Is the Impact of Digitization on Domestic Inflation Non-Linear? The Case of Emerging Markets

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ABSTRACT

This paper analyzes the impact of digitization on domestic inflation for a sample of 54 advanced economies (AEs) and emerging markets (EMs) over the period 2004-2018. Using System Generalized Method of Moments (GMM) estimation methodology, the study confirms a non-linear deflationary effect of the improvement in digitization, with the highest deflationary derived from the digital infrastructure and factors of digital production. Additionally, our results show that these deflationary effects are smaller in EMs versus the full sample, however, these effects are reinforced by the investment in human capital and the improvement in governance. Our policy recommendations for the full sample are directed towards expanding network coverage, increasing fixed and broadband download speed, boosting telecommunications, as well as strengthening intellectual property rights, and incentivizing innovation and patenting. In addition, for EMs, policy priorities should focus on maximizing school enrollments, controlling corruption, rule of law, and voice and accountability measures to recoup the maximum benefits of the improvement in digitization on domestic inflation.

JEL Classification Numbers: C23; G21; O47
Keywords: Inflation; Digitization; System GMM; Advanced Economies; Emerging Markets

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1. Introduction

In recent years, digitization has emerged as one possible explanation for the low and stable inflation trend observed across both emerging markets (EMs) and advanced economies (AEs), especially since the Great Recession. Digitization—including Internet of Things (IoT), big data analytics, machine learning, blockchain, artificial intelligence and beyond—is undoubtedly transforming industries worldwide, and it is increasingly possible that the fast-growing digitization of the economy is influencing inflation in a number of ways: for instance, by enhancing productivity and lowering marginal costs, which might lead to lower inflation.

Since the Great Recession, two major trends in inflation, particularly in AEs around the world, have been documented extensively in economic literature. First, inflation remained relatively higher than expected and quite stable in the immediate aftermath of the financial crisis (IMF 2013; Coibion and Gorodnichenko, 2015). This phenomenon is referred to in the literature as the "missing disinflation," because a global recession should normally have led to lower inflation in light of higher unemployment and reduced consumer confidence and demand, which, among many other factors, should have lowered the prices of goods and services. The second trend observed in more recent years is that inflation, particularly core inflation, seems to have remained consistently below the Central Banks' targets (Bhatnagar et al., 2017).

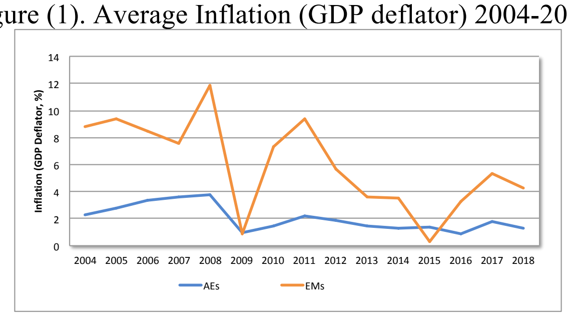
However, the low and stable inflation trends are not necessarily new phenomena. Long before the Great Recession, since the mid-70s, economists started noticing a potential "flattening" of the Phillips Curve in AEs (Kuttner and Robinson, 2010). In other words, it is possible that the downward-sloping relationship between inflation and unemployment as we know it has become weaker in recent decades. Many explanations have been given for this: some argued that Central Banks have simply done a better job at communicating essential information and thus anchoring people's inflation expectations, which affect the level of inflation in the present (Williams, 2006). Others have argued that lower inflation is a result of globalization and an ever-expanding global supply chain (Borio and Filardo, 2007).

And yet another possible explanation is that digitization, which has transformed the global economy, has driven the lower trend in domestic inflation in recent years, particularly in AEs. Without a doubt, digitization is transforming industries worldwide. In the U.S. alone, the digital economy grew at an average annual rate of 5.6% from 2006-2016, almost 4 times higher than 1.5% growth rate for the overall economy (Bureau of Economic Analysis, 2018). The adoption of digital tools in the workplace transforms transactions and increases efficiency in communication and production, and technological advances across sectors and industries—from agriculture and manufacturing to IT—in return create new jobs. In EMs, the OECD (2019) estimated that an additional 10% of internet usage contributes 1.17 percentage points to the GDP. Moreover, a causal relationship between digitization and economic growth has been established: Katz and Callorda (2017) used an endogenous growth model to find that a 1% increase in digitization, measured using the Digital Ecosystem Development Index which is computed using the principal component analysis of eight digitization pillars attempting to quantify the extent of digitization in all major areas of life and sectors of the economy, from household digitization to digital factors of production, leads to 0.13% increase in GDP per capita—though the magnitude is lower in non-OECD countries than in OECD countries. Similarly, a 10% increase in digitization in the Arab States region would lead to a 2.49% increase in GDP per capita (Katz and Callorda, 2020).

Given the overwhelming evidence that digitization contributes to economic growth, it might also influence other macroeconomic variables such as inflation. Indeed, using Phillips Curve estimates on a relatively small sample of AEs and EMs, Csonto (2019) found evidence of a negative effect of digitization on inflation in the short run. The study shows that this effect, however, is relatively small: on average, 1% increase in the extent of digitization lowers inflation by 0.006%. The study indicates multiple channels through which this result could occur, one plausible explanation being that digitization has lowered the costs of production and improved efficiency, therefore leading to lower prices.

Inflation dynamics in EMs are also known to be different than those in AEs. The most notable difference is that inflation is usually higher and considerably less stable in EMs than in AEs (IMF, 2018). This trend is visible in Figure (1) below, which shows average inflation rates over our time period 2004-2018 for AEs and EMs. While the average inflation rate for EMs approaches 12% in 2008 and drops as low as 1% in 2015, the average inflation rate in AEs never increases above 4% and remains relatively stable throughout the years.

Figure (1). Average Inflation (GDP deflator) 2004-2018.

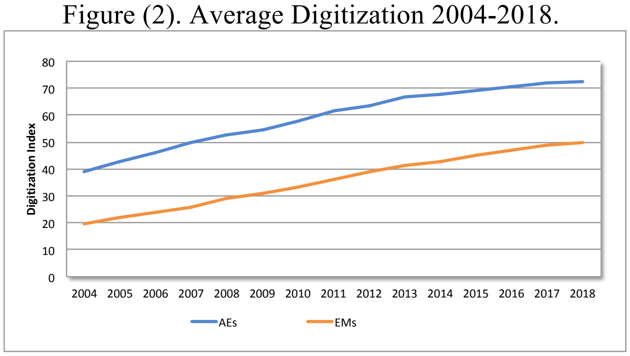


Source: Authors

What are the factors contributing to more unstable and higher inflation in EMs? In the World Economic Outlook Report from 2018, the IMF analyzed some of the explanations behind this dynamic: on the one hand, in EMs, a higher proportion of overall consumption is comprised of food and other similar commodities, whose prices tend to be more volatile (IMF, 2018). On the other hand, monetary policy and economic institutions overall tend to be less developed, reliable, or consistent in EMs, which might render the Central Bank unable to control inflationary pressures, for instance, in response to a shock (IMF, 2018).

