

Inflation and Indivisible Investment in Developing Economies

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Abstract

In countries with limited access to finance, firms accumulate retained earnings to finance indivisible investment projects. McKinnon (1973) illustrates that when cash is used as a primary store of value, inflation may discourage investment as it increases the cost of accumulating retained earnings. This paper formalizes this argument in a dynamic framework and provides a simple calibration

of the model that suggests sizable effects of inflation on investment. The mechanism is particularly relevant for small firms, as firms with lower cash flows must accumulate retained earnings for longer periods of time to meet the price of indivisible investment goods. Consistent with the model, empirical evidence suggests that inflation disproportionately reduces investment in small firms.

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1 Introduction

It has long been understood that inflation is distortionary, as it “taxes” the holding of money. While this principle has been widely studied (see, for example, Lucas and Stokey (1987) and Cole and Stockman (1992)), concrete examples of inefficiencies caused by this distortion are hard to come by. A notable exception can be found in McKinnon (1973) (Chapter 6). McKinnon suggests that, for firms in developing countries with limited access to finance, indivisible investment projects are money-intensive: absent access to credit, firms must accumulate retained earnings to finance indivisible investment projects. If firms do not have access to inflation-protected stores of value (e.g., inflation protected savings accounts), they may choose to store retained earnings in cash. The fact that indivisible investment opportunities require agents to store money for potentially long periods of time makes them money-intensive. McKinnon concludes that, given their money intensity, inflation discourages this type of investment.

Of course, the overall effect of inflation on investment is difficult to assess empirically, as it is difficult to find an exogenous source of variation in inflation. Moreover, it is a-priori ambiguous whether inflation encourages or discourages investment: while money-intensive investment projects are discouraged, there may be over-investment in other projects, as agents look for alternative short-term stores of value to substitute for money. The net effect of inflation on aggregate investment is beyond the scope of this paper. Instead, we focus on the implications for indivisible investment projects in firms with limited access to finance, and aim to quantify the distortionary effects of inflation suggested by McKinnon’s model.

We present a continuous time model of firms’ investment decisions, in the spirit of McKinnon (1973). The argument in McKinnon (1973) is presented in a simplified setting, in which firms’ profits are exogenous. Here, we allow for firms’ profits to be determined endogenously, depending on their past levels of investment. A calibration of the model suggests sizable effects of

inflation on investment: a 7.4% inflation rate (which is the average in our sample of developing countries) generates a 7-11% drop in capital stocks.

It is interesting to note that, while quantitatively relevant, McKinnon's original argument does not readily generalize to environments with endogenous profits and arbitrary initial capital stocks (rather, the argument requires initial capital stocks that are "sufficiently low"). The intuition follows directly from McKinnon's reasoning: at high inflation rates, it is more costly to hold money for long periods of time. By increasing its capital stock, the firm can increase its cash flows, making it possible to finance indivisible investments by accumulating retained earnings for shorter time periods. This increases the incentives to accumulate capital, particularly for small firms for which the indivisibility plays a bigger role. Consistent with this reasoning, our calibration suggests that the relationship between investment and inflation may be non-monotone.

We proceed by empirically investigating whether, in developing economies, inflation drives a wedge between investment in large and small firms. Intuitively, firms with lower cash flows must hold money for longer periods of time in order to finance a given size of indivisible investment; thus, McKinnon's mechanism is likely to be more relevant for small firms. Using the World Bank's Enterprise Survey, we show that when inflation is high, small firms are more likely to stop investing than large firms. In addition, conditional on investment, inflation reduces investment in small firms relative to large firms.¹

This paper is related to a long line of research about inflation and investment. The theoretical literature on the topic is inconclusive: while McKinnon (1973), Stockman (1981) and, more recently, Smith and van Egteren (2005) suggest a negative relationship between inflation and investment, Tobin (1965) and Fischer (1979) argue that the relationship should be positive,

¹Following The Enterprise Survey, we define small firms as those with less than 20 full-time permanent workers, and large firms are those with 20 or more full-time permanent workers.

as agents substitute away from money into capital. Sidrauski (1967) presents a model in which the steady state capital stock is unaffected by the rate of inflation, and determined solely by the subjective discount rate. In our view, the robust conclusion of this literature is that inflation causes misallocation of investment, by encouraging certain types of investment and discouraging other types. We see this as misallocation because in a “Friedman rule” economy in which agents are satiated with real balances (see Friedman (1969)), the composition of investment should be determined solely by the real rates of return on investment projects, and not by their money intensity or the degree to which they can substitute for money. Our aim in this paper is to quantify a certain component of the misallocation of investment caused by inflation, namely the misallocation caused by McKinnon’s indivisible investment channel.

