02	0	0.07
IMF ratio	1122	0.06	0.17	0	2.52	3045	0.02	0.04	0	0.52	138	0.02	0.03	0	0.21
Public Debt ratio	1116	0.67	0.84	0	8.90	2997	0.42	0.51	0	8.32	138	0.22	0.17	0	0.85
ST Debt ratio	1116	0.12	0.55	0	7.27	2997	0.08	0.13	0	2.38	138	0.11	0.12	0	0.55
Private Debt ratio	1116	0.01	0.05	0	0.71	2997	0.04	0.08	0	0.87	138	0.14	0.17	0	0.92
Total Debt ratio	1116	0.86	1.39	0	18.55	2997	0.56	0.62	0	10.90	138	0.50	0.29	0	1.68

3.1.1. Construction of an institutional quality index: a principal components analysis

We introduce institutional quality dimension based on the Worldwide Governance Indicators (WGI) of Kaufmann et al. (2010). There are six indicators of governance: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. The indicators are based on over 30 underlying data sources reporting the perceptions of governance of a large number of survey respondents and expert assessments worldwide. The values vary between −2.5 and 2.5. "−2.5" is the minimum and "+2.5" is the maximum value of all six indicators.

According to Kaufmann et al. (2010), one of the important features in good governance is " government effectiveness" which is defined as perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Another important factor is "rule of law", which captures perceptions of the extent to which agents have confidence in and abide by the rules of the society, and in particular the quality of contract enforcement,

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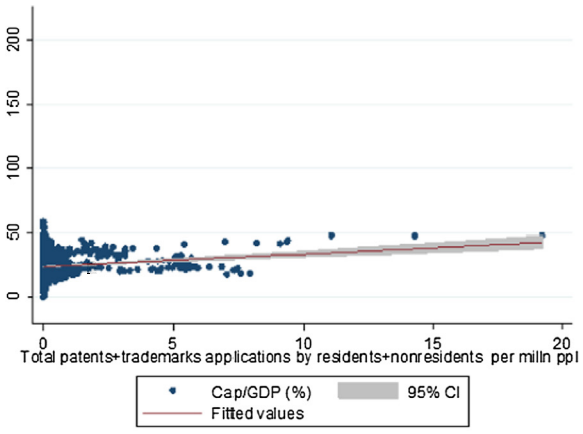
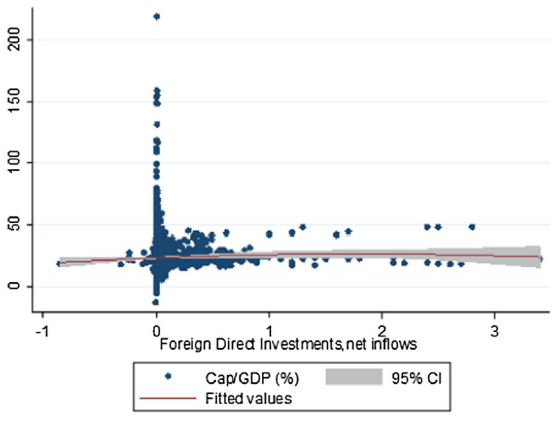
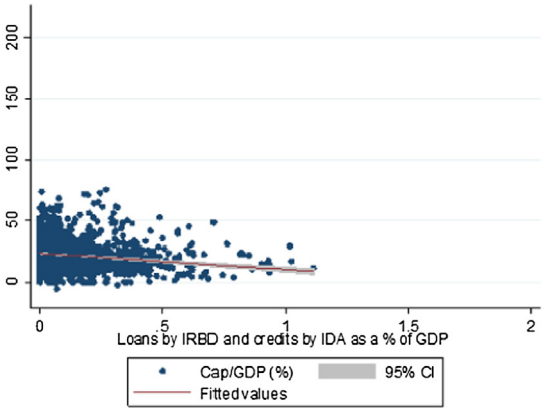


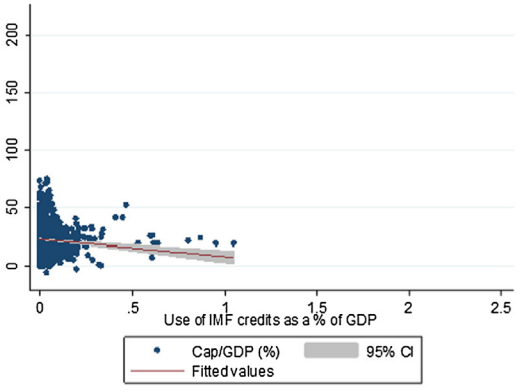
Graph 1-Total IPR vs. Capital accumulation (in logs)



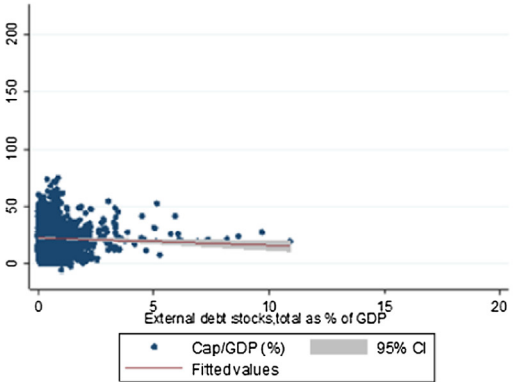
Graph 2- Foreign Direct Investments vs Capital accumulation



Graph 3- WorldBank loans vs Capital accumulation



Graph 4- IMF credits vs capital accumulation



Graph 5- External debt vs Capital accumulation

Fig. 1. Scatter Plots for explanatory variables

property rights, the police, and the courts, as well as the likelihood of crime and violence. Another one is the "control of corruption", which captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. "Regulatory quality" reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. "Voice and accountability" reflect perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. "Political Stability and Absence of Violence/Terrorism" measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. In our analysis, each of these six dimensions is used as one indicator in the PCA shown below (see Table 2).

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Table 2
Principal components analysis for institutional quality index.

		PC1	PC2	PC3	PC4	PC5	PC6
Eigenvalue		5.0889	0.4112	0.2869	0.1208	0.0476	0.04442
Proportion		0.8482	0.0685	0.0478	0.0201	0.0079	0.0074
Variable	Notation						
Control of Corruption	Cc	**0.4234**	−0.1032	−0.2273	−0.6755	0.1244	0.5354
Government Effectiveness	Ge	**0.424**	−0.2827	−0.2684	0.0904	0.6138	−0.5323
Political Stability and Absence of Violence/terrorism	Pv	**0.3619**	0.8756	−0.2019	0.2251	0.0849	0.0612
Regulatory Quality	Rq	**0.4153**	−0.3715	−0.0691	0.6646	−0.1924	0.4539
Rule of Law	Rl	**0.4335**	−0.0447	−0.09	−0.1984	−0.7368	−0.4688
Voice and Accountability	Va	**0.3868**	0.0527	0.907	−0.0615	0.144	−0.0216

Notes: The table presents the results of the PCA. PC1 to PC6 indicates principal components from 1 to 6. As PC1 is 5.0889 we only take this component. We take corresponding weights of the PC1 for 6 variables to form the IQ index.

Recently, there has been particular attention on the impact of institutional quality and its impact on economic development. Different authors used different proxies for the quality of institutions. For instance, Chen and Chen (2018) used the WGI of Kaufmann et al. (2010) by taking the average of the six indicators listed above, whereas Challe et al. (2019) only used the three of them (government effectiveness, control of corruption and rule of law). However, the components used in the construction of the governance quality are highly correlated with each other. To sufficiently capture the common variation among these correlated components as a single measure, we develop an index that represents the overall quality of institutions using principal components analysis (henceforth PCA). The first principal component is the single linear combination of the governance indicators that explain most of the variations we see in these indicators. This index will sufficiently deal with the problem of multicollinearity and over-parameterisation, as a single measure of institutional quality. Since the institutional quality of a country consists of six dimensions, we combine those dimensions into one component by capturing common variation among those variables using PCA and then construct the institutional quality variable. Table 2 presents the PCA for the institutional quality index. Eigenvalues of the 6 components are as 5.088, 0.411, 0.286, 0.121, 0.048 and 0.044, suggesting that the first component with eigenvalue being greater than 1 is relevant which explains 85% of the variation of the sample variance. Considering the first component, we create an index of institutional quality using weights (i.e. 0.4234, 0.4240, 0.3619, 0.4153, 0.4335 and 0.3868) assigned to the first principal component. Based on the first principal component, we construct the institutional quality variable as follows:

$$Institutional\ \ Quality\ \ Index\ \ (IQ) = IQ = \sum_{i=1}^{n} w_{ij} \cdot X_i$$

where w_{ij} are the component's loadings or weights, and *Xi* are the original variables.

$$IQ = 0.4234 * cc + 0.4240 * ge + 0.3619 * pv + 0.4153 * rq + 0.4335 * rl + 0.3868 * va$$

3.2. Methodology

Considering the movements in macroeconomic series, the stationarity of variables should be ensured. To test the stationarity of our variables we use Augmented-Dickey Fuller test proposed by Choi (2001). Results show that our series are stationary. More detailed explanation on the unit root tests can be found in the Appendix A (see Table 11 in Appendix A). We use Fixed-Effects for our benchmark estimations and Dynamic-System GMM estimations for the rest of the analysis. In FE estimates we tested for the joint significance of u_i by F test and reported under each table titled as "F test error term." After conducting Hausmann Test and Breusch-Pagan LM test, we determined whether Fixed Effects model is preferred over Random effects and pooled OLS estimations. Therefore in all benchmark estimations, we also added time and country dummies to address observed and unobserved parts of the error terms u_i.

If we consider a simple regression as y = xb + u, OLS regression breaks down where explanatory variable x and the error term u are correlated; in other words, the variable x becomes endogenous. This is the failure of the zero conditional mean assumption E [u|x] = 0. When two or more variables are jointly determined within the model, it is known that OLS estimators produce biased and inconsistent estimates. Therefore, GMM estimation should be preferred. Another problem is heterogeneity which is created by unobservable factors. Therefore, as we face both endogeneity and unobserved heterogeneity, GMM approach is selected as a method of estimation suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (2000, 1998). System GMM which is an extended version of difference GMM and is a system composed of equations in first differences and equations in levels. In principle, lagged levels are used as instruments for the equations in first differences and lagged first differences are used as instruments for the equations in levels. According to Blundell and Bond (2000) system GMM provides better and more robust results when estimating production functions. In addition, we need to address the dynamic nature of our dependent variable by using dynamic system GMM. In our estimations, the internal instruments are drawn from lagged and differenced variables. We used two and three lags in our regressions as GMM-type instruments. The results with both were

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similar with three lags slightly better and therefore, for the sake of brevity, we reported the results with three lags in our tables. We used $y_{i,t-1}$, $y_{i,t-2}$ and $y_{i,t-3}$ for lagged variables, and if the data are transformed by differencing, then it is $\Delta y_{i,t-1}$, $\Delta y_{i,t-2}$ and $\Delta y_{i,t-3}$. The following diagnostic tests are conducted to ensure the assumptions and validity of dynamic GMM estimations: the Sargan-Hansen test, Arellano and Bond test, and the Wald Chi-Squared test[2].