In light of this different inflation behavior, it might be the case that any impact digitization has on domestic inflation is different—possibly smaller or altogether insignificant—in EMs than in AEs. There are many valid reasons to believe this would be the case: for instance, while digitization may reduce marginal costs and enhance productivity for businesses in EMs, these economies have weaker institutions and policies which might otherwise be unable to effectively combat inflationary pressures. Moreover, the level of digitization itself turns out to be lower in EMs than in AEs. As seen in Figure (2) below, the average digitization levels in AEs and EMs follow a similar trend over the years: they both increase significantly from 2004 to 2018, with the increases seeming to flatten out toward the end of the period. If the digital ecosystem of EMs is overall less developed, this could mean that its impact on domestic inflation might be smaller in magnitude as well. If true, this result would be consistent with Katz and Callorda (2017), which found that the impact of the digital ecosystem on growth as well is higher in AEs than in EMs.

Figure (2). Average Digitization 2004-2018.



Source: Authors

In this paper, we develop an econometric model in order to explore the impact of digitization on domestic inflation in EMs and fill the gaps in the literature by answering four main questions; first, what is the effect of digitization on domestic inflation? Second, is this relationship linear or non-linear? Third, is the effect different in EMs than in AEs? Finally, what is the potential role of policy complementarities in the digitization-inflation link including increasing education enrollment and good governance? The rest of the paper is organized as follows: section 3 presents a literature review on inflation and digitization, section 4 describes our dataset, section 5 explains our estimation methodology, section 6 includes a description and interpretation of our estimation results, and section 7 provides concluding remarks. References can be found in section 8, while the appendix in section 9 includes additional tables and graphs referenced, but not otherwise included, throughout the paper.

3. Literature Review

The relationship between inflation and other major macroeconomic factors has long been theorized and analyzed by economists. The traditional Phillips Curve establishes a downward-sloping relationship between the level of the inflation and the unemployment rate: as the unemployment rate increases, the inflation rate decreases. The accelerationist version of the Phillips Curve establishes a relationship between the unemployment or output gap and the change of rate in inflation. Valadkhani (2014) finds that the output gap positively influences inflation in Canada, the UK, and the US over the time period from 1970 to 2013. More recently, Jasova et al. (2020) use a New-Keynesian Phillips Curve model on a panel of both AEs and EMs from 1994Q1 to 2017Q4 to find that both domestic and global output gaps are significant drivers of inflation before and after the Great Recession, especially for countries targeting inflation (Svensson, 1999; Gerlach and Svensson, 2003).

Other research, however, has questioned whether the Phillips Curve still holds today, especially in AEs such as the United States—where inflation has remained remarkably low, even during periods of time when the unemployment rate was low and decreasing. Kuttner and Robinson (2010) have found empirical evidence in support of a "flattening" of the Phillips Curve hypothesis—that is, a decrease in the slope of the Phillips Curve, which suggests a potential weakening of inflation's sensitivity to the output (or unemployment) gap. Additionally, the IMF (2013) found evidence that inflation has indeed become less responsive to unemployment than in the past. However, this trend seems to hold true mostly for AEs, but not necessarily for EMs. While Jasova et al. (2020) find a significant decline in the impact of domestic output gaps on inflation in AEs, they do not find any empirical evidence in support of a flattening of the Phillips Curve hypothesis when estimating the New-Keynesian Phillips curve for EMs.

Other major macroeconomic factors that influence inflation—such as inflation expectations, the exchange rate, and globalization—have become increasingly important overtime, potentially further altering traditional Phillips Curve dynamics. To that end, the expectations-augmented Phillips Curve predicts that inflation expectations for the next time period also affect the present level of inflation. In other words, an increase in inflation expectations leads to an increase in the actual rate of inflation. Inflation expectations have played an increasingly important part in determining the level of inflation. Many have suggested that the recently observed inflation dynamics can be understood and explained well in a framework of inflations expectations. Bernanke (2010), for instance, has argued that the relatively low and stable inflation which has been observed in many countries around the world can be explained by better anchored inflation expectations: people's inflation expectations remaining relatively constant throughout time prevented the inflation rate from decreasing as much as it otherwise might have in light of the Great Recession. Similar results were found by the IMF (2013)—that a weaker relationship between past and current levels of inflation is reflective of better anchored inflation expectations.

Most importantly and relevant for our study, inflation expectations turn out to play a particularly important role in determining domestic inflation in EMs, where inflation is indeed higher and generally less stable than in AEs. Domestic factors, and not global ones, are the most important determinants of domestic inflation in EMs, with inflation expectations being a key determinant. In 2018, the IMF, which has done considerable work in the area of EMs, found evidence of the effect of inflation expectations on both the level of and the variation in inflation.

Moreover, consistent with the New Keynesian Phillips Curve, there is a strong relationship between lagged inflation and the current inflation rate. For instance, Csonto et al. (2019) use a panel regression model and finds a significant positive effect of lagged inflation. However, endogeneity inevitable poses a concern when it comes to the Phillips Curve estimates with lagged inflation. Accordingly, Hondroyiannis et al. (2007) use GMM estimation for the New Keynesian Phillips Curve; they similarly find a highly significant and positive effect for lagged inflation. Nevertheless, when using time varying coefficient (TMV) estimation, they find that the "role of lagged inflation in the NKPC is spurious."

The nominal exchange rate, another potentially important determinant of inflation in EMs, has been analyzed by Bailliu et al. (2002) in a study focusing on inflation determinants in Mexico, an emerging market, after adopting a floating exchange rate regime. Exchange rates are believed to affect inflation mainly by influencing the prices of imports. In their study, Bailliu et al. (2002) find that a one percent exchange rate depreciation increased inflation by 0.34%.

Relatedly, Romer (1993) predicted that more open economies lead to lower average inflation, and indeed found empirical evidence of a negative relationship between openness and inflation. Since then, though, significant doubt has been cast on this relationship: Samimi et al. (2012), for instance, use panel data on both advanced and developing economies to find that there is a positive significant association between openness and inflation. However, when the authors use the KOF globalization index as a different proxy for an economy's openness instead of the traditional openness measure, they find results consistent with Romer's hypothesis. Similarly, Ghosh (2014) analyzes the effect of trade openness and exchange rate regime on inflation for a panel of 137 countries during the time period from 1999 to 2012 and finds no significant evidence of a negative relationship between trade openness and inflation—except for countries where openness is low and/or inflation really high. This result is consistent with the empirical findings of Hanif and Batool (2006) that openness has a significant negative impact on inflation in Pakistan, a developing economy.

Oil prices as well are well documented to have a positive and significant effect on inflation in the literature. Choi et al. (2018), for instance, analyze a panel of 72 advanced and developing economies around the world from 1970 to 2015 to find that a 10% increase in global oil inflation causes a rise in domestic inflation by 0.4 percentage points. Mukhtarov et al. (2019) also find that oil prices have positive effects on inflation in the long-term in Azerbaijan: a 1% increase in oil prices leads to a 0.58% increase in inflation. Similarly, the study of Kamber and Wong (2018) reports that inflation gaps are largely driven by commodity price shocks and inflation targeting might have reduced the role that foreign shocks play in the overall trends of inflation.