The empirical literature on anticipated inflation and investment is sparse. A notable exception is Fama and Gibbons (1982), who find a negative relationship between expected inflation and the real interest rate. There are also studies pointing at a negative relationship between inflation uncertainty and investment (see Holland (1993) for a survey, and Fisher (2013)). To the best of our knowledge, our paper is the first to explore the empirical relationship between inflation and the ratio of investment in small and large firms, and, more specifically, quantitatively assess the McKinnon’s indivisibility model using micro data.

Our paper is also related to the theoretical literature on indivisible investment. Most closely related (other than, of course, McKinnon (1973)), is Galor and Zeira (1993), who consider the effects of wealth distribution on investment in human capital in the presence of indivisibility and credit market imperfections. They show that households with low wealth may be unable to finance indivisible investments, which will result in lower investment rates. The added insight in McKinnon (1973) is that the rate of return on saving - which, in the absence of access to inflation-protected accounts, is affected

by inflation - may influence the extent to which undercapitalized firms are able to save towards the self-financing of the indivisible investment. Our model can be thought of more generally as studying the comparative statics of this indivisibility channel with respect to changes in the saving rate, and in the presence of capital depreciation (which generates a reoccurring need for financing indivisible investment).

2 Model

This section presents a continuous time model of indivisible investment, in which firms face various constraints emphasized in McKinnon (1973). Specifically, firms do not have any access to credit, and must finance investment from retained earnings. Further, firms do not have access to saving accounts, and their only way to store retained earnings is by holding cash. Finally, investment is indivisible, so investment requires the accumulation of retained earnings for measurable amounts of time. McKinnon's original argument is that, in such environments, inflation reduces investment. We show that this is the case when initial capital stocks are sufficiently low, and derive implications for the effect of inflation on the misallocation of investment between large and small firms. However, we show that McKinnon's argument does not necessarily extend to environments with higher initial capital stocks.

Consider an economy composed of identical production units, each operating a decreasing returns technology of the form $y = f(k)$, where y is the output produced by the production unit, k is the capital employed by the production unit, and $f(\cdot)$ is a decreasing returns technology satisfying the usual assumptions $f, f' > 0$, $f'' < 0$, $\lim_{k \rightarrow 0} f'(k) = \infty$ and $\lim_{k \rightarrow \infty} f'(k) = 0$.

Firms are collections of production units, where the (discrete) number of production units belonging to firm i is denoted n_i . Production units within a firm are indexed $j = 1, \dots, n_i$. Time is continuous and indexed $t \in [0, \infty)$; firms discount future profits at a rate ρ . The capital stock depreciates at a

rate δ .

Investment is indivisible: if a firm invests i units of the final good in a certain production unit, the capital stock of that production unit increases by $C \lfloor \frac{i}{C} \rfloor$ (where $\lfloor x \rfloor$ is the largest integer that is less than or equal to x). In other words, investment has to be a multiple of C , the size of the indivisible investment good.

The firm must finance investment from retained earnings. The firm sells its output at a nominal price p_t . The firm can decide to distribute dividends, or to retain earnings (s_t), held as cash. To finance investment, the firm must accumulate retained earnings until it has enough money (M_t) to finance the indivisible investment. The price p_t increases at a rate π (the rate of inflation). The firm solves:

$$V(\{k_{i,j,0}\}_{j=1}^{n_i}, M_{i,0}, \{p_t\}_{t \in [0, \infty)}) = \max_{k_{i,j,t}, i_{i,j,t}, s_{i,t}, M_{i,t}} \int_0^\infty e^{-\rho t} \left(\sum_{j=1}^{n_i} f(k_{i,j,t}) - s_{i,t} \right) dt$$