In addition to that, when there is an implementation of a new program or policy change, the impact of this could be measured by looking at the differences between pre and post-policy change by using a 'natural experiment' type difference-in-differences approach (see Bertrand and Mullainathan, 2003) and nonparametric matching estimators (see Abadie and Imbens, 2006; Imbens and Wooldridge, 2009). While innovation makes a positive impact on capital accumulation across-countries, the extent of change in this impact during pre and post-TRIPs agreement is worth investigating. Using this modelling strategy can help establish causal inferences and investigate the effects of a programme implementation among treated and control groups. This approach allows us, to capture the mean difference in the outcome variable between high innovation-based and low innovation-based countries after implementation of TRIPs, by removing biases due to omitted time-invariant factors. In our case, the DD captures the mean difference of capital accumulation between high R&D and low R&D-based countries as well as in high- and low-institutional quality countries after the 2005 extension made to the TRIPs agreement. Comparing the capital accumulation of high and low-institutional quality and innovation-based countries allows us to capture the effect of TRIPs agreement.

In addition to the former, both differences in the level of innovation and level of the institutional quality can create heterogeneity in the way capital gets accumulated across countries. In order to observe how institutional quality matters in capital accumulation of high and low-R&D based countries, we further use difference-in-difference-in-differences (DDD) approach (see studies such as Long et al., 2010; Vig, 2013). DDD approach allows us to test whether there is any interaction between the countries' rate of innovativeness and their institutional quality in accumulating capital. This approach allows us to investigate the cross-sectional heterogeneity in the treated and control groups and we examine the magnitude of the effect of institutional quality since the implementation of TRIPs agreement. Here we have high- and low- quality institutions as well as high- and low-R&D based countries. So, the potential benefit of innovation in accumulating capital may vary with the differences in the level of institutional quality at country level.

However, it should be noted that those estimators measure how the relationship occurs in the centre of the distribution and assumes a homogenous relationship among the variables across the whole sample. As we have a large number of countries with different economic structures and differences in institutions, that relationship may vary across different points of the capital accumulation variable. To address this, we use Quantile Difference in-Differences Regression (Q-DD) approach. This method is a type of DD estimation using quantile estimation technique. Quantile regression has firstly been introduced by Koenker and Bassett (1978). Meyer and Viscusi (1995) first used Quantile regression approach in a "natural-experiment" type of estimation.

4. Empirical results and discussions

4.1. Benchmark estimations: the impact of IMF and World Bank lending, and total external debt on capital accumulation

In the benchmark estimations, we investigate the direct impact of two types of capital flows and IPR. Namely, we investigate the role of FDI inflows and IMF credit on capital accumulation, controlling for time and country fixed effects in our models. Tables 3a and 3b present the benchmark results. FDI and IPR both have a positive impact on the increase in capital stock. However, their joint impact found to be negative for the developing countries points to an inverse U-shaped relationship. Up to a certain level, IPR and FDI have positive impacts on capital stock. However, there is a threshold level for IPR, above which FDI is less effective in boosting capital accumulation. This result is consistent with the recent literature. Kashcheeva (2013) explains why there is a joint adverse effect of IPR and FDI, based on the reason that current patent systems are harmful to small firms as it is costly. To the extent that small domestic innovating firms are the major inventors in developing countries, the negatively significant interaction of FDI and IPR for the subsample of developing countries most likely captures the deterrent effect of stringent IP laws on small firms. We also find this negative FDI and IPR joint impact, with an inverse U-shaped relation, implying that there is a threshold for a positive impact and after that level, the joint impact tends to be harmful instead of being beneficial.

Both the REER index and trade openness have a positive impact on capital stock. Also, market capitalisation has a positive impact on capital accumulation showing that countries with more developed stock markets tend to accumulate more capital, while financial development in terms of the local credit market is not as effective. Therefore, financial development measured by broad money (m3) over GDP has a negative coefficient. This is consistent with Mattana and Panetti (2014) who

[2] The Sargan-Hansen test tests for joint validity of the instruments. It tests for the existence of the overidentification of the model. Arellano and Bond, (1991) develop AR test for a phenomenon that would render some lags invalid as instruments, namely, autocorrelation in the idiosyncratic disturbance term, vit. In all of our models we conducted AR (1) and AR (2) test to encounter order-1 and 2 serial correlations. The test shows only order-1 serial correlation due to the dynamic nature of our model including lagged dependent variable as one of the explanatory variables. The Wald Chi square test tests the null hypothesis that two coefficients of interest are simultaneously equal to zero. If the test fails to reject the null hypothesis, this suggests that removing the variables from the model does not cause harm to the fit of that model, since a predictor with a coefficient that is very small relative to its standard error does not contribute to the dependent variable. The rejection of the null hypothesis indicates that the coefficients are not simultaneously equal to zero.

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Table 3a
Testing the Impact of Lending Mechanisms and External Debt on IPR –Capital Accumulation Relation in Developing Countries.

Regions: Asia, Middle East, Africa, Latin America	All Developing World												G7 counties
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
FDI	0.4479***	0.6179***	0.5541***	0.6528***	0.6382***	0.6048***	0.5736***	0.5877***	0.4592***	0.5306***	0.49***	0.5550***	0.1269*
	[0.1550]	[0.1430]	[0.1440]	[0.1405]	[0.1410]	[0.1404]	[0.098]	[0.0945]	[0.1001]	[0.0939]	[0.0965]	[0.0945]	[0.175]
IPR	0.0188**	0.0232***	0.0223***	0.02176***	0.02351***	0.01996**	0.0208**	0.0213***	0.02043***	0.02303***	0.02292***	0.02113***	0.00802**
	[0.008]	[0.0081]	[0.0079]	[0.0082]	[0.0082]	[0.0082]	[0.00813]	[0.00808]	[0.0078]	[0.0079]	[0.0079]	[0.0807]	[0.00323]
FDIxIPR	−0.3405*	−0.4255**	−0.4037**	−0.4086**	−0.4395**	−0.3682*	−0.38*	−0.3911**	−0.3644*	−0.4235**	−0.4182**	−0.3906**	0.2392**
	[0.203]	[0.196]	[0.1924]	[0.1961]	[0.1961]	[0.1954]	[0.196]	[0.1947]	[0.1891]	[0.1913]	[0.1897]	[0.193]	[0.1143]
Debt Variables													
IMF ratio	−0.3225*						−0.082						
	[0.1706]						[0.1267]						
IBRD ratio		−0.306*						−0.3173*					
		[0.170]						[0.1643]					
Public Debt ratio			−0.1469**						−0.09466**				
			[0.0651]						[0.0386]				
Private Debt ratio				−0.0505						0.07158			
				[0.061]						[0.0404]			
ST Debt ratio					0.0429						0.1538		
					[0.0925]						[0.0663]		
Total Debt ratio						−0.06694*						0.321	
						[0.0348]						[2.698]	
Control Variables													
Trade Openness	0.0624***	0.0454**	0.0630**	0.0574**	0.0481*	0.0681**	0.0545***	0.0561***	0.0652***	0.0486*	0.0524**	0.0696***	0.384**
	[0.0184]	[0.0209]	[0.0268]	[0.0281]	[0.0267]	[0.0279]	[0.0199]	[0.0197]	[0.0227]	[0.0260]	[0.0240]	[0.0250]	[0.162]
REER index (2010 = 100)	0.0798***	0.0234	0.0146	0.0261	0.0272*	0.0176	0.0284*	0.0274*	0.0223	0.0302*	0.0349**	0.0348**	0.0660**
	[0.0120]	[0.0148]	[0.0167]	[0.0161]	[0.0163]	[0.0165]	[0.0149]	[0.0145]	[0.0160]	[0.0155]	[0.0152]	[0.0157]	[0.0276]
Instability	0.00929	−0.0172	−0.0283**	−0.0273**	−0.0277**	−0.0261**	−0.0340***	−0.0332***	−0.0374***	−0.0379***	−0.0376***	−0.0426***	0.0661
	[0.00940]	[0.0113]	[0.0128]	[0.0130]	[0.0131]	[0.0129]	[0.0100]	[0.00993]	[0.0107]	[0.0109]	[0.0107]	[0.0107]	[0.0575]
Financial Development	−0.100***	−0.0687**	−0.0700*	−0.0638*	−0.0799**	−0.0485	−0.0948***	−0.0956***	−0.0788***	−0.0989***	−0.103***	−0.0950***	0.0433**
	[0.0248]	[0.0328]	[0.0355]	[0.0376]	[0.0392]	[0.0378]	[0.0292]	[0.0285]	[0.0298]	[0.0295]	[0.0295]	[0.0303]	[0.0178]
Market Capitalisation	0.0126*	0.0416***	0.0575***	0.0559***	0.0574***	0.0550***	0.0402***	0.0417***	0.0554***	0.0566***	0.0591***	0.0556***	0.0188*
	[0.00762]	[0.00916]	[0.0101]	[0.0102]	[0.0104]	[0.0101]	[0.00911]	[0.00906]	[0.00979]	[0.00988]	[0.00993]	[0.00998]	[0.00981]
Constant	15.54***	28.06***	21.29***	17.88***	18.88***	18.97***	26.99***	28.00***	19.74***	18.57***	18.23***	15.86***	−2.193
	[2.429]	[4.359]	[5.613]	[5.640]	[5.589]	[5.515]	[4.239]	[4.128]	[5.341]	[5.362]	[5.210]	[5.177]	[7.508]
Observations	254	254	236	236	236	236	284	284	266	266	266	266	104
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
F Statistic	10.35	4.037	3.539	3.353	3.333	3.480	5.892	6.057	5.892	5.745	5.859	5.586	6.535
F Test for ui = 0	16.19	18.26	16.78	16.89	17.81	15.81	18.22	18.51	16.12	18.83	19.31	16.07	5.442
R-square	0.296	0.494	0.480	0.466	0.465	0.475	0.553	0.560	0.568	0.562	0.567	0.555	0.835
Adjusted R-square	0.197	0.312	0.276	0.258	0.255	0.270	0.409	0.418	0.419	0.411	0.417	0.402	0.701

Notes: (1) * p < 0.10 ** p < 0.05 *** p < 0.01. (2) Standard errors in brackets. (3) Hausmann and Breusch-Pagan Tests indicate choosing FE estimation instead of RE or OLS. (4) IPR variable is Total patents + trademarks applications, scaled by million people. (5) First 6 columns cover the regions Asia, Middle East, Africa, Latin America, second six columns are for entire developing countries. (6) The last column is G7 countries, they do not have any IMF credits, IBRD & IDA lendings or external debt.

Table 3b
Marginal effects of FDI on cross-country capital stock at different levels of IPR.