In light of these new inflation dynamics, digitization has emerged as yet another possible explanation for lower and more stable inflation. It is important to acknowledge that, while it is broadly accepted that digitization has impacted every aspect of human life, and every sector and industry of the economy, the exact impact of digitization on the economy is notoriously difficult to measure. This is largely due to the fact that there is no universal definition or exact measurement of digitization (IMF, 2018). The most comprehensive measure of digitization, to our knowledge, has been developed by Katz and Callorda (2017; 2018; 2020).

Recently, several attempts have been made to formally measure the impact of digitization on various aspects of the economy, particularly GDP (or GDP per capita) and economic growth. There is significant empirical evidence that increases in digitization have positive effects on economic growth. For instance, Katz and Callorda (2017) analyze a panel of 73 countries from 2004-2015; they find that an increase by 1% in the digitization index leads to a 0.13% growth in GDP per capita. More recently, Katz and Callorda (2020) study the impact of digitization on the economy of the Arab States region and find that 10% increase in penetration of mobile broadband would lead to a 1.81% increase in GDP per capita, while an increase in the digitization index by 10% would lead to a 2.49% rise in GDP per capita.

That being said, digitization could impact inflation in a variety of ways. Charbonneau et al. (2017) describe three main channels: first, digitization is likely to enhance productivity and lower operational costs for firms. Second, digitization can change the overall market structure—on the one hand by diminishing barriers to entry for new firms, for whom technology is more readily available than it ever used to before, but on the other hand, by allowing mega-companies like Amazon and the like to emerge and dominate the market. Third, and the most direct, mechanism is that digitization can directly cause a decline in the prices of telecommunications or information goods and services.

The productivity channel and the lower barriers to entry hypothesis both seem especially relevant to EMs. Indeed, as mentioned above, the integration of the IoT alone in EMs has the potential to lower costs of production significantly. EMs are countries usually experiencing rapid growth, or at least many simultaneous structural changes. While these countries often no longer rely on agriculture as their main productivity sector, many industries and sectors, just like many institutions—political or economic—may not yet be fully developed in EMs. The readily available digital platforms and advanced technologies we use nowadays definitely help facilitate access to information, goods and services—not just from one's country, but from around the world, thereby expanding these countries' exposure to and integration in the global economy. They also make it significantly less expensive and difficult for many new businesses to emerge, and for market competition to grow—which could in theory lower prices.

Nevertheless, the impact of digitization on inflation is a relatively new topic that has not been extensively studied. Hoon Yi and Choi (2005) test the hypothesis that the Internet can lead to lower inflation through improved productivity; using panel data from 1991 to 2000, they find that increasing the Internet users-to-population ratio has a significantly negative effect on the inflation rate. However, the Internet usage is just one of many complex aspects of digitization. Csonto et al. (2019) used the number of existing IP addresses in a country as a proxy to quantify the extent of digitization and conducted a panel study to analyze the impact of digitization on inflation using sample of 36 AEs and EMs. Estimating a traditional Phillips Curve, the authors found that digitization has a negative effect on domestic inflation. As far as the mechanism behind these results, the paper concluded that digitization impacts inflation mainly through a cost-productivity channel.

However, evidence on the topic is somewhat mixed. For example, no conclusive evidence to support the possible disinflationary effects of digitization was found in Canada so far (Charbonneau et al., 2017). The authors argue that this result might be due to the fact that the so-called "digital economy" is insignificant part of the Canadian economy overall: for instance, only a very small share of retail sales are online. Additionally, there essentially is an oligopoly in telecommunications in Canada, which might be working to keep the prices up, or at least prevent them from dropping, thereby cancelling any potential downward effects of digitization on inflation (Charbonneau et al., 2017).

Lastly, we hypothesize that impact of digitization on domestic inflation can be non-linear such that digitization lowers inflation only up to a certain point (for instance, by initially lowering costs of production), but have positive inflationary pressures at higher digitization levels leading to an increase in the rate of inflation. Our hypothesis is based on the fact that digitization reduces average cost of production and enhances productivity, and thus creates economies of scale. Nevertheless, once the digitization index reaches a threshold level further improvement in digitization tends to decrease as penetration increases, giving rise to diseconomies of scale, an increase in the average cost of production, and thus an increase in the rate of inflation. Our hypothesis goes in line with Lang (2009), Hawash and Lang (2010), Vu (2011), Albiman and Sulong (2017), and Emara and Zhang (2021) providing evidence of non-linear effects of various ICT measures on economic growth and productivity; however, to the best of our knowledge, we are not aware of any previous studies to have found empirical evidence of a non-linear relationship between digitization and inflation.

Against the above background, the main motivation for this paper stems from the fact that studies that cover the impact of major macroeconomic factors on domestic inflation has long been theorized and analyzed by economists. Nevertheless, the literature that studies the impact of digitization as an important determinant for lower and more stable inflation in both AEs and EMs is very thin. Hence, our aim in this study is to fill the gaps in the literature by studying the impact of digitization on domestic inflation, exploring the functional form of this digitization-inflation link, and analyzing whether this link is reinforced by human capital accumulation and good governance in EMs.

4. Data

A panel dataset on a sample of 54 AEs and EMs is used over the period 2004-2018. Table 1 of the Appendix provides the list and classifications of countries in our dataset. The decision to only include EMs and AEs was motivated by the literature, where most analyses on inflation or on both digitization and inflation have focused on these two groups of countries. The data on all relevant macroeconomic variables are collected from the World Development Indicators (WDI) database. Tables 2 and 3 present the description of all variables and their descriptive statistics, respectively. We included data on the annual inflation rate using the GDP deflator expressed as percentages. We obtained data on total exports and imports, expressed in billions of constant 2010 US dollars, to construct an openness index following instructions from the Federal Reserve Bank of St. Louis. Additionally, we included data on the exchange rate of every country, expressed as local currency to US dollar ratio, foreign direct investment net inflows, expressed as a percentage of GDP, and pump gasoline (oil) prices, expressed in US dollars. For the output gap variable, we followed Hodrick and Prescott (1997) and Corbae and Ouliaris (2002), to compute it as the percentage difference between GDP and potential GDP, where the latter is estimated using the trend component filtered using the Hodrick-Prescott (HP) filter on the GDP expressed in billions of constant 2010 US dollars[2].

Following Cebula (2015) we use a Linear Weighted Average (LWA) methodology for determining inflation expectations, as shown in the formula listed below; which gives more importance to the present inflation rate than the previous inflation rates by weighing the current actual inflation rate more heavily.

$$\pi_t^e = \frac{3 \cdot \pi_t + 2 \cdot \pi_{t-1} + 1 \cdot \pi_{t-2}}{6}$$

The decision of which countries and years to include was largely motivated by the availability of the data on the Digital Ecosystem Development Index of Katz and Callorda (2018), or digitization index from here onwards, which consists of eight pillars including infrastructure, digital competition, digital industries, digitization of production, digital factors of production, household digitization, digital connectivity, and regulatory framework and public policy. Finally, we use school enrollments on the primary, secondary, and tertiary levels, all percentage gross, and their principal component analysis to give us one holistic measure of education. Finally, we use the principal component analysis of six

[2] For more details on the HP filter, please check Nguyen, G. (2014).

governance measures including control of corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability measures.