s.t. $\{k_{i,j,0}\}_{j=1}^{n_i}$, $M_{i,0}$ and:

$$\dot{k}_{i,j,t} = -\delta k_{i,j,t} \text{ if } i_{i,j,t} = 0 \quad (1)$$

$$k_{i,j,t} = \lim_{\tau \rightarrow t-} k_{i,j,\tau} + C \lfloor \frac{i_{i,j,t}}{C} \rfloor \text{ if } i_{i,j,t} > 0 \quad (2)$$

$$p_t \sum_{j=0}^{n_i} i_{i,j,t} \leq M_{i,t} \quad (3)$$

$$\dot{M}_{i,t} = p_t s_{i,t} \text{ if } \sum_{j=0}^{n_i} i_{i,j,t} = 0 \quad (4)$$

$$M_{i,t} = \lim_{\tau \rightarrow t-} M_{i,\tau} - p_t \sum_{j=0}^{n_i} i_{i,j,t} \text{ if } \sum_{j=0}^{n_i} i_{i,j,t} > 0 \quad (5)$$

$$\sum_{j=1}^{n_i} f(k_{i,j,t}) \geq s_{i,t} \geq 0 \quad (6)$$

The firm maximizes the (real) net present value of its dividends, which

are given by the total output produced by each of its production units ($\sum_{j=1}^{n_i} f(k_{i,j,t})$) minus retained earnings ($s_{i,t} \geq 0$). The first and second constraints describe the evolution of capital stocks: if the firm does not invest in capital for production unit j , its capital stock depreciates at a rate δ . Otherwise, the production unit's capital stock increases by the size of the indivisible investment, times the number of indivisible investment units that the firm installs (note that $\lfloor \frac{i_{i,j,t}}{C} \rfloor = \max n \in N \text{ s.t. } nC \leq i_{i,j,t}$). Note that $\lim_{\tau \rightarrow t-} k_{i,j,\tau}$ is the limit of the capital stock at it approaches t (and depreciation approaches 0).

The third constraint (equation 3) is the “cash in advance” constraint on investment. It states that the nominal price of investment goods purchased by the firm at time t must be less than or equal to the value of its cash stock, $M_{i,t}$. Equations 4-5 describe the evolution of the firm's cash stock. If the firm does not invest, its cash stock increases by the nominal value of retained earnings. If the firm invests, its cash stock falls by the total cost of the firm's investment. The final constraint states that the firm cannot raise external finance, so retained earnings must be weakly positive and less than the firm's cash flow.

We assume that all production units have the same initial capital stocks, $k_{i,j,0} = k_0 \geq 0$, and that $M_{i,0} = 0$. Throughout, we will restrict the range of inflation to $\pi \geq -\rho$.²

Lemma 1 *The net present value of the firm is decreasing with the rate of inflation π : $\frac{\partial V}{\partial \pi} \leq 0$.*

To prove this lemma, note that any sequence of dividends that is feasible under π is feasible under any $\pi' < \pi$. To see this, note that by choosing the same sequence of retained earnings (s_t), the firm has enough retained earnings

²This restriction rules out scenarios in which the return on retained earnings is higher than the discount rate, and firms accumulate retained earnings for reasons that have nothing to do with investment or investment indivisibility.

to finance the same sequence of investment (as the return on retained earnings is higher). Thus, it can implement the same sequence of dividends, and be left with a cash surplus.

The following proposition states that, for sufficiently low initial capital stocks, inflation reduces investment disproportionately for firms with lower cash flows (which, in this case, are firms with fewer production units). This insight constitutes the motivation for our empirical investigation in section 4:

Proposition 1 *Let $k^{ss}(n_i, \pi) = \lim_{T \rightarrow \infty} \frac{1}{T} \int_0^T \frac{\sum_{j=1}^{n_i} k_{i,j,t}}{n_i} dt$ denote the limit of the average capital level in firm i (where the average is taken both across production units and across time). Let $n_s < n_l$ denote the number of production units in small and large firms respectively, and let $\pi_l < \pi_h$ denote two levels of inflation (low and high, respectively). For k_0 sufficiently small,*

$$k^{ss}(n_s, \pi_h) k^{ss}(n_l, \pi_l) \leq k^{ss}(n_s, \pi_l) k^{ss}(n_l, \pi_h) \quad (7)$$