Percentile of IPR	Corresponding Country	Value of IPR (scaled by million people)	Marginal effects of FDI (in % of GDP)	Std errors
1%	Ethiopia, Rwanda	0.0219	0.926	0.099
5%	Bangladesh, Burundi, Egypt, Madagascar, Mali, Nepal, Nigeria	0.0501	0.915	0.096
10%	India, Kenya, Malawi, Pakistan, Sudan, Uganda	0.0758	0.904	0.094
25%	Angola, Albania, Algeria, Cuba, Haiti, Indonesia, Iran, Iraq, Kyrgyz Rep, Morocco, Mozambique, Philippines, Saudi Arabia, Sierra Leone, Sri Lanka, Tajikistan, Tunisia, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe	0.233	0.839	0.079
50%	Armenia, Azerbaijan, Belarus, Bolivia, Bosna and Herzegovina, Brazil, Bulgaria, China, Colombia, Croatia, Dominican Rep, Ecuador, El Salvador, Georgia, Guatemala, Guyana, Honduras, Hungary, Italy, Jamaica, Kazakhstan, Liberia, Macedonia, Mauritius, Mexico, Moldova, Mongolia, Nicaragua, Peru, Poland, Romania, Russia, Serbia, South Africa, Thailand, Turkey, Turkmenistan, Ukraine	0.749	0.629	0.049
75%	Argentina, Austria, Chile, Costa Rica, Czech Rep, Estonia, Fiji, Finland, France, Germany, Greece, Ireland, Jordan, Kuwait, Latvia, Lithuania, Malaysia, Panama, Portugal, Slovak Republic, Slovenia, Spain, Trinidad and Tobago, United Kingdom, United States, Venezuela	1.699	0.240	0.103
90%	Australia, Bahamas, Bahrain, Belgium, Belize, Cyprus, Denmark, Israel, Korea, Malta, Montenegro, Netherlands, Norway, Paraguay, Sweden, Switzerland, Uruguay	2.865	−0.236	0.221
95%	Barbados, Hong Kong, Iceland, Japan, New Zealand, Singapore	4.935	−1.08	0.437
99%	Canada, Luxembourg, Macao, Monaco	14.925	−5.16	1.49

Notes: Column 1 shows the percentile of IPR. Column 2 classifies countries according to their IPR values (Total patents and trademarks per thousand people) into different percentiles. Column 3 shows the mean value of IPR rate in the corresponding percentiles. Column 4 shows the magnitude of the marginal effect of FDI and finally, column 5 shows standard errors.

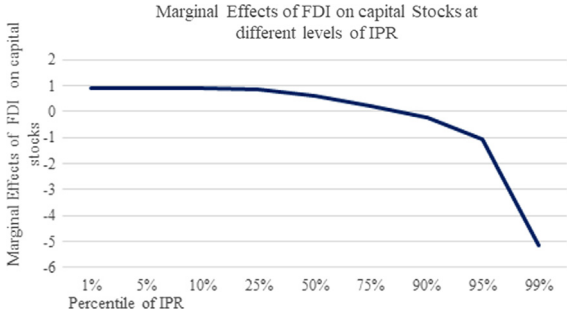

Fig. 2. Marginal Effects of FDI on capital stocks at different levels of IPR. $\left(\frac{\delta CapitalStock}{FDI} = \widehat{\beta_1} + \widehat{\beta_2} * IPR\right)$.

develop a growth model with banks and markets and found that at a low level of economic development, relative liquidity is higher because the agents have difficulty in accessing the stock markets and therefore prefer banks, making relative liquidity to be higher. Mattana and Panetti, (2014) suggest that there is a threshold after which agents are wealthy enough and have access to markets as well as banks. Thus, the whole liquidity of the financial system will drop. Instability of an economy is found to have a negative and significant impact on capital accumulation, whereas the impact of the use of IMF credits is found to be negative. Majority of the earlier studies on IMF credits and growth, either found negative or insignificant relation (see studies such as Bird, (2001); Barro and Lee, (2005); Easterly, (2005); Dreher, (2006); Dreher et al., (2009)). In Table 3a column 1 we estimate the following equation:

$$CapitalStock_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 FDI_{i,t} \times IPR_{i,t} + \beta_4 IMF_{i,t} + \sum \gamma (MacroControls)_{i,t}$$

In Table 3a we estimate the impact of lending mechanisms and IPR on capital stock. In the first 6 columns of the table, the regions Asia, Middle East, Africa and Latin America are used. The regions of North America, Europe, and Oceania are excluded. The motive is that regions of Asia, Middle East, Africa and Latin America are the regions where still most of the countries located are either developing or least developed. However, in the columns from 7 to12 all developing countries are included. In the 13th column of the table, only G7 countries are taken as a sample to check how financial flows and IPR impact capital accumulation. In Table 3a, FDI inflows have a positive impact on capital stock in the whole sample. Also, in G7 countries both the FDI inflows and IPR have a positive impact on capital accumulation. As opposed to developing sample, for the G7, the joint impact of FDI and IPR is positive. Therefore, it is possible to say that countries above a certain level of development can benefit from increasing IPR. Controlling for macroeconomic indicators, we find that trade openness contributes to capital accumulation, whereas the REER index varies across the regions. Additionally, instability also has a negative impact on the

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Table 4
The Joint Impact of IMF, World Bank loans and IPR on capital stock.

	(1)	(2)	(3)	(4)
FDI	0.5564	0.4986	0.7264**	0.7373**
	[0.3539]	[0.3537]	[0.3352]	[0.3334]
IPR	0.0296	0.0119	0.03361	0.04297
	[0.0308]	[0.0321]	[0.0303]	[0.0305]
FDIxIPR	−0.1779	0.06814	−0.2826	−0.4534
	[0.745]	[0.7538]	[0.7342]	[0.7353]
Debt Variables				
IMF ratio	−1.092***	−1.323***		
	[0.4042]	[0.4292]		
IPRxIMF		3.323*		
		[1.904]		
IBRD ratio			−1.892***	−1.972***
			[0.4160]	[0.417]
IPRxIBRD				4.965*
				[2.595]
Control Variables				
Trade Openness	0.372***	0.371***	0.366***	0.364***
	[0.0626]	[0.0624]	[0.0614]	[0.0611]
Market Capitalisation	−0.0717***	−0.0697**	−0.0773***	−0.0734***
	[0.0276]	[0.0274]	[0.0272]	[0.0271]
REER index (2010 = 100)	0.328***	0.335***	0.327***	0.338***
	[0.0429]	[0.0428]	[0.0417]	[0.0419]
Financial Development	0.231***	0.237***	0.186**	0.188**
	[0.0815]	[0.0813]	[0.0807]	[0.0804]
Instability	−0.0636**	−0.0622**	−0.0748**	−0.0813***
	[0.0299]	[0.0297]	[0.0294]	[0.0294]
Constant	82.42***	82.00***	91.47***	87.46***
	[10.20]	[10.29]	[9.997]	[10.20]
Obs.	288	288	288	288
Wald Chi-sq.	160.8	164.5	181.5	186.5
Adj. R-sq.	0.592	0.582	0.647	0.6905

Notes: (1) Standard errors are reported in brackets. (2) * p < 0.10 ** p < 0.05 *** p < 0.01. (3) Hausmann and Breusch- Pagan Tests indicate choosing FE estimation instead of RE or OLS. (4) IPR variable is Total patents + trademarks applications (scaled by million people).

capital stock regardless of the type of borrowings used. The impacts of financial development and market capitalisation are as expected. Financial development has a negative effect on capital accumulation, and market capitalisation has a positive impact on the capital-output ratio in all developing countries. However, for G7 countries financial development has a positive impact on capital accumulation due to these countries' higher liquidity rates. In Table 3a, the impact of both IMF and World Bank credits is negative in developing countries. Public and publicly guaranteed debts have a negative impact on capital stock while short-term or privately non-guaranteed have no significant impact. Total external debt stocks are negative in developing groups, though insignificant for the developing world. In Table 3a we focus on two different empirical models. The first one is for developing regions and developing countries, and the second one is for G7 countries. The models are specified as below:

$$\text{Developing countries}: \; CapitalStock_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 FDI_{i,t} \times IPR_{i,t} + \beta_4 External\ debts_{i,t} + \sum \gamma (MacroControls)_{i,t}$$

$$\text{G7 Countries}: \; CapitalStock_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 FDI_{i,t} \times IPR_{i,t} + \sum \gamma (MacroControls)_{i,t}$$

Following our benchmark model estimated in Table 3a column 1, we estimate the marginal effects based on the estimation in column 1 (see Table 3b). Fig. 2 portrays the marginal effect of FDI rate on capital accumulation at different levels of IPR (scaled by million people). In Table 3b, the estimation of marginal effects on capital is carried out at different percentiles (1th, 5th, 10th, 25th, 50th, 75th, 90th, 95th and 99th). Marginal effects estimations assist us in determining at what level, capital stock is affected, and we check whether the interactions justify the marginal effects of FDI on capital stock at different levels of IPR. Column 1 shows the percentile of IPR. Column 2 classifies countries according to their IPR values (Total patents and trademarks scaled by million people) into different percentiles. Column 3 shows the mean value of the IPR rate in the corresponding percentiles. Column 4 shows the magnitude of the marginal effect of FDI and finally, column 5 shows standard errors. Estimation suggests that the marginal effect of FDI variable has a decreasing pattern overall. The effect is positive from the 1st percentile of IPR until the 75th percentile. After that, from 90th percentile, a decreasing pattern is observed from positive to negative matching with a significant negative coefficient of the interaction term of FDI and IPR in our estimation model. This indicates that at the highest levels of IPR, the impact of FDI on capital stocks starts declining. This means that

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although both FDI and IPR directly affects capital stock positively, greater IPR moderates the effect of FDI on domestic capital stock. The only exception to this is G7 countries, as it is observed in the last column of Table 3a. The FDI and IPR interaction is positive for G7 countries, showing that the moderating impact of IPR disappears for the advanced economies. This means that additional IP assets become beneficial on FDI-capital accumulation relationship of G7 countries. In summary, at highest levels of IPR, the marginal effect of FDI shows lower capital accumulation, implying that any additional IPR at the top end is not beneficial for emerging economies, leading us to identify other institutional differences across those countries.

4.2. The Joint impact of lending mechanisms and IPR on cross-country capital accumulation

Another aspect that differentiates our research from the earlier literature is that we investigate both direct and indirect effects of borrowings from international lending institutions such as, IMF and World Bank lending on capital stock. The literature looked at the subject only from the growth perspective and the direct impact was found to be either negative or insignificant (see Abbott et al., (2010)). However, we investigate the joint impact of different lending mechanisms and IPR on cross country capital accumulation. Table 4 examines the joint impact of both IMF and World Bank lending with the degree of innovation or intellectual assets that can productively utilise these loans. In Table 4, our models are estimated using Fixed-Effects regression. Table 4 suggests that both IMF and World Bank lending have a direct negative impact on capital accumulation. However, the indirect impact of those is positive when interacted with IPR. This result indicates that if the IMF or World Bank loans are used for financing innovation activities, this contributes positively to capital accumulation. In Table 4 we estimate the following equations:

$$CapitalStock_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 FDI_{i,t} \times IPR_{i,t} + \beta_4 IMF_{i,t} + \beta_5 IMF_{i,t} \times IPR_{i,t} + \sum \gamma (MacroControls)_{i,t}$$

$$CapitalStock_{i,t} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 IPR_{i,t} + \beta_3 FDI_{i,t} \times IPR_{i,t} + \beta_4 IBRD_{i,t} + \beta_5 IBRD_{i,t} \times IPR_{i,t} + \sum \gamma (MacroControls)_{i,t}$$

As opposed to the typical approach in the literature- that is the impact of external borrowings on growth-we look at the subject from an innovation perspective. If the external financial flows namely IMF and World Bank lendings are used for financing of innovation activities, it leads to higher capital accumulation. We estimate the joint impact of lending mechanisms and innovation activities on capital stocks in Table 5, via introducing interaction terms of IMF, World Bank and external debt variables with IPR.