5. Estimation Methodology

The inflation model is estimated using panel System GMM panel estimation methodology proposed by Arellano and Bover (1995), Blundell and Bond (1998), and Blundell, Bond, and Windmeijer (2001)[3] to examine the impact of changes in the macroeconomic variables and digitization levels on the variation of the domestic price level. Our main model is as follows,

$$inf_{i,t} = \alpha + \rho inf_{i,t-1} + \beta X_{i,t} + \delta dig_{i,t} + \varepsilon_{i,t} \quad (1)$$
$$i = 1, 2,\ldots N,\ t = 2004,\ldots T$$

where inf_{it} refers to inflation measured by the GDP deflator (% annual) for country i at time t, $infl_{it-1}$ is the AR(1) endogenous variable, $X_{i,t}$ is the set of regressors including output gap, inflation expectation, exchange rate, openness index, inflows of foreign direct investment, and the logarithm of the pump price for gasoline. The variable $dig_{i,t}$ represents the logarithm of digitization index or the logarithm of one of its eight pillars. Finally, the variable ε_{it} is the error term of the regression.

To test for the potential non-linear deflationary effects of digitization, we expand the previous model by adding the quadratic term of digitization, or dig^2, as follows,

$$inf_{i,t} = \alpha + \rho inf_{i,t-1} + \beta X_{i,t-1} + \delta dig_{i,t} + \gamma dig_{i,t}^2 + \varepsilon_{i,t} \quad (2)$$
$$i = 1, 2\ldots N,\ t = 2004,\ldots T$$

The non-linear effect of digitization on inflation is derived by computing the first derivative of Equation (2) with respect to the $Dig_{i,t}$ variable. We expect a negative δ coefficient and a positive γ coefficient which implies that a one unit increase in the digitization index decreases inflation by a magnitude of δ, however, this effect is decreasing at an increasing rate of "2γ". The statistical significance of the total effect of digitization on inflation is estimated using the standard errors of the coefficients δ and γ. Additionally, the threshold level of the digitization index, or $Dig_{i,t}^*$ is calculated as $\left|\frac{\delta}{2\gamma}\right|$ where any level of $dig_{i,t}$ below $dig_{i,t}^*$ will result in a decrease in inflation and any level above it results in a rate increase. Next, to test whether the effect of digitization on inflation is different in EMs versus the full sample, we restrict the sample to EMs and re-estimate the regression models of Equations (1) and (2).

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[3] For more details on the estimation methodology, check Emara and El Said (2020).

Finally, the last part of our empirical analysis analyzes the effect of two policy tools; education and governance by testing whether investing in human capital and/or improving governance maximizes the deflationary impact of digitization. To do so, we expand our model as shown in Equation (3) to add the variable "*policy*" which is replaced by the three variables of school enrollments and their principal component, "*edu*," each one in a turn.

$$inf_{i,t} = \alpha + \rho inf_{i,t-1} + \beta X_{i,t-1} + \delta dig_{i,t} + \gamma dig_{i,t}^2 + \vartheta\left(dig_{i,t} * policy_{i,t}\right) + \varphi(dig_{i,t}^2 * policy_{i,t}) + \varepsilon_{i,t} \quad (3)$$
$$i = 1, 2 \ldots N,\ t = 2004 \ldots T$$

Similarly, to access the impact of the improvement in governance, the variable *policy* is replaced with the six areas of governance and their principal component "gov," each one in a turn.

Based on Equation (3) we analyze how policy tools affects the impact of the improvement in digitization on inflation by computing the first derivative with respect to digitization as follows, $\frac{\partial inf_{i,t}}{\partial dig_{i,t}} = \delta + 2\gamma dig + \vartheta policy + 2\varphi dig_{i,t} * policy$. And the total effect of digitization is computed by adding the coefficient $\delta, \gamma, \vartheta,$ and φ and their statistical significance is jointly tested using the F-test. Finally, for all the regression models, the set of instruments used include the lagged levels as well as lagged differences of our variables starting from the second lag and the Hansen test is performed to ensure that these instruments are overidentified. Additionally, the Arellano and Bond test is performed to ensure the absence of serial correlation in second order. All test results are reported on the estimation tables in the Appendix.

6. Estimation Results

To estimate the impact of digitization on domestic inflation we begin by highlighting the linear model using alternative measures of digitization for the full sample, then we outline our results for EMs sample, we next present the results for the non-linear specification, and then we proceed to discuss the role of institutional quality, proxied by governance indicators, and human capital, proxied by school enrollments, in affecting the role of digitization on inflation. For all regression tables[4], the Arellano and Bond serial correlation test as well as the Hansen overidentification test are presented. The tests confirm that there is no serial correlation in second order and that the set of instruments used is overidentified.

Column (1) of Table 4 shows that the persistence of inflation is strongly negative, where a one percentage point increase in lagged inflation, "*l.inf,*" leads to a decrease in this year's actual inflation by

[4] It is important to note that the p values of the Inverse Chi-squared statistic of the Fisher-type unit-root test (based on augmented Dickey-Fuller tests) confirm the absence of unit root in our panels under the given test conditions (panel means and time trend). Hence our model is trend stationary.

about 0.61 percentage point, confirming a short term autoregressive first order relationship consistent with the empirical results of Csonto et al. (2019) and Hondroyiannis et al. (2007).

The results also show that a one percent increase in the output gap, "*outgap*," leads to a 0.14 percentage point increase in the actual inflation rate. This result is expected and is in line with the empirical findings of the Philips curve—see, for instance, Valadkhani (2014); Jasova et al. (2020). Additionally, a one percentage point increase in inflation expectations, "*inf_exp*," leads to about 1.92 percentage point increase in the actual level of inflation rate. This result is consistent with both the theory—as inflation expectations increase, we expect the current level of inflation to also increase—and the empirical evidence—see, for instance, Csonto et al. (2019), Bernanke (2010), and IMF (2018).

Next, a ten percent increase in the real effective exchange rate, "*exch*," leads to an increase of 0.56 percentage point in the inflation rate, which goes in line with the empirical findings of Bailliu et al. (2002). Adding the openness measure, "*op*," to our model, we notice a statistical insignificant impact on inflation in all regressions. This result supports the findings of Ghosh (2014) that there is no significant evidence of a negative relationship between trade openness and inflation—except for countries where openness is low and/or inflation really high.

Furthermore, a one percent increase in foreign direct investment, "*fdi*," results in 0.045 percentage point increase in inflation rate. An expected result in the context of aggregate demand analysis: increases in foreign direct investment inflows lead to increases in spending, which is then reflected in an increased aggregate demand, leading to a demand-push inflation. In the seventh row, a one percentage point increase in oil prices "*oil*," leads to a 0.01 percentage point increase in the actual inflation rate, consistent with the results of Choi et al. (2018) and Mukhtarov et al. (2019).