If we focus on the World Bank (IBRD & IDA) lending and external debt stocks, World Bank lendings alone have a negative and significant impact on cross-country capital stock in Table 5. However, the joint impact of World Bank credits and IPR variable on capital stock turns positive and significant at less than 1% level, as shown in column 1 of Table 5. On the other hand, IMF loans also have a direct negative impact on the capital stock, and the impact of IMF loans on capital stocks is positive if they are invested in innovative or productive activities (see Table 5 column 2). In Table 5, columns 3–6, we investigated the direct and indirect impacts of external debt stocks namely private and publicly guaranteed debt, short term debt, private-non-guaranteed debt and total debt on capital accumulation. If we look at the external debt stocks, the case is similar to borrowing from multilateral institutions for all types of debt including private non-guaranteed debt and publicly guaranteed debt stocks, meaning that these debts have a direct negative impact on capital accumulation, whereas their joint impact with IPR on capital turns positive in columns 3–5. The total debt also has a positive impact on capital flows in column 6, Table 5 if jointly used with innovation activities. This shows that the positive impact of IPR dominates the sample if financed by external debt. However, short-term debt stocks still have a negative effect on capital stocks even if we interact with innovation. This shows that short-term debt is usually used to finance short-term activities and has a quick repayment; therefore, they do not contribute to innovation activities.

In Table 6 we estimate the joint impact of World Bank loans with innovation across all developing countries in the pre and post-Global Financial Crisis. First 6 columns present all periods whereas column 7 represents pre-crisis and column 8 represents the post-financial crisis period. We took the year 2008 as the beginning of the recent global financial crisis and look at the periods before and after the year 2007. The years from 2008 onwards are counted as post-crisis period whereas until 2007 is pre-crisis. The results indicate that IBRD loans have a direct negative impact at all times whereas in the post-crisis period it generates a positive impact if used for innovation activities. This suggests that in the post-crisis period, developing countries may benefit from World Bank loans if they use the loans to generate innovative output. Also, FDI inflows have a direct positive impact whereas the indirect impact becomes negative with higher IPR meaning that there is an optimal level of IPR, above which there is little contribution to FDI-capital accumulation relationship.

4.3. Exploring channels: does institutional quality matter for innovation-capital accumulation relationship? Implementation of TRIPs agreement in developing countries

R&D activities generate innovation output or intellectual capital of a country which can officially be registered as intellectual properties subject to national intellectual property rights (i.e. Patent Law, Trademark Law and Design Law, etc.). There have been various arguments on how to acknowledge those national intellectual property rights in a global framework. After

[3] Later on, this deadline for developing countries was extended to 2013 for some least developed countries.

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Table 5
The Joint impact of lending and Innovation on capital accumulation.

	IBRD	IMF	Public Debt	ST Debt	Priv. Debt	Total Debt
Capital Stock$_{(t-1)}$	0.635***	0.66***	0.628***	0.713***	0.707***	0.611***
	[0.0390]	[0.0383]	[0.0340]	[0.0375]	[0.0370]	[0.0315]
FDI	0.3364***	0.3386***	0.2727***	0.3579***	0.3401***	0.2720***
	[0.073]	[0.0735]	[0.0557]	[0.0662]	[0.0661]	[0.0531]
IPR	0.0221***	0.0241***	0.01847***	0.02385***	0.0177***	0.01486***
	[0.0043]	[0.0047]	[0.0042]	[0.0060]	[0.0447]	[0.0043]
FDIxIPR	−0.400***	−0.3484***	−0.2893***	−0.2175*	−0.3422***	−0.3398***
	[0.1078]	[0.1117]	[0.1042]	[0.1255]	[0.1102]	[0.1092]
Debt Variables						
IBRD ratio	−0.3284***					
	[0.0841]					
IPRxIBRD	1.358***					
	[0.2560]					
IMF ratio		−0.2310***				
		[0.0895]				
IPRxIMF		0.5029*				
		[0.330]				
Public Debt ratio			−0.0687***			
			[0.0121]			
Public Debt ratio XIPR			0.1550***			
			[0.05281]			
ST Debt ratio				−0.1368***		
				[0.0464]		
ST debtXIPR				−0.1293		
				[0.0978]		
Private Debt ratio					−0.1411***	
					[0.02607]	
Private DebtXIPR					0.2450***	
					[0.0828]	
Total Debt ratio						−0.0777***
						[0.0085]
Total DebtXIPR						0.06768*
						[0.0352]
Control Variables						
Trade Openness	0.070***	0.045***	0.0365***	0.0212**	0.038***	0.043***
	[0.0101]	[0.0101]	[0.0086]	[0.009]	[0.00926]	[0.00859]
REER index (2010 = 100)	0.0507***	0.04***	0.0437***	0.036***	0.0412***	0.0308***
	[0.0092]	[0.008]	[0.00888]	[0.0097	[0.009]	[0.009]
Financial Development	−0.07***	−0.057***	−0.0457***	−0.028**	−0.044***	−0.039***
	[0.0122]	[0.0123]	[0.0108]	[0.0112]	[0.0112]	[0.0103]
Market Capitalisation	−0.0091*	−0.00903*	−0.000166	0.00212	0.00164	−0.00725
	[0.0049]	[0.005]	[0.00427]	[0.005]	[0.00435]	[0.00458]
Instability	−0.0011	−0.00009	0.00514	0.00334	0.00157	0.00454
	[0.0052]	[0.0053]	[0.00491]	[0.005]	[0.00517]	[0.00463]
Constant	2.173*	3.519**	3.960***	2.446**	1.697	7.110***
	[1.270]	[1.423]	[1.228]	[1.084]	[1.114]	[1.201]
Obs.	288	288	270	270	270	270
Wald Chi-sq.	1141	980.2	1440.7	1070.3	1115.9	1418.5
Adj. R-sq.	0.731	0.749	0.756	0.771	0.9884	0.9917
Sargan	15.27	17.24	15.6	16.47	14.43	14.61
AR (1)	−1.307	−1.726*	−1.768*	−2.128**	−1.66*	−1.842*
AR (2)	−1.091	−1.341	−0.871	−0.944	−0.853	−0.828

Notes: (1) Standard errors are reported in brackets (2) * p < 0.10 ** p < 0.05 *** p < 0.01 (3) Models are estimated using Dynamic GMM. (4) The dependent variable is Capital stocks (as % of GDP) in each column. (5) IPR variable is Total patents + trademarks applications scaled by million people (6) AR(1) and AR (2) tests show the standard z-scores for AB tests. AR(1) and AR(2) tests for zero autocorrelation in the first differenced errors. It checks for potential serial correlation. The null hypothesis is H0: no autocorrelation. Star indicates the following probabilities: * p < 0.10 ** p < 0.05 *** p < 0.01. (7) In these estimations, 3rd level lags are used as GMM type instruments, followed by AR tests.

several decades of debates, the World Trade Organisation (WTO) framed the TRIPs (Trade-Related Aspects of Intellectual Properties) agreement which aims to harmonise national intellectual property rights. The signatories to this agreement include over 164 countries that jointly contribute to more than 90 per cent of world trade. The agreement was first signed on January 1, 1995 and has had an implementation period of 1 year for industrialised countries and up to 11 years for developing and transition economies.[3] In our paper, we consider the extension period until "2005". We take the year 2005 as the

[3] Later on, this deadline for developing countries was extended to 2013 for some least developed countries.

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Table 6
The Joint impact of lending and Innovation on Capital stock of Developing Countries in Pre- and Post-Crisis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7) Pre-Crisis	(8) Post-Crisis
Capital Stock$_{(t-1)}$	0.767***	0.778***	0.775***	0.616***	0.625***	0.669***	0.565***	0.367**
	[0.00072]	[0.00134]	[0.00251]	[0.00306]	[0.00339]	[0.0768]	[0.0820]	[0.144]
Debt Variable								
IBRD ratio	−0.0259***	−0.0481***	−0.04904***	−0.4416**	−2.320*	−40.70***	−49.63***	−61.14
	[0.0025]	[0.0028]	[0.00847]	[0.02104]	[1.348]	[15.48]	[17.40]	[40.07]
IPR		0.44***	0.189	0.358***	1.288***	0.722	0.8069***	0.142
		[0.023]	[0.014]	[0.0115]	[0.0260]	[0.0252]	[0.0295]	[0.675]
IPRxIBRD			0.3636***	0.4093**	0.3535**	1.086*	−2.496	5.266***
			[0.0786]	[0.1830]	[0.1630]	[0.6265]	[1.855]	[2.018]
Foreign Inflows								
FDI				0.4486***	0.4354***	0.4651	0.09905	0.5267***
				[0.0065]	[0.0127]	[0.02662]	[0.0189]	[0.1696]
FDIxIPR					−0.2689***	−0.2895	−1.544**	−0.2516**
					[0.0851]	[0.5462]	[0.6371]	[0.1051]
Control Variables								
Financial Development						0.0507***	0.0865***	0.0248
						[0.0154]	[0.00886]	[0.0554]
Instability						−0.00260	−0.0185**	−0.165***
						[0.00442]	[0.00793]	[0.0424]
Market Capitalisation						0.00109	0.0000957	0.0225**
						[0.00257]	[0.00191]	[0.0106]
REER (2010 = 100)						0.0513***	0.0298**	0.119***
						[0.00290]	[0.0123]	[0.0463]
Trade Openness						0.0673***	0.115***	0.00665
						[0.0144]	[0.0415]	[0.0294]
Constant	5.358***	5.493***	5.485***	8.030***	7.574***	1.875	2.154	−1.468
	[0.0391]	[0.0631]	[0.0645]	[0.100]	[0.142]	[2.240]	[2.611]	[6.284]
Obs.	4226	1526	1526	1433	1433	288	227	61
Wald Chi-sq.	1,340,014	351,489	851,733	1,634,493	1,462,998	126489.1	2529.1	13366.4
Adj. R-sq.	0.754	0.709	0.710	0.697	0.702	0.738	0.523	0.527
Sargan	123.6	74.42	75.86	73.57	71.90	14.37	11.06	7.880
AR (1)	−7.149***	−4.983***	−4.995***	−4.977***	−4.985***	−2.321**	−1.788*	−1.926*
AR (2)	−1.413	−0.996	−1.001	−1.091	−1.065	−0.984	−0.632	−0.812

Notes: (1) Standard errors are reported in brackets (2) * p < 0.10 ** p < 0.05 *** p < 0.01 (3) Models are estimated using Dynamic GMM. (4) IPR variable is Total patents + trademarks applications scaled by million people (5) AR(1) and AR(2) tests show the standard z-scores for AB tests. AR(1) and AR(2) tests for zero autocorrelation in the first differenced errors. It checks for potential serial correlation. The null hypothesis is H0: no autocorrelation. Stars indicate the following probabilities : * p < 0.10 ** p < 0.05 *** p < 0.01 6). In these estimations 3rd level lags are used as GMM type instruments, followed by AR tests.

deadline of the TRIPs implementation period for investigating the role of temporal variation in pre-and post-TRIPs periods. For this purpose, we used a natural experiment type of approach by conducting difference-in-differences (DD) estimations in the pre- and post-2005 time period. The year 2005 is taken as the deadline to TRIPs execution period as developing countries were expected to implement the agreement by that time. Overall, the TRIPs agreement aims to harmonize intellectual property rights in order to regulate international trade relations. And thus, some developing countries which were less able to attract international trade, will be able to benefit from capital flows through international trade or even attract greater foreign investment.

As shown in the previous section, innovation plays a critical role in boosting capital accumulation. However, innovation may not contribute towards capital-accumulation equally especially across developed and developing countries. The potential benefit from innovation depends on country-specific features such as macroeconomic structures, differences in regulatory systems, the strength of legal enforcements and so on. That benefit can potentially be fortified through better institutional quality. For example, a better rule of law may have an impact on how innovations are protected worldwide. As per the studies of Papageorgiadis et al., (2020, 2019, 2013), Branstetter et al., (2006, 2011, 2007), Hu and Png (2013); Kashcheeva, 2013; Yasar et al., 2011, stronger law enforcements on IP attracts higher rates of FDI. Papageorgiadis et al. (2020, 2013) find that the strength of informal institutions connected to the enforcement of IP in a country directly affects outcomes and positively moderates the effect of formal legal aspects of IP law on FDI outflows from the USA towards other countries. Papageorgiadis et al., (2019) on the other hand, also find that higher strength of IP institutions attracts Chinese higher outward FDI. However, the shape of this relationship displays an inverted U-shape showing that for the European countries which were Former Eastern Bloc (FEB) members, the strength of IP has moderating effects for FDI. Therefore, this shows that Chinese firms were attracted to less strict IP protection while investing in FEB countries. Similarly, it could be argued that countries above a certain level of development (see Sweet and Eterovic Maggio (2015)) and social complexity (see Kemeny, 2010) can benefit from financial inflows. Therefore, in order to capture those attributes, we introduce an institutional quality index variable in the estimations. Country- specific factors such as stronger enforcements and other types of government related control mechanisms such as regulations and control of corruption form the quality of the institutions.

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Therefore, it is crucial to introduce a governance variable to capture those institutional differences across countries. We use Kaufmann et al. (2010) Governance Indices: voice and accountability; political stability; government effectiveness; regulatory quality; rule of law; and control of corruption. As these indicators are highly correlated, we capture common variation among these indicators using PCA and construct a composite index of institutional quality (the only PC with eigenvalue more than one i.e., 5.088 and with 85% variation). Then, we separate the countries into two groups as countries with high- and low-institutional quality.

Using the institutional quality index, we aim to test whether the differences in the quality of the institutions matter in explaining cross-country variations in capital accumulation. We also challenge the innovation-capital accumulation relationship by testing the potential impact of institutional quality variations across countries. Cross-country differences in institutional quality refer to the differences in legal enforcements of countries. The crucial reason for introducing institutional quality to our sample is to test whether countries with stronger institutional quality tend to benefit from innovation-capital accumulation relationship favourably. We test whether the cross-country heterogeneity in the institutional quality matter for the innovation-capital accumulation relationship. The empirical analysis of this matter could be conducted in two different ways. The first appropriate method is to employ a difference-in-differences (DD) approach and the second method is to add interaction terms in order to observe the joint impact of institutional quality and innovation in the cross-country capital accumulation. In the previous sections, we have used FE and dynamic system GMM estimations and found a robust link between innovation and capital accumulation. In order to explore the channels through which innovation impacts capital accumulation, we employ "natural experiment" type of DD estimators (see Bertrand and Mullainathan, 2003) and non-parametric matching estimators (see Abadie and Imbens, 2006; Imbens and Wooldridge, 2009). Firstly, in Table 7a, we focus on the DD approach in order to observe the impact of the quality of institutions on capital accumulation before and after the implementation of the TRIPs agreement. Here we classify the countries as countries with high- or low-institutional quality. Any country above the sample mean is classified as having high-institutional quality and others are referred to as having low-institutional quality. High IQ refers to the countries with stronger institutional mechanisms whereas the low IQ refers to weak institutions.

However, it should be noted that the DD estimators measure how the relationship occurs in the centre of the distribution and assumes a homogenous relationship among the variables across whole sample. As we have a large number of countries with different economic structures and differences in institutions, that relationship may vary across different points of the capital accumulation variable. To address this, we further use Quantile Difference-in-Differences Regression (Q-DD) approach as mentioned earlier. The first 6 columns of Table 7a and 7b present different percentiles (i.e. 10th, 25th, 50th, 75th, 90th, and 95th) whereas column 7 presents the DD approach using the matching techniques suggested by Imbens and Wooldridge, (2009). Results of Table 7a indicate that countries with higher institutional quality benefit more in terms of capital accumulation than lower institutional quality countries in the post TRIPs period.

Furthermore, in Table 7b we employ a second set DD estimations in order to observe the differences in cross-country innovation on capital accumulation before and after the implementation of TRIPs agreement. We use R&D expenses (as %

Table 7a
Impact of Institutional Quality differences in cross-country capital accumulation: Q-DD Approach.

Variables	(1)10th percentile	(2)25th percentile	(3)50th percentile	(4)75th percentile	(5)90th percentile	(6)95th percentile	(7)All sample
Before 2005 (Extension to TRIPs)							
low Institutional Quality countries	2.825	5.460	7.647	11.32	16.71	19.27	10.04
	0.150	0.138	0.238	0.293	0.552	1.083	0.288
high Institutional Quality countries	1.744	3.033	5.010	7.816	13.49	20.72	6.583
	0.304	0.307	0.560	0.724	1.397	1.755	0.679
Difference Before	−1.081***	−2.427***	−2.638***	−3.506***	−3.213***	1.449*	−3.457***
	0.326	0.327	0.593	0.762	1.482	2.280	0.717
After TRIPs agreement							
low Institutional Quality countries	4.108	5.344	7.149	9.375	11.88	10.79	7.775
	0.117	0.119	0.218	0.279	0.538	1.142	0.265
high Institutional Quality countries	4.351	5.532	6.981	9.122	13.25	17.20	7.960
	0.246	0.251	0.458	0.591	1.199	1.524	0.556
Difference After	0.243***	0.187***	−0.168***	−0.253***	1.368***	6.412***	0.185***
	0.259	0.264	0.477	0.612	1.221	2.146	0.576
Diff-in-diff	1.324***	2.614***	2.469***	3.254***	4.581**	4.963**	3.642***
	(0.414)	(0.420)	(0.758)	(0.971)	(1.896)	(2.335)	(0.916)

Notes: (1) Our dependent variable is capital stocks (as % of GDP). (2) We use Q-DD approach in the first 6 columns and 7th column estimates the full sample impact. The pre-TRIPs period starts with 1996 till 2005 and post-TRIPs is 2006–2017. (3) We separate the sample as high- and low-institutional quality countries depending on their level of IQ. The country has high-IQ if greater than the mean IQ or low-IQ if less than the mean.

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Table 7b
Impact of R&D usage differences in cross-country capital accumulation: Q-DD Approach.

Variables	(1)10th percentile	(2)25th percentile	(3)50th percentile	(4)75th percentile	(5)90th percentile	(6)95th percentile	(7)All sample
Before 2005 (Extension to TRIPs)							
low R&D-based countries	4.123	5.354	7.267	9.392	11.92	13.19	7.937
	0.115	0.141	0.196	0.235	0.498	0.829	0.256
high R&D-based countries	5.392	6.503	7.969	9.045	11.14	11.58	8.402
	0.469	0.616	0.897	1.063	2.089	3.114	1.179
	1.269***	1.150***	0.702***	−0.347**	−0.782**	−1.606***	0.465***
Difference Before	0.478	0.625	0.908	1.078	2.121	3.196	1.193
After TRIPs agreement							
low R&D-based countries	2.670	4.958	7.158	10.76	15.47	19.11	9.228
	0.133	0.151	0.209	0.246	0.503	0.915	0.272
high R&D based countries	7.874	10.19	23.74	35.04	46.49	42.14	25.71
	0.557	0.686	0.976	1.165	2.392	3.575	1.285
Difference After	5.204***	5.229***	16.59***	24.28***	31.02***	23.04***	16.48***
	0.558	0.690	0.985	1.185	2.457	3.705	1.296
Diff-in-diff	3.935***	4.079***	15.88***	24.63***	31.81***	24.64***	16.01***
	(0.736)	(0.932)	(1.340)	(1.600)	(3.235)	(4.875)	(1.762)

Notes: (1) Our dependent variable is capital stocks (as % of GDP). (2) We use Q-DD approach in the first 6 columns and 7th column estimates the full sample impact. The pre-TRIPs period starts with 1996 till 2005 and post-TRIPs is 2006–2017. (3) We separate the sample as high- and low-institutional quality countries depending on their level of IQ. The country has high-IQ if greater than the mean IQ or low-IQ if less than the mean.

Table 7c
Impact of Institutional Quality and R&D differences on capital accumulation: DDD Approach.

Variables	(1)		(2)
Before 2005 (Extension to TRIPs)			
low R&D-based AND high institutional qual.	24.74	Low institutional quality AND high R&D-based	27.91
	0.0993		0.153
low R&D-based AND low institutional qual.	24.80	Low institutional quality AND low R&D-based	26.19
	0.0651		0.0682
high R&D-based AND high institutional qual.	28.01	High institutional quality AND high R&D-based	27.72
	0.149		0.120
high R&D-based AND low institutional qual.	28.16	High institutional quality AND low R&D-based	26.48
	0.193		0.111
Difference before	−0.0875**		−0.481**
	0.268		0.231
After TRIPs agreement			
low R&D-based AND high institutional qual.	25.61	Low institutional quality AND high R&D-based	27.80
	0.0795		0.294
low R&D-based AND low institutional qual.	25.80	Low institutional quality AND low R&D-based	26.98
	0.0591		0.0645
high R&D-based AND high institutional qual.	28.40	High institutional quality AND high R&D-based	28.20
	0.106		0.0865
high R&D-based AND low institutional qual.	29.90	High institutional quality AND low R&D-based	26.85
	0.329		0.0833
Difference after TRIPs	1.313***		0.530***
	0.359		0.314
Difference-in-difference-in Differences	1.321***		1.0116***
	(0.4477)		(0.3889)

Notes: (1) Our dependent variable is capital stock (as % of GDP). (2) We use Q-DD approach in the first 6 columns and the 7th column estimates the full sample impact. The pre-TRIPs period starts with 1996 till 2005 and post-TRIPs is 2006–2017. (3) We separate the sample as high- and low-institutional quality countries depending on their level of IQ. The country has high-IQ if greater than the mean IQ or low-IQ if less than the mean.

of GDP) as an indicator of innovation in a country. Here we classify the countries as high or low R&D-based according to their R&D expenses (as % of GDP). Countries with R&D rates above the sample mean are referred to as high R&D-based and others are low R&D-based if their R&D rates are below the mean. In the DD approach, a country is observed before and after the implementation of a specific program (TRIPs agreement in our case). By doing so, we are able to control for observed and unobserved factors apart from the variable of interest (i.e. R&D or institutional quality). Therefore, having a control group (low R&D countries) apart from a treatment group (high R&D countries) would eliminate biases. Table 7b indicates that after

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the TRIPs implementation it is found that countries at the higher-ends in terms of innovation rates benefit more in terms of capital accumulation. The overall sample also shows a positive gain in the post-TRIPs period.