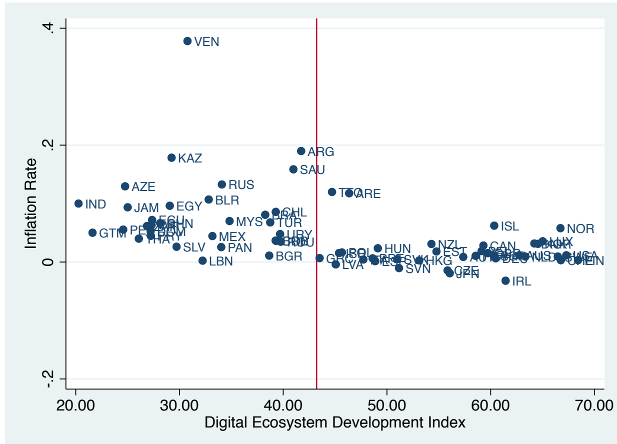
Finally, a ten percent increase in the digitization index, "*digindex*," leads to a 0.09 percentage point decrease in the inflation rate, consistent with the results of Csonto et al. (2019) and Hoon Yi and Choi (2005). In Column (2) and (3), a ten percent increase in the Infrastructure of Digital Services Index, "*infra*," and Digital Connectivity Index, "*conn*," leads to a 0.09 and 0.08 percentage point decrease in the inflation rate, respectively. Columns (4) and (5) indicate that the coefficients of the Household Digitization Index, "*dighou*," and the Digitization of Production Index, "*digprod*," are equal, where a ten percent increase in any of these two pillars lead to 0.09 percentage point decrease in inflation. Next, in Column (6) a ten percent increase in Digital Industries Index, "*comp*," decreases inflation by 0.08 percentage points. In Column (7) Factors of Digital Production Index, "*eco*," has the largest impact on inflation rate, where a ten percent increase in this pillar leads to 0.12 percentage point decrease in the inflation rate. Column (8) shows that the impact of Digital Competitive Intensity Index, "*fp*," is the second largest of the eight pillars where a ten percent increase leads to 0.10 percentage point decrease in the inflation rate. Finally, in Column (9) Regulatory Framework and Public Policies Index, "*instr*," has the smallest impact of all pillars, where a ten percent increase leads to 0.06 percentage point decrease in the inflation rate.

Next, the results of the linear model for EMs are presented in Table 5, where in Column (1) a one percentage point increase in *l.inf* decreases in the current inflation rate by about 0.62 percentage point. A one percent increase in *outgap* and *inf_exp* increases inflation by about 0.15 and 0.84 percentage point, respectively. A ten percent increase in *exch* increases inflation by 0.84 percentage points. A one percent increase in *fdi* and *oil* result in a 0.048 and 0.01 percentage points increase in inflation rate, respectively. These results align with the full sample results and all of the macroeconomic coefficients are robust to the different specifications in Columns (1) through (9).

Furthermore, similar to our findings for the full sample, the results confirm that all the digitization measures have deflationary effects in EMs. In Column (1), a ten percent increase in the *digindex* decreases the actual inflation rate by about 0.1 percentage points. The highest deflationary impact derived from the *eco* pillar while the lowest is derived from the *instr* pillar, where a ten percent increase in each pillar results in 0.12 and 0.05 percentage points decrease in inflation rate, as shown in Columns (7) and (9), respectively. Columns (2), (4), and (8) show that the impacts of *infra*, *dighou*, and *fp* on inflation rate are equal, where a ten percent increase in any of these three pillars lead to a about 0.11 percentage points decrease in inflation rate, respectively. Finally, Columns (5) and (6) shows that *digprod* and *comp* have the same impact on inflation rate, where a ten percent increase in any of these two pillars leads to a 0.09 percentage points decrease in inflation, respectively.

Next, Table 6 shows the results of the non-linear model for the full sample. The estimation results of adding the *digindex*, and its quadratic term are presented Column 1, confirming that a ten percent increase in this index results in a decrease in inflation rate by about 0.28 percentage points, however, this rate is decreasing at an increasing rate of two times 0.05, or 0.1 percentage point, with a cutoff point of about 41.22 points, which is on the 50th percentile of the index, as shown on Figure (3). Additionally, the total effect of a ten percent increase in *digindex* decreases inflation rate by about 0.23 percentage points, aligning with previous findings of Lang (2009), Hawash and Lang (2010), Vu (2011), Albiman and Sulong (2017), and Emara and Zhang (2021).

Figure (3): Inflation and Digitization – The Cutoff Point



Source: Authors.

This deflationary non-linear effect of digitization on inflation is mainly derived from the *eco* pillar, followed by *instr*, *digprod*, *fp*, *infra*, *dighou*, *comp*, and then *conn*, where a ten percent increase in each of these pillars results in a decrease in inflation rate by about 0.26, 0.25 0.23, 0.21, 0.21, 0.18, and 0.14 percentage points, respectively, with threshold levels for each pillar reported on the table.

Next, Table 7 reports the non-linear analysis for EMs, where Column (1) shows that a ten percent increase in *digindex* decreases inflation rate by about 0.16 percentage points, however this rate is decreasing at an increasing rate of 2 times 0.01, or 0.02, percentage points, leading to a total effect of -0.014 and a cutoff point of 41.85. Similar to our full sample results, the highest effect is derived from the *eco* pillar and the lowest is derived from the *conn* pillar, where a ten percent increase in each of these pillars decreases inflation rate by about 0.26 and 0.07 percentage point, respectively. Additionally, the second highest impact is derived from the *infra* pillar followed by the *instr*, *dighou*, and *comp*, where a ten percent increase in each of these pillars causes a decrease in inflation rate by about 0.20, 0.18, 0.16, and 0.15 percentage points, respectively. Finally, the impact of the *digprod* and *fp* pillars have equal effects on inflation rate, where at ten percent increase in any of these two pillars leads to a fall in inflation rate by about 0.14 percentage points. The threshold levels of each pillar are reported on the table.

It is interesting to note that non-linear deflationary effects of digitization are smaller in EMs versus that of the full sample. Accordingly, we analyze the impact of two policy interventions—human capital accumulation and improvement in governance. Table 8 computes the total effects of digitization when interacted with the three levels of school enrollments; primary, "*schp*," secondary, "*schs*," tertiary, "*scht*," and their linear combination using the principal component analysis, "*edu*," each one in a turn. As per the results of the first row of the table, when *digindex* is interacted with the variable *edu*, the impact of digitization is magnified where a one percent increase in *digindex* in the presence of high levels of school enrollments decreases the actual inflation by 0.172 percentage points. This impact is mainly derived from the effect of *schp* and *scht* where a one percent increase *digindex* when interacted with each of these two variables, each one in a turn, leads to decreases actual inflation by about 0.11 and 0.04, respectively. This result implies that education matters and is a pre-condition for the digitization to have a stronger deflationary effect. Education can help to maximize the deflationary benefits of digitization in a given economy. Humans often still need to operate many of the useful digital tools and networks in order for them to deliver their potential. Moreover, the economy always benefits from higher levels of human capital, and a more educated population could indeed make more efficient use of the technology available. The effect of the interaction term of *digindex* with *schs* is however insignificant.

Finally, Table 9 shows that one percent increase in *digindex* when interacted with governance, "*gov*," decreases actual inflation by about 0.033 percentage points. This deflationary effect is mainly derived from the impact of the improvement in corruption, "*corrup*," rule of law, "*rl*," and voice and accountability, "*vacc*," where a one unit increase in each of these subindices decreases inflation by about 0.0215, 0.0217, 0.0156 percentage points, respectively. Lower levels of corruption and improvements in the rule of law are necessary for the smooth functioning and stability of institutions, as well as for the overall health of the economy. This implies that the deflationary effect of digitization is maximized in places with less corruption and stronger rule of law and accountability. Government effectiveness, "*geff*," political stability, "*pols*," and regulatory quality, "*regq*," do not contribute to the digitization-inflation link.