In addition to the former, both differences in the level of innovation and the level of institutional quality can create heterogeneity in the way capital accumulates across countries. In order to observe how institutional quality matters in capital accumulation of high and low-R&D based countries, we further use difference-in-difference-in-differences (DDD) approach (see Table 7c). Here we have high- and low- quality institutions as well as high- and low-R&D based countries. DDD approach allows us to test whether there is any interaction between the countries' rate of innovativeness and their institutional quality in accumulating capital. This approach allows us to investigate the cross-sectional heterogeneity in the innovation rate of treated and control groups and we examine the magnitude of the effect of institutional quality since the implementation of TRIPs agreement. DDD effect represents the difference in the effect of institutional quality before and after TRIPs agreement and between high-R&D and low-R&D based countries. This approach captures the time change in the average impact of the institutional quality in the high-R&D based countries by netting out the change in the average effect

Table 8
Impact of Institutional Quality on External Debt, FDI and Capital accumulation relationship.

	(1)	(2)	(3)	(4)	(5) Post-TRIPs	(6) Post-TRIPs	(7) Post TRIPs	(8) Post TRIPs
Capital Stock$_{(t-1)}$	0.941***	0.967***	0.841***	0.970***	0.972***	0.925***	0.899***	0.851***
	[0.0147]	[0.0121]	[0.0176]	[0.0227]	[0.0055]	[0.0108]	[0.0523]	[0.0374]
IQ	0.155**	0.0473***	0.302**	0.200**	0.0207*	0.0068	2.457*	0.0318**
	[0.290]	[0.0163]	[0.544]	[0.119]	[0.0141]	[0.0221]	[2.230]	[0.319]
FDI	0.0257*	0.00239	0.0600***	0.0473**	0.00185**	0.00119*	0.0401*	0.0346**
	[0.0106]	[0.0015]	[0.0063]	[0.0221]	[0.0009]	[0.0013]	[0.0381]	[0.0234]
IPR	0.737**	0.0472	0.178**	0.783***	0.0584***	0.162***	−0.400	0.282*
	[0.461]	[0.0508]	[0.337]	[0.627]	[0.0166]	[0.0434]	[2.102]	[0.641]
Foreign Investment Inflows								
FDIxIPR				−0.458**				−0.434***
				[0.528]				[0.541]
FDIxIPRxIQ				0.108***				0.0290***
				[0.306]				[0.301]
Debt Variables								
IMF ratio	−0.02916*			−0.1148***	−0.942***			0.04395*
	[0.0274]			[0.0317]	[0.171]			[0.0693]
IMFxIQ	0.0486***				0.0290***			
	[0.03773]				[0.131]			
IBRD ratio		−0.0129***				−0.01293*		
		[0.430]				[0.0079]		
IBRDxIQ		0.0032***				0.0108***		
		[0.472]				[0.0046]		
Total Debt ratio			0.0905				−0.0239*	
			[0.287]				[0.056]	
Total DebtXIQ			0.348*				0.121**	
			[0.337]				[2.702]	
Control Variables								
Financial Development	0.0173***	0.00035	0.0221***	0.0169***	0.000715**	0.000409	0.0174	0.0164***
	[0.0034]	[0.00062]	[0.00374]	[0.00353]	[0.000309]	[0.000439]	[0.0156]	[0.00482]
Instability	−0.0860***	0.00014	−0.0268***	−0.0281***	0.0000828	−0.00172	−0.0902***	−0.105***
	[0.0094]	[0.00041]	[0.00869]	[0.00767]	[0.000312]	[0.00115]	[0.0130]	[0.0162]
Market Capitalisation	−0.00233***	0.00042**	−0.00125	−0.00408**	0.000112	0.000334**	−0.00207	−0.00248
	[0.00047]	[0.00018]	[0.00108]	[0.00195]	[0.000135]	[0.00016]	[0.00208]	[0.00197]
REER (2010=100)	0.00709***	−0.00002	0.00761***	0.00507**	−0.000066	−0.00032	0.00023	0.00295
	[0.00059]	[0.00023]	[0.00102]	[0.00252]	[0.000155]	[0.000213]	[0.000947]	[0.00276]
Constant	−0.883**	0.994***	−1.039***	−0.368	0.825***	2.143***	0.708	1.009**
	[0.444]	[0.311]	[0.191]	[0.425]	[0.146]	[0.306]	[1.520]	[0.475]
Obs.	170	170	174	214	214	116	148	148
Wald Chi-sq.	291.34	82.33	119	257.68	121.18	68.40	42.51	1192.3
Adj. R sq.	0.847	0.995	0.840	0.919	0.998	0.996	0.729	−0.137
Sargan	15.69	98.15	17.88	338.3	257.0	39.60	11.65	187.6
AR (1)	−2.399***	−2.387***	−2.400***	−2.524***	−1.542	−2.199**	−1.547	−1.654*
AR (2)	−2.338***	−2.388***	−1.923*	−2.322**	−1.871*	−2.006**	−1.876*	−1.210

Notes: (1) Standard errors are reported in brackets. (2) * p < 0.10 ** p < 0.05 *** p < 0.01. (3) Models are estimated using Dynamic GMM. (4) IPR variable is Total patents + trademarks applications scaled by million people. (5) IQ variable stands for the institutional quality index. (6) The institutional quality index variable is available between 1996 and 2017. Therefore, our data in this table is limited by the availability of this variable. (6) Post-TRIPs period stands for after the implementation period extension of the TRIPs agreement to developing countries, namely from the year 2005. Therefore, post-TRIPs estimations cover the time period between 2005 and 2017. (7) AR(1) and AR(2) tests show the standard z-scores for AB tests. AR(1) and AR(2) tests for zero autocorrelation in the first differenced errors. It checks for potential serial correlation. The null hypothesis is H0: no autocorrelation. Stars indicate the following probabilities : * p < 0.10 ** p < 0.05 *** p < 0.01. (8) In these estimations 3rd level lags are used as GMM type instruments, followed by AR tests.

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Table 9
The Impact of World Bank loans on IPR –Capital Stock Relation at different income Levels.

	(1)FE Upper-Mid	(2)FE Upper-Mid	(3)FE Low-Mid	(4)FE Low-Mid	(5)FE Low	(6)FE Low		(7)GMM Upper-mid	(8)GMM Upper-mid	(9)GMM Low-mid	(10)GMM Low-mid	(11)GMM Low	(12)GMM Low
Capital Stock$_{(t-1)}$								0.508***	0.437***	0.468***	0.565***	0.467***	0.367**
								[0.122]	[0.118]	[0.155]	[0.0820]	[0.157]	[0.144]
FDI	0.5877***	0.5830***	0.5982***	0.6004***	0.6108***	0.6036***		0.2332***	0.2742**	0.2954**	0.09905	0.2713**	0.5267***
	[0.0945]	[0.0939]	[0.0978]	[0.1006]	[0.1006]	[0.0972]		[0.0486]	[0.1207]	[0.1163]	[0.1892]	[0.1175]	[0.1696]
IPR	0.02136***	0.02578***	0.0158*	0.0215**	0.0172**	0.01368		0.0255***	0.02007	0.01988*	0.08069***	0.02014*	0.142
	[0.0081]	[0.0084]	[0.0088]	[0.0092]	[0.0085]	[0.0094]		[0.0092]	[0.0139]	[0.0120]	[0.02952]	[0.0118]	[0.675]
FDIxIPR	−0.3911**	−0.4468**	−0.2823	−0.3494	−0.2885	−0.2536		−0.3794**	−0.4973*	−0.5200**	−1.544**	−0.5273**	−0.2516**
	[0.1947]	[0.1961]	[0.2123]	[0.2114]	[0.2061]	[0.2158]		[0.1908]	[0.2986]	[0.2190]	[0.6371]	[0.2207]	[0.1051]
Debt Variables													
IBRD ratio	−0.3173*	−0.2779*	−0.3929**	−0.2950*	−0.3586**	−0.3421**		−0.5864**	−0.5495***	−0.6463**	−0.4963***	−0.6517**	−0.6114
	[0.1643]	[0.1524]	[0.1566]	[0.1618]	[0.1752]	[0.1465]		[0.2357]	[0.1513]	[0.2888]	[0.1740]	[0.3025]	[0.4007]
IBRDxIPR		1.536*		1.216*		0.6589			1.655***		2.496*		5.266***
		[0.9350]		[1.054]		[1.016]			[0.6210]		[1.855]		[2.018]
Control Variables													
Trade Openness	0.0561***	0.0507**	0.0554***	0.0533**	0.0565***	0.0567***		0.0491***	0.0477***	0.023	0.115***	0.0237	0.00665
	[0.0197]	[0.0197]	[0.0184]	[0.0206]	[0.0207]	[0.0185]		[0.0158]	[0.0168]	[0.0366]	[0.0415]	[0.0366]	[0.0294]
REER (2010 = 100)	0.0274*	0.0282*	0.0854***	0.0275*	0.0268*	0.0847***		0.0350***	0.0437***	0.0311***	0.0298**	0.0313***	0.119***
	[0.0145]	[0.0143]	[0.0120]	[0.0149]	[0.0151]	[0.0121]		[0.00679]	[0.00738]	[0.00707]	[0.0123]	[0.00763]	[0.0463]
Instability	−0.0332***	−0.0319***	−0.00568	−0.0309***	−0.0319***	−0.00692		−0.00144	−0.00244	−0.000076	−0.0185**	0.000186	0.165***
	[0.00993]	[0.00985]	[0.00846]	[0.0103]	[0.0104]	[0.00851]		[0.00828]	[0.00627]	[0.0093]	[0.00793]	[0.00927]	[0.0424]
Financial Development	−0.0956***	−0.0909***	−0.101***	−0.0901***	−0.0891***	−0.0999***		−0.0544	−0.0140	−0.0333	−0.0865***	−0.033	0.0248
	[0.0285]	[0.0283]	[0.0274]	[0.0332]	[0.0334]	[0.0271]		[0.0344]	[0.0375]	[0.0362]	[0.00886]	[0.0357]	[0.0554]
Market Capitalisation	0.0417***	0.0439***	0.0127	0.0465***	0.0452***	0.0123		−0.004***	0.00118	−0.00502**	0.0000957	−0.00411*	−0.0225**
	[0.0091]	[0.0091]	[0.0079]	[0.0095]	[0.0095]	[0.0079]		[0.0016]	[0.0018]	[0.0020]	[0.00191]	[0.00218]	[0.0106]
Constant	28.00***	26.87***	16.20***	27.13***	28.06***	16.28***		8.588**	6.200**	12.42*	2.154	12.38*	−1.468
	[4.128]	[4.112]	[2.560]	[4.302]	[4.314]	[2.638]		[3.819]	[2.557]	[7.394]	[2.611]	[7.446]	[6.284]
Observations	284	288	258	262	258	262	Obs.	284	288	258	227	258	61
Country Fixed Effects	YES	YES	YES	YES	YES	YES	Wald Chi-sq.	21,008	17151.6	21,463	2529.1	27616.7	13366.4
Time Fixed Effects	YES	YES	YES	YES	YES	YES	Adj. R-sq.	0.578	0.629	0.569	0.523	0.681	0.527
F statistic	6.057	6.045	17.78	5.652	5.716	16.15	Sargan	13.31	12.38	11.37	11.06	11.38	7.880
F Test for ui = 0	18.51	18.70	16.36	19.70	19.67	16.12	AR (1)	−2.034**	−2.024**	−2.261**	−1.788*	−2.228**	−1.926*
R sq	0.56	0.563	0.414	0.574	0.574	0.414	AR (2)	−0.4	−0.380	−0.446	−0.632	−0.461	−0.812
Adj. R-sq	0.418	0.419	0.336	0.424	0.427	0.332							

Notes: (1)* p < 0.10 ** p < 0.05 *** p < 0.01. (2) Standard errors in brackets. (3) IPR variable is Total patents + trademarks applications scaled by million people. (4) 7) Columns 1 to 6 are estimated using Fixed Effects estimations adding country and time fixed effects after testing for the time and individual fixed effects. Hausmann and Breusch- Pagan Tests indicate choosing FE estimation instead of RE or OLS. (5) Columns 7 to 12 are estimated using dynamic system GMM. Hansen and AR(1) and AR(2) tests are conducted. (6) AR(1) and AR(2) tests show the standard z-scores for AB tests. AR(1) and AR(2) tests for zero autocorrelation in the first differenced errors. It checks for potential serial correlation. The null hypothesis is H0: no autocorrelation. Star indicates the following probabilities : * p < 0.10 ** p < 0.05 *** p < 0.01. (7) In the estimations shown in columns 7 to 12, 3rd level lags are used as GMM type instruments, followed by AR tests.