7. Conclusion

Using system panel GMM estimation methodology, this paper analyzes the impact of digitization on domestic inflation for a sample of 54 AEs and EMs over the period 2014-2018. The results confirm a non-linear deflationary effect of the improvement in digitization on domestic inflation in both the full sample and EMs sample. This result implies that improvement in digitization initially lowers inflation, however, once digitization reaches a cutoff level, further improvement in digitization leads to an increase in the rate of inflation. Furthermore, for EMs, our results show that the deflationary effect of the improvement in digitization is smaller than the full sample. However, this deflationary effect is strengthened by the investment in human capital and the improvement in governance.

Our policy implications are directed towards a national strategic plan aimed investing in their digital ecosystem to ensure lower and more stable inflation. Given that the highest deflationary impact is derived from the factors of digital production and digital infrastructure pillars, policy priorities include: expanding the 2G, 3G, and 4G network coverage, increasing fixed and broadband download speed, boosting telecommunications investment, adding more secure Internet servers, and boosting the economy's innovation capacity. Additionally, for EMs, policies aiming at maximizing school enrollments, controlling corruption, rule of law, and voice and accountability measures should be top priorities in order to recoup the maximum benefits of the improvement in digitization on domestic inflation.

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Appendix[5]

Table 1: List of Countries

Country ID	Advanced Economies (AEs)
1	Australia
2	Canada
3	Czech Republic
4	Denmark
5	Hong Kong SAR, China
6	Iceland
7	Israel
8	Japan
9	Korea Rep.
10	Latvia
11	New Zealand
12	Norway
13	Singapore
14	Sweden
15	Switzerland
16	Taiwan
17	United Kingdom
18	United States
	Emerging Markets (EMs)
19	Argentina
20	Azerbaijan
21	Barbados
22	Belarus
23	Brazil
24	Bulgaria
25	Chile
26	China
27	Colombia
28	Costa Rica
29	Dominican Republic

[5] For all estimation results’ tables, the ***, **, * *and *’ denotes statistical significance at the 1%, 5%, 10%, and 15% levels respectively. Numbers in round parentheses (.) are the robust standard errors*

30	Ecuador
31	Egypt
32	El Salvador
33	Estonia
34	Guatemala
35	Hungary
36	India
37	Jamaica
38	Kazakhstan
39	Lebanon
40	Malaysia
41	Mexico
42	Panama
43	Paraguay
44	Peru
45	Poland
46	Romania
47	Russian Federation
48	Saudi Arabia
49	South Africa
50	Thailand
51	Turkey
52	United Arab Emirates
53	Uruguay
54	Venezuela, RB

Table 2: Definition and Sources of Variables

Variable Name	Definition	Abbreviation
Inflation	Percentage change in GDP deflator (base year varies by country).	*inf*
Output Gap	Difference between Growth rate of real GDP per capita (constant 2000 US$) and the potential growth rate of real GDP per capita. Authors computation.	*outgap*
Inflation Expectation	Author computation following Cebula (2015)	*inf_exp*
Exchange Rate	Real effective exchange rate index (2010 = 100)	*reer*
Openness	The sum of exports and imports of goods and services (both in constant 2010 US$) as a percent of GDP (constant 2010 US$).	*op*
Foreign Direct Investment	Foreign direct investment, net inflows (% of GDP)	*fdi*
Oil	Pump price for gasoline (US$ per liter)	*oil*
Digital Ecosystem Development Index	Composite Index of the following eight pillars.	*digindex*
Infrastructure of Digital Services Index	Investments, quality of services, coverage, and service infrastructure of the digital ecosystem using 15 indicators such as average broadband download speed and number of satellites.	*infra*
Digital Connectivity Index	Affordability, penetration, and ownership in the digital ecosystem using eleven indicators such as monthly fixed and penetration of computers and smartphone users.	*conn*
Household Digitization Index	Internet use, E-government, E-commerce, and over the top media services (OTTs) using seven indicators that characterize the household digital ecosystem.	*dighou*
Digitization of Production Index	Digital infrastructure, digital supply chain, digital distribution, and digital processing using six indicators that characterize the digital ecosystem of the enterprise sector.	*digprod*
Digital Industries Index	Weight of digital industries, Internet of Things (IoT), and content production using seven indicators such as high tech and ICT services exports, and Machine-to-Machine (M2M) connections.	*comp*
Factors of Digital Production Index	Human capital, schools, innovation, investment in innovation, and economic development in the digital ecosystem using eight indicators such as GDP per capita, and USPTO patents.	*eco*
Digital Competitive Intensity Index	Level of competition using 4 indicators: the Herfindahl-Hirschman Index (HHI) fixed and mobile broadband, pay TV, and mobile telephony.	*fp*
Regulatory Framework and Public Policies Index	Role of government in the digital ecosystem and cyber-security and piracy using four indicators such as % of regulatory agency attributions and % of non-licensed installed software.	*instr*
Education	The principal component of the next three variables (Authors computation).	*edu*
Primary School Enrollment	Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music.	*schp*
Secondary School Enrollment	Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers.	*schs*
Tertiary School Enrollment	Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum	*scht*

	condition of admission, the successful completion of education at the secondary level.	
Governance	The principal component of the next six indicators (Authors computation).	*gov*
Control of Corruption	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.	*corrup*
Government Effectiveness	Perceptions of the quality such as public services, the quality of the civil service and the degree of its independence from political pressures.	*goveff*
Political Stability and Absence of Violence/Terrorism	Perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.	*pols*
Regulatory Quality	Perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	*regq*
Rule of Law	Perceptions of the extent to which agents have confidence in and abide by the rules of society, and the likelihood of crime and violence.	*rl*
Voice and Accountability	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.	*vacc*

Source: World Development Indicators (WDI), World Bank, 2020 and Katz and Callorda (2018).

Table 3: Descriptive Statistic – Full Sample

Variable	Obs	Mean	Std. Dev.	Min	Max
inf	1,841	0.044	0.070	-0.323	0.561
outgap	1,838	0.000	0.045	-0.963	0.810
unemp	1,394	8.847	6.452	0.140	47.500
exch	1,466	0.020	0.097	-0.325	1.460
op	1,599	0.989	0.615	0.182	4.344
fdi	1,804	0.072	0.220	-0.583	4.516
oil	1,464	1.125	0.503	0.000	2.540
digindex	1,020	46.676	17.197	6.708	81.530
infra	1,020	37.734	18.007	2.581	93.614
conn	1,020	57.037	22.318	5.589	95.723
dighou	1,020	40.353	21.109	6.031	91.444
digprod	1,020	58.155	29.694	1.451	100.00(
comp	1,020	66.058	18.323	5.727	96.759
eco	1,020	18.325	10.093	3.172	55.784
fp	1,020	37.027	20.718	4.456	83.622
instr	1,020	55.428	18.279	1.007	88.491
EMs Sample					
inf	1,310	0.054	0.080	-0.323	0.561
outgap	1,307	0.000	0.049	-0.963	0.810
unemp	866	9.691	7.372	0.140	47.500
exch	1,195	0.024	0.101	-0.325	1.460
op	1,058	0.866	0.339	0.182	2.0188
fdi	1,296	0.049	0.058	-0.180	0.578
oil	1,009	0.943	0.451	0.000	2.540
digindex	540	35.656	12.360	6.708	64.101
infra	540	29.283	14.831	2.581	78.414
conn	540	47.225	21.162	5.589	95.723
dighou	540	28.590	14.696	6.031	68.445
digprod	540	37.605	19.392	1.451	76.968
comp	540	59.840	19.764	5.727	95.724
eco	540	13.130	5.829	3.172	37.179

fp	540	22.776	11.305	4.456	52.444
instr	540	46.756	17.669	1.007	82.165

Source: Authors.