Table 10
The Impact IMF Credits on IPR – Capital stock Relation at different income Levels.

IMF credits	(1)FE Upper-mid	(2)FE Upper-mid	(3)FE Low-mid	(4)FE Low-mid	(5)FE Low	(6)FE Low		(7)GMM Upper-mid	(8)GMM Low-mid	(9)GMM Low-mid	(10)GMM Low	(11)GMM Low
Capital Stock$_{(t-1)}$								0.538***	0.914***	0.514***	0.325**	0.511***	0.616***
								[0.0870]	[0.0686]	[0.0955]	[0.143]	[0.0946]	[0.0648]
FDI	0.5736***	0.5836***	0.5939***	0.6019***	0.5892***	0,5890***		0.2355***	0.4031**	0.2528**	0.4828***	0.2627**	0.1567
	[0.0988]	[0.09945]	[0.1051]	[0.1056]	[0.1050]	[0.1047]		[0.0746]	[0.1987]	[0.1273]	[0.1157]	[0.1269]	[0.1225]
IPR	0.0208**	0.02180**	0.01727**	0.0179**	0.01566*	0.01518		0.02.217**	0.0088	0.00692	0.01209	0.00597	0.00715
	[0.0081]	[0.00848]	[0.00864]	[0.0089]	[0.0089]	[0.0094]		[0.0095]	[0.0249]	[0.01445]	[0.0162]	[0.01448]	[0.0192]
FDIxIPR	−0.3838*	−0.3974**	−0.2947	−0.3039	−0.2762	−0.2695		−0.3804**	−0.2084	−0.26.22	−0.1154	−0.2559	−0.1091
	[0.1962]	[0.1980]	[0.2082]	[0.2100]	[0.2149]	[0.2184]		[0.1912]	[0.385]	[0.2483]	[0.2613]	[0.2443]	[0.2522]
Debt Variables													
IMF ratio	−0.08248	−0.05329	−0.06021	−0.03917	−0.1153	−0.1145		−0.3368***	−0.2040	−0.4803***	−0.3803***	−0.5083***	−0.4618**
	[0.1267]	[0.1299]	[0.1329]	[0.1356]	[0.1318]	[0.1359]		[0.0793]	[0.1320]	[0.1358]	[0.1083]	[0.1405]	[0.1812]
IPRxIMF		0.2000*		0.1467*		0.08818*			0.3040*		0.7688*		0.7945*
		[0.5163]		[0.5356]		[0.0555]			[0.1070]		[0.6741]		[0.5725]
Control Variables													
Trade Openness	0.0545***	0.0545***	0.0567***	0.0566***	0.0571***	0.0572***		0.0386***	−0.0379	0.0819*	0.0644**	0.0853*	0.0471***
	[0.0199]	[0.0198]	[0.0209]	[0.0208]	[0.0186]	[0.0186]		[0.0131]	[0.0505]	[0.0434]	[0.0263]	[0.0435]	[0.0132]
REER (2010 = 100)	0.0284*	0.0284*	0.0286*	0.0286*	0.0875***	0.0876***		0.0333***	0.0374	0.0287***	0.0459***	0.0279***	0.0333***
	[0.0149]	[0.0148]	[0.0155]	[0.0155]	[0.0123]	[0.0123]		[0.00625]	[0.0307]	[0.00714]	[0.00840]	[0.00697]	[0.00661]
Instability	−0.0340***	−0.0338***	−0.0326***	−0.0325***	−0.00799	−0.00794		−0.00169	−0.0168***	−0.0190*	−0.00876	−0.0183*	−0.00493
	[0.0100]	[0.00994]	[0.0105]	[0.0104]	[0.00855]	[0.00851]		[0.00675]	[0.00529]	[0.00997]	[0.00845]	[0.00986]	[0.00879]
Financial Development	−0.0948***	−0.0945***	−0.0927***	−0.0922***	−0.0890***	−0.0884***		−0.0215	−0.0656*	0.0152	0.00184	0.0189	−0.0161
	[0.0292]	[0.0289]	[0.0345]	[0.0342]	[0.0278]	[0.0276]		[0.0237]	[0.0379]	[0.0400]	[0.0253]	[0.0405]	[0.0259]
Market Capitalisation	0.0402***	0.0400***	0.0430***	0.0429***	0.0133	0.0134*		−0.00375*	−0.00333	−0.00337**	−0.00507	−0.00431***	−0.00517
	[0.00911]	[0.00907]	[0.00955]	[0.00950]	[0.00809]	[0.00807]		[0.00193]	[0.00908]	[0.00133]	[0.00418]	[0.00127]	[0.00399]
Constant	26.99***	26.63***	26.72***	26.34***	14.07***	13.71***		6.181***	18.32	2.31	5.043	2.042	4.050**
	[4.239]	[4.222]	[4.477]	[4.456]	[2.536]	[2.529]		[1.944]	[13.23]	[4.627]	[3.323]	[4.443]	[1.992]
Observations	284	288	258	262	258	262	Obs.	284	288	258	288	258	288
Country Fixed Effects	YES	YES	YES	YES	YES	YES	Chi-sq.	78459.1	1439.7	13314.4	8090.2	11,261	20304.7
Time Fixed Effects	YES	YES	YES	YES	YES	YES	Adj.R-sq.	0.42	0.986	0.444	0.989	0.749	0.989
F Statistic	5.892	5.807	5.512	5.442	16.76	15.19	Sargan	12.97	17.24	8.695	9.303	8.731	13.47
F Test for ui = 0	18.22	19.22	19.24	20.18	16.05	16.89	AR(1)	−2.295**	−1.726*	−3.383***	−2.022**	−3.319***	−2.466***
R-sq.	0.553	0.553	0.565	0.565	0.399	0.399	AR(2)	−0.369	−1.341	−0.778	−0.471	−0.779	−0.528
Adj. R-sq.	0.409	0.406	0.415	0.411	0.32	0.315							

Notes: (1) * p < 0.10 ** p < 0.05 *** p < 0.01. (2) Standard errors in brackets. (3) IPR variable is Total patents + trademarks applications scaled by million people. (4) 7) Columns 1 to 6 are estimated using Fixed Effects estimations adding country and time fixed effects after testing for the time and individual fixed effects. Hausmann and Breusch- Pagan Tests indicate choosing FE estimation instead of RE or OLS. (5) Columns 7 to 12 are estimated using dynamic system GMM. Hansen and AR(1) and AR(2) tests are conducted. (6) AR(1) and AR(2) tests show the standard z-scores for AB tests. AR(1) and AR(2) tests for zero autocorrelation in the first differenced errors. It checks for potential serial correlation. The null hypothesis is H0: no autocorrelation. Stars indicate the following probabilities : * p < 0.10 ** p < 0.05 *** p < 0.01. (7) In the estimations shown in columns 7 to 11, 3rd level lags are used as GMM type instruments, followed by AR tests.

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for low-R&D countries (Table 7c column 1). On the other hand, the same estimations can be done for high-institutional and low-institutional quality to see the difference in the impact of innovation between pre- and post-TRIPs periods (See column 2 of Table 7c). Both estimations validate that the TRIPs agreement makes a positive contribution towards R&D- capital accumulation relationship for countries with better institutional quality.

We find that the countries with high institutional quality tend to raise their capital stock at a higher rate than countries with low institutional quality during both pre and post-TRIPs periods. Secondly, high R&D-based countries tend to have greater capital accumulation only in the post-TRIPs period. DD and DDD models in Table 7a–7c show that institutional quality creates differences in capital accumulation across countries in the post-TRIPs period. We also found that countries with the better institutional quality and higher R&D tend to accumulate higher capital in the post-TRIPs period. This signals us that better institutional quality tends to have a positive impact on capital accumulation. In Table 8, we estimated whether high-institutional quality countries benefit in the post- TRIPs period. Columns 1-2-3 of Table 8 estimates the role of institutional quality on debt-capital accumulation relationship for all time periods whereas column 5-6-7 estimates for the post-TRIPs period. Table 8 shows that all types of external debt flows including multilateral lending from IMF and World Bank tend to boost capital accumulation with higher institutional quality. In addition to the debt-institutional quality relation, we also control whether better institutional quality has an impact on FDI-IPR relationship. We find that countries with better institutional quality tend to benefit positively from FDI- IPR relation in generating higher capital stocks mainly in the post-TRIPs period which dominates the overall sample period.

4.4. Robustness checks

To ensure the robustness of our results, we introduce income level classifications in order to capture different levels of economic development across countries. This tends to be an alternative measure to cross-country institutional differences which we use in the main estimations. According to Bravo-Ortega and García Marín, (2011), differences in the institutional mechanisms such as income levels and socioeconomic conditions positively influence TFP. Therefore, by using income-level classifications we conducted two different robustness checks: checking the impact of multilateral lendings, and external debt flows at different income levels using FE and GMM.

In this part, we aim to estimate the impact of various lending mechanisms on capital accumulation by using the IMF credits, and the World Bank loans. We considered World Bank income-level classification and estimated the impact on lower-income, lower-middle income, and upper-middle-income countries to see how different type of lending mechanisms works for countries with different income levels. Table 9, columns 1 to 6 estimate the impact of World Bank loans, on the capital stocks of the countries with different income levels using FE estimations. After the specification tests, Fixed Effects model is preferred to Random Effects or pooled OLS regressions. Columns 7–12 of Table 9 estimate the models using dynamic System GMM. FDI and IPR are both positive for all lower-income, lower-middle and upper-middle-income countries in both FE and GMM estimations. The joint impact of IPR and FDI is negative in both FE and dynamic GMM estimations which we have explained using different country heterogeneities. Trade openness is significant and positive throughout in FE, and significant only in upper-middle-income countries when estimated using GMM, while the impact of REER index is positive and significant in both estimation methods for all three income groups. Macroeconomic instability and financial development have both a negative and significant impact on capital accumulation in FE estimations while they are found to be negative and insignificant if estimated by GMM. Finally, World Bank loans have a significant negative impact on capital stock in both FE and GMM for all low income, lower-middle and higher-middle-income countries. However, those loans provide a positive impact at all income levels if the countries are more innovation-oriented (greater amount of intellectual capital).

In Table 10, columns 1–6 estimate the impact of IMF credits on capital accumulation at different income levels by using FE estimation, and columns 7–12 by using dynamic GMM estimations. The impact of FDI is to be positive and highly significant for all income levels in both FE and GMM estimations. However, the impact of IPR variable is only positive and significant at all income levels in FE estimations while in GMM it is significant only at upper-middle income levels. The joint impact of FDI and IPR is negative, parallel to our benchmark model in previous parts. But the impact is only significant at upper-middle income level in both FE and GMM estimations. In Table 10, trade openness, REER and market capitalisation have a positive impact. In addition, IMF credits have a direct negative impact on capital accumulation at all income levels in both GMM and FE. However, if those loans are used for financing innovative activities or in more innovation-oriented countries, the joint impact becomes positive for all three income groups.

5. Conclusions

External inflows play an important role in cross-country capital accumulation. Nevertheless, there is a puzzle in the innovation and external flow relationship, as the impact of different types of financial flows on capital stocks may vary across countries. Besides, more innovation-focused countries or countries with higher amount of intellectual property stocks can benefit differently from financial inflows. Thus, countries with more intellectual assets are considered as high innovation-based countries and they tend to have more patents and trademarks, and therefore, could accumulate higher amount of capital. Whether the impact of FDI on capital stock varies at different levels of innovation is another puzzle. And because the majority of the earlier studies look at the firm or sectoral level, the cross-country overall effects on this debate have been

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neglected. Also, lending mechanisms such as the World Bank or IMF are known to have an adverse impact on domestic capital stocks. However, the impact of those lending mechanisms may be different if the country is more innovation-oriented, which has been given little attention in the prior literature. By integrating these two strands of literature, we examine whether institutional differences matter in assessing the innovation-external flows linkage for cross-country capital stock, using FE and dynamic GMM, and Difference-in-Differences (DD) estimations, with data for 175 countries over 1970–2017 time period.

Our analysis suggests that greater IPR impacts capital accumulation positively. Additionally, parallel to the literature, when the indirect impact is considered, countries that have better innovation tend to benefit more from FDI inflows in accumulating capital. However, there is a threshold up to which IPR is beneficial, and after that point, IPR is no longer beneficial in attracting FDI to non-G7 countries. This is because those developing countries who benefit from knowledge spill-over find it impossible either with tighter IP protection or weaker general institutional environment. For G7 countries the joint impact of FDI flows with innovation is positive throughout. This finding is parallel to the previous studies such as Sweet and Eterovic Maggio (2015) who find that only the countries that have an above-average level of economic development can benefit from stronger IPR enforcement. Kemeny (2010) found the FDI-innovation impact to be favourable, conditional on an economy's social capability. Li et al. (2016) find that the impact of FDI tends to be moderated by factors such as absorptive capacity, foreign presence, and competition intensity in the domestic market. On the other hand, according to the findings of Papageorgiadis et al., (2020, 2019, 2013), stronger law enforcements on IP attract higher FDI. Therefore, we challenge this indirect impact of FDI and IPR in the context of non-G7 countries by integrating institutional quality dimension into our analysis. Our results suggest that countries with better institutional quality benefit more in terms of capital accumulation.

The literature on the IMF credits (also World Bank loans) suggests that IMF credits have a negative effect on growth as those loans are meant for stability rather than economic growth. However, IMF credits, as well as World Bank loans and their impact on capital stocks along with innovation, were not explored in the previous literature. In our analysis, IMF credits and total external debt stock both have a direct adverse impact on capital accumulation. Our research diverges from the existing literature in the following aspect. We find that the lending mechanisms such as IMF, World Bank and total external debt have a negative impact on capital stocks. However, if those loans are used in creating innovation activities, then the joint impact of those funds with innovation becomes positive. This means that these sources of lending are only beneficial if the borrowing country has a greater amount of intellectual property or if those funds are used in financing innovation-oriented activities. This is a key finding which has not been captured in the previous literature. Additionally, we also analysed how those loans impact cross-country capital stocks in pre- and post-crisis periods. We find that developing countries benefit from World Bank loans in the post-crisis period when they are used for innovation activities. Our results are novel as previous literature on lending mechanisms did not analyse the impact considering the recent financial crisis. In addition to those findings, we also incorporated institutional quality mechanisms into the analysis. The results suggest that countries with better institutional quality benefit positively from multilateral lending, particularly so in the post TRIPs period.

In addition to the impact of innovation on capital accumulation, we also looked at the policy implications of TRIPs agreement using DD estimations. The years from 1996 to 2004 cover pre-TRIPs period whereas 2005 to 2017 cover post-TRIPs period. The reason for starting from 1996 is because of the data availability of institutional quality dimension. Kaufmann et al. (2010) develop institutional quality measures for 175 countries during the years 1996–2017. Therefore, while we investigate the policy implications of TRIPs, we used the restricted sample. Our results suggest that countries with better institutional quality benefit more in terms of capital accumulation in the post-TRIPs period. Additionally, more-R&D based countries have greater capital accumulation in the post-TRIPs period. In addition to these two findings, differences in countries' innovation intensities also create heterogeneity between high-institutional quality and low-institutional quality countries. Therefore, both differences in the level of innovation and level of the institutional quality can create heterogeneity in a way that can make capital accumulation to vary across countries. By using the DDD approach, we were able to capture any interaction effects between these groups. DDD estimations examine how institutional quality matters in capital accumulation of high and low-R&D based countries. This approach allowed us to investigate the cross-sectional heterogeneity in the innovation intensity of treated (high-institutional quality) and control (low-institutional quality) groups since the implementation of the TRIPs agreement. TRIPs agreement makes a positive contribution towards capital accumulation and R&D relationship for countries that have better institutional quality.

Therefore, countries with better institutional quality benefit positively from FDI and innovation relationship in general, including during post TRIPs period. This is also parallel to our benchmark results showing that FDI and innovation relationship is positive for G-7 countries. As G-7 countries have high-institutional quality, this explains why the joint impact is positive for the group. Besides, countries with better institutional quality in non-G7 category also benefit positively from IMF and World Bank loans. Following the TRIPs agreement, the impact of those multilateral loans is also positive, meaning that following the implementation of TRIPs, the high-institutional quality countries benefit positively in generating greater capital stocks by borrowing from those institutions. Also, we found that the results are similar even for total external debt, meaning that higher external debt stocks can boost capital accumulation in the countries with stronger institutional quality. This proves that developing countries can increase the benefits from financial flows such as FDI or from multilateral lendings by improving their quality of institutions.

Besides, the robustness of our results is ensured by conducting two robustness checks. After examining the factors influencing capital accumulation in the world economy, as a robustness check, we investigated how the same elements behave in the countries with different income levels. There is a direct positive impact of FDI on capital accumulation in both FE and

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GMM estimations, while the indirect effect of IPR and FDI is found to be negative in both FE and GMM for different income groups. IMF and World Bank credits have a negative impact on all lower-, lower-middle and upper-middle-income countries, while their indirect impact jointly with IPR becomes positive at all income levels in both FE and GMM. This is parallel to our main estimations. This means that if a country is focusing on innovation activities, those loans become beneficial at all levels of income groups.

In summing up, this paper contributes to the literature with three novel findings. Firstly, we find that although FDI and IPR have positive effects on capital accumulation for most of the countries, greater IPR moderates the effect of FDI, especially for developing countries. Developing countries are less innovative; therefore, developing countries with higher level of innovation can attract more capital inflows. Secondly, by considering other external financial flows, we find that the direct impact of lending mechanisms such as IMF and World Bank is negative. However, these loans are only beneficial if the borrowing country possesses greater amount of intellectual property or if those funds are used for financing more innovation-based activities. Also, the impact of World Bank loans becomes positive for the developing countries in the post-crisis period if such loans are channelled towards innovation activities. Finally, developing countries benefit more from external financial flows when they are combined with greater innovation and better institutional quality in the recipient countries.

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Appendix A. Unit root tests

There are different unit root tests suggested in the literature such as the (Breitung and Das, 2005; Im et al., 2003; Levin et al., 2002; Choi, 2001; Breitung, 2000; Harris and Tzavalis, 1999) tests, with the null hypothesis that all the panels contain a unit root. The tests make different asymptotic assumptions regarding the number of panels in the dataset and the number of periods in each panel, including tests appropriate for datasets with a large number of panels and few time periods, datasets with few panels but many time periods, and datasets with many panels and many time periods. The majority of the tests assume a balanced panel dataset, but the Im–Pesaran–Shin and Fisher-type tests allow for unbalanced panels. Therefore, we preferred Fisher type unit root test that uses ADF (Augmented-Dickey Fuller) test, because we have an unbalanced panel data and there are gaps in each time series. Fisher-type tests conduct unit-root tests for each panel individually, and then combine the p-values from these tests to produce an overall test. If the number of panels, N, is fixed, then these tests are consistent with the alternative that at least one panel is stationary. Table 11 reports the p-values using the inverse chi-squared, inverse normal, and inverse logit transformations. Also, a modified version of the inverse chi-squared transformation proposed by Choi (2001) is reported for use when N is believed to tend to infinity because the standard inverse chi-squared test statistic goes to infinity. The cross-sectional means are removed from the series in order to mitigate the effects of cross-sectional correlation. In other words, we subtract the cross-sectional averages from the series to mitigate the impact

Table 11
Unit Root Tests.

Ho = Panel variable contains unit root
H1 = Panel variable is stationary

Variable	Inverse $Chi^2(x)$ -P	Inverse normal- Z	Inverse logit(t)-L*	Modified Inverse $Chi^2(x)$ Pm
Capital Stock	706.106***	−7.569***	−8.8277***	12.038***
FDI	1329.35***	−19.0729***	−23.925***	34.44***
IPR	1536.72***	−21.868***	−28.042***	41.959***
Trade Openness	541.23***	−2.6053***	3.44***	5.76***
Market Capitilisation	462.43***	7.57***	8.93***	12.008***
Financial Development	554.44	2.898***	5.007***	8.841***
REER	1710.77***	33.34***	47.92***	78.53***
Instability	1360.88***	22.025***	25.19***	33.36***
IRBD ratio	315.1240***	0.9172	1.915***	2.712***
IMF ratio	280.343*	1.919***	1.99***	1.2625*
Public Debt ratio	348.97***	3.49***	4.39***	4.32***
ST Debt ratio	484.99***	4.580***	6.690***	10.378***
Priv Debt ratio	5071.98***	3.047***	4.016***	6.087***
Total Debt ratio	409.076***	−5.410***	6.275***	6.9967***

All tests include trends and demeaned values. As per Levin, Lin, and the Chu, using demeaned values mitigates the impact of cross-sectional dependence. ADF test examines the null hypothesis of a unit root against the stationary alternative. *, ** and *** indicate variables that are significant at the 10%, 5%, and 1% levels respectively.

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of cross-sectional dependence. We reject the null hypothesis of unit root at 1% level in all variables. Therefore, all variables in our panel dataset are stationary. The results are presented as follows.

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