Table 4: Inflation and Digitization – Full Sample

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.inf	-0.608***	-0.606***	-0.606***	-0.606***	-0.613***	-0.607***	-0.605***	-0.614***	-0.619***
	(0.026)	(0.025)	(0.025)	(0.025)	(0.029)	(0.027)	(0.024)	(0.027)	(0.030)
outgap	0.144***	0.150***	0.140***	0.145***	0.148***	0.137***	0.170***	0.164***	0.131***
	(0.041)	(0.042)	(0.042)	(0.043)	(0.039)	(0.040)	(0.043)	(0.041)	(0.043)
inf_exp	1.919***	1.902***	1.906***	1.915***	1.941***	1.922***	1.920***	1.921***	1.860***
	(0.056)	(0.052)	(0.052)	(0.052)	(0.062)	(0.057)	(0.054)	(0.055)	(0.046)
exch	0.056***	0.060***	0.058***	0.059***	0.055***	0.052**	0.058***	0.057***	0.041**
	(0.021)	(0.022)	(0.022)	(0.021)	(0.021)	(0.020)	(0.020)	(0.021)	(0.019)
op	0.014	0.014	0.014	0.012	0.015	0.013	0.014	0.014	0.007
	(0.015)	(0.014)	(0.015)	(0.013)	(0.017)	(0.014)	(0.015)	(0.014)	(0.008)
fdi	0.045*	0.046*	0.044**	0.049**	0.044**	0.043*	0.042*	0.041*	0.033*
	(0.023)	(0.024)	(0.022)	(0.024)	(0.023)	(0.023)	(0.024)	(0.022)	(0.020)
loil	0.010***	0.009***	0.009***	0.011***	0.012***	0.009***	0.012***	0.011***	0.007***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)
digindex	-0.009**								
	(0.004)								
infra		-0.009**							
		(0.004)							
conn			-0.008**						
			(0.004)						
dighou				-0.009**					
				(0.004)					
digprod					-0.009**				
					(0.004)				
comp						-0.008**			
						(0.003)			
eco							-0.012**		
							(0.005)		
fp								-0.010**	
								(0.004)	
instr									-0.006***
									(0.002)
Observations	501	501	501	501	501	501	501	501	501
No. Countries	54	54	54	54	54	54	54	54	54
AB, AR(1) p-value	0.0187	0.0185	0.0173	0.0174	0.0170	0.0209	0.0156	0.0184	0.0155
AB, AR(2) p-value	0.0585	0.0566	0.0491	0.0531	0.0792	0.0603	0.0693	0.0573	0.0600
Hansen p-value	0.0499	0.0519	0.0434	0.0434	0.0516	0.0516	0.0497	0.0562	0.0392

*Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels respectively*

Numbers in round parentheses (.) are the robust standard errors

Table 5: Inflation and Digitization – EMs Sample

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.inf	-0.619***	-0.618***	-0.617***	-0.617***	-0.624***	-0.618***	-0.619***	-0.625***	-0.621***
	(0.026)	(0.025)	(0.025)	(0.025)	(0.028)	(0.026)	(0.024)	(0.026)	(0.028)
outgap	0.153*	0.154*	0.149*	0.153*	0.153*	0.149*	0.155**	0.170**	0.139*
	(0.081)	(0.081)	(0.084)	(0.085)	(0.080)	(0.079)	(0.077)	(0.083)	(0.076)
inf_exp	1.830***	1.809***	1.820***	1.823***	1.843***	1.842***	1.826***	1.826***	1.822***
	(0.044)	(0.044)	(0.043)	(0.043)	(0.047)	(0.045)	(0.047)	(0.045)	(0.047)
exch	0.084**	0.085**	0.090**	0.088**	0.078**	0.079**	0.075**	0.084**	0.064**
	(0.036)	(0.037)	(0.038)	(0.037)	(0.036)	(0.035)	(0.033)	(0.037)	(0.032)
op	0.021	0.020	0.023	0.018	0.016	0.021	0.015	0.018	0.003
	(0.018)	(0.017)	(0.019)	(0.018)	(0.016)	(0.020)	(0.018)	(0.015)	(0.014)
fdi	0.048*	0.048*	0.044**	0.050**	0.058*’	0.046*	0.046*	0.038*’	0.052*
	(0.025)	(0.025)	(0.021)	(0.022)	(0.037)	(0.024)	(0.024)	(0.023)	(0.030)
loil	0.006***	0.006***	0.006***	0.007***	0.007***	0.006***	0.007***	0.006***	0.005***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
digindex	-0.010**								
	(0.004)								
infra		-0.011**							
		(0.004)							
conn			-0.010**						
			(0.004)						
dighou				-0.011**					
				(0.005)					
digprod					-0.009**				
					(0.004)				
comp						-0.009**			
						(0.004)			
eco							-0.012**		
							(0.006)		
fp								-0.011**	
								(0.004)	
instr									-0.005*
									(0.003)
Observations	328	328	328	328	328	328	328	328	328
No. Countries	35	35	35	35	35	35	35	35	35
AB, AR(1) p-value	0.0330	0.0336	0.0301	0.0299	0.0305	0.0361	0.0349	0.0319	0.0347
AB, AR(2) p-value	0.0411	0.0402	0.0347	0.0366	0.0508	0.0446	0.0479	0.0387	0.0490
Hansen p-value	0.151	0.108	0.0898	0.0356	0.129	0.165	0.128	0.195	0.146

*Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels respectively*
Numbers in round parentheses (.) are the robust standard errors

Table 6: Inflation and Digitization – Non-Linear Model - Full Sample

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.inf	-0.609***	-0.609***	-0.608***	-0.608***	-0.611***	-0.608***	-0.609***	-0.608***	-0.612***
	(0.028)	(0.027)	(0.025)	(0.027)	(0.029)	(0.027)	(0.028)	(0.029)	(0.030)
outgap	0.124***	0.128***	0.134***	0.129***	0.129***	0.130***	0.120***	0.119***	0.123***
	(0.044)	(0.045)	(0.044)	(0.042)	(0.043)	(0.043)	(0.042)	(0.045)	(0.046)
inf_exp	1.926***	1.928***	1.920***	1.920***	1.918***	1.927***	1.915***	1.923***	1.924***
	(0.059)	(0.059)	(0.062)	(0.060)	(0.057)	(0.060)	(0.056)	(0.058)	(0.060)
exch	0.041*	0.046*	0.052**	0.044**	0.045**	0.045**	0.043**	0.046**	0.042**
	(0.022)	(0.024)	(0.026)	(0.021)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)
op	0.011	0.014	0.014	0.013	0.013	0.010	0.012	0.012	0.000
	(0.014)	(0.015)	(0.015)	(0.014)	(0.014)	(0.012)	(0.014)	(0.014)	(0.008)
fdi	0.043**	0.039*	0.042*	0.041*	0.046*	0.050**	0.039**	0.040*	0.058**
	(0.022)	(0.021)	(0.022)	(0.022)	(0.024)	(0.024)	(0.019)	(0.021)	(0.028)
loil	0.007**	0.008***	0.009***	0.007**	0.006*	0.009***	0.006*	0.007**	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
digindex	-0.028***								
	(0.007)								
digindexsq	0.005***								
	(0.002)								
infra		-0.025***							
		(0.007)							
infrasq		0.004***							
		(0.002)							
conn			-0.016**						
			(0.007)						
connsq			0.002						
			(0.002)						
dighou				-0.024***					
				(0.008)					
dighousq				0.004***					
				(0.001)					
digprod					-0.028***				
					(0.010)				
digprodsq					0.005***				
					(0.002)				
comp						-0.022***			
						(0.008)			
compsq						0.003**			
						(0.002)			

eco							-0.033***		
							(0.010)		
ecosq							0.008***		
							(0.002)		
fp								-0.026***	
								(0.007)	
fpsq								0.005***	
								(0.001)	
instr									-0.032***
									(0.010)
instrsq									0.007***
									(0.002)
Total Effects	-0.0229***	-0.021***	-0.0141***	-0.0197***	-0.0229***	-0.0183***	-0.0257***	-0.0211***	-0.025***
	(0.0059)	(0.0054)	(0.0051)	(0.0067)	(0.0082)	(0.0062)	(0.008)	(0.006)	(0.008)
Threshold Levels	43.22	46.98	61.86	45.95	56.51	63.17	23.23	42.74	47.27
Observations	501	501	501	501	501	501	501	501	501
No. Countries	54	54	54	54	54	54	54	54	54
AB, AR(1) p-value	0.0212	0.0208	0.0195	0.0206	0.0163	0.0201	0.0183	0.0202	0.0208
AB, AR(2) p-value	0.0644	0.0637	0.0545	0.0620	0.0623	0.0640	0.0531	0.0643	0.0713
Hansen p-value	0.0834	0.0798	0.0772	0.0976	0.0779	0.0605	0.0995	0.0659	0.0390

*Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels respectively*
Numbers in round parentheses (.) are the robust standard errors

Table 7: Inflation and Digitization – Non-Linear Model – EMs Sample

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
l.inf	-0.613***	-0.613***	-0.611***	-0.612***	-0.617***	-0.613***	-0.618***	-0.617***	-0.622***
	(0.026)	(0.026)	(0.024)	(0.025)	(0.028)	(0.027)	(0.027)	(0.025)	(0.030)
outgap	0.138*	0.132*	0.138*	0.138*	0.133*	0.127*	0.145*	0.162*	0.119
	(0.078)	(0.076)	(0.078)	(0.074)	(0.075)	(0.071)	(0.080)	(0.092)	(0.078)
inf_exp	1.873***	1.882***	1.849***	1.869***	1.874***	1.877***	1.842***	1.862***	1.838***
	(0.059)	(0.061)	(0.056)	(0.060)	(0.057)	(0.059)	(0.048)	(0.057)	(0.052)
exch	0.066**	0.062**	0.073**	0.069**	0.060**	0.056**	0.075**	0.080**	0.057*
	(0.032)	(0.031)	(0.036)	(0.027)	(0.030)	(0.028)	(0.034)	(0.038)	(0.031)
op	0.018	0.017	0.015	0.017	0.010	0.012	0.022	0.016	-0.002
	(0.018)	(0.019)	(0.016)	(0.018)	(0.012)	(0.014)	(0.020)	(0.020)	(0.014)
fdi	0.036*’	0.038*’	0.035*’	0.040*	0.034*’	0.041*	0.050**	0.048*	0.047**
	(0.023)	(0.024)	(0.023)	(0.024)	(0.023)	(0.024)	(0.024)	(0.029)	(0.023)
loil	0.007***	0.007***	0.006***	0.007***	0.007***	0.007***	0.006***	0.007***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
digindex	-0.016*								
	(0.009)								
digindexsq	0.001								
	(0.003)								
infra		-0.023***							
		(0.007)							
infrasq		0.004**							
		(0.002)							
conn			-0.006						
			(0.007)						
connsq			-0.001						
			(0.002)						
dighou				-0.019*					
				(0.010)					
dighousq				0.002					
				(0.002)					
digprod					-0.016***				
					(0.006)				
digprodsq					0.002*				
					(0.001)				
comp						-0.018**			
						(0.008)			

compsq						0.002*'			
						(0.002)			
eco							-0.033***		
							(0.012)		
ecosq							0.007***		
							(0.003)		
fp								-0.015**	
								(0.007)	
fpsq								0.001	
								(0.002)	
instr									-0.023**
									(0.009)
instrsq									0.005**
									(0.002)
Total Effects	-0.014**	-0.0195***	-0.0071*'	-0.061*	-0.0142***	-0.0153**	-0.0262***	-0.0139**	-0.0184**
	(0.0066)	(0.0055)	(0.0047)	(0.008)	(0.005)	(0.0069)	(0.0095)	(0.0061)	(0.0073)
Threshold Levels	41.85	33.54	66.42	39.63	47.36	64.21	17.85	30.81	35.45
Observations	328	328	328	328	328	328	328	328	328
No. Countries	35	35	35	35	35	35	35	35	35
AB, AR(1) p-value	0.0372	0.0398	0.0320	0.0351	0.0324	0.0371	0.0338	0.0341	0.0372
AB, AR(2) p-value	0.0518	0.0551	0.0409	0.0489	0.0601	0.0548	0.0459	0.0427	0.0496
Hansen p-value	0.109	0.108	0.0959	0.109	0.0822	0.0921	0.0856	0.0538	0.0591

*Notes: ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels respectively*
Numbers in round parentheses (.) are the robust standard errors

Table 8: Impact of Education on the Inflation-Digitization Link in EMs

Regressors	Total Effects
digindex & Education	-0.172* (0.010)
digindex & Primary School Enrollment	-0.108** (0.048)
digindex & Secondary School Enrollment	-0.009 (0.013)
digindex & Tertiary School Enrollment	-0.040*** (0.014)

*Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels Respectively. Numbers in round parentheses (.) are the robust standard errors*

Table 9: Impact of Governance on the Inflation-Digitization Link in EMs

Regressors	Total Effects
digindex & Governance	-0.033*** (0.011)
digindex & Control of Corruption	-0.022* (0.011)
digindex & Government Effectiveness	-0.005 (0.011)
digindex & Political Stability	-0.017 (0.017)
digindex & regulatory Quality	-0.009 (0.021)
digindex & Rule of Law	-0.022* (0.012)
digindex & Voice and Accountability	-0.016** (0.007)

*Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels Respectively. Numbers in round parentheses (.) are the robust standard errors*