The proof of the above proposition, together with other omitted proofs, is in the appendix. The above proposition states that, at low levels of capital, inflation reduces investment in small firms relatively more than in large firms. Given the discrete space $\{n_s, n_l\}$ and $\{\pi_l, \pi_h\}$, equation 7 presents a log-supermodularity condition: in the language of complementarity, for a sufficiently low k_0 , inflation and firm size are “complements”.

Relation to McKinnon. An implication of this analysis is that, in the presence of investment indivisibility, inflation has a negative effect on investment, provided that initial capital stocks are sufficiently small. This result resonates with McKinnon’s informal argument. To derive this implication,

let $n_l = \infty$ and $n_s = 1$. It is easy to see that, for $n_l = \infty$, indivisibility plays no role, and the large firm's problem collapses into the standard framework in which investment is continuous. In this case, regardless of inflation, the large firm's steady state capital level is pinned down by some $k^{ss}(n = \infty, \pi) = k^{ss} > 0$. Thus, equation 7 collapses to:

$$k^{ss}(n_s = 1, \pi_h) \leq k^{ss}(n_s = 1, \pi_l) \quad (8)$$

In line with McKinnon's argument, a special case of our analysis implies that in the presence of indivisibility, inflation reduces investment (provided that k_0 is sufficiently low).

The formal analysis reveals that McKinnon's conclusion holds true only when initial capital levels are sufficiently low. Similarly, our conclusion that inflation drives a wedge between small and large firms is valid only for initial capital stocks that are sufficiently small. The calibration in the next section includes a counter example, in which inflation increases indivisible investment in small firms. This example confirms that both McKinnon's argument regarding the relationship between investment and inflation and our result in Proposition 1 depend on initial capital levels being sufficiently low. Interestingly, the intuition follows directly from McKinnon's original argument: at high levels of inflation, higher income is more valuable because it reduces the cost of investment. In inflationary environments, firms with higher capital stocks effectively face a lower cost of capital, as they can finance the indivisible investment by retaining earnings for shorter periods. This may lead to a *positive* relationship between inflation and investment in small firms.

3 Calibration

To quantify the effects of inflation on indivisible investment, we calibrate the model using a discrete time approximation. The length of a period is

specified as a day. We consider the problem of a small firm that consists of a single production unit.

To compute the equilibrium investment path starting from $M = 0$ and some initial capital stock k_0 , we use the following proposition, that characterizes the solution to the firm's problem:

Proposition 2 *Consider a firm with $M_0 = 0$ and a single production unit, and assume that $\pi \geq -\rho$. The solution to the firm's problem takes the following form:*

1. *The firm chooses a target capital level, $\underline{k}$. If $\underline{k} = 0$, the firm sets $s_t = 0$ for all t and consumes dividends; in the long run, capital depreciates and converges to 0.*
2. *If $0 < k < \underline{k}$, the firm starts accumulating cash reserves and investing (setting $s_t = f(k_t)$). It continues investing until $k \geq \underline{k}$.*
3. *At some point when $k \geq \underline{k} > 0$ and $M = 0$, the firm consumes dividends and sets $s_t = 0$, up until capital depreciates to $k = \underline{k}$.*
4. *At this point, the firm converges to a steady state cycle, in which, whenever capital hits $\underline{k}$, it begins accumulating cash towards investment by setting $s_t = f(k_t)$; when investment is complete (and $M = 0$), the firm consumes dividends (by setting $s_t = 0$) until capital depreciates back to $\underline{k}$.*

The above proposition states that the firm's capital stock converges to a steady state cycle in which the firm cycles through two phases: when $k = \underline{k}$, the firm enters a period in which it does not distribute any dividends and uses all of its retained earnings to accumulate cash. After accumulating sufficient amounts of cash, the firm invests (in multiples of the indivisible investment good), and enters a period in which it distributes dividends and allows capital to depreciate. This period ends when capital depreciates to $k = \underline{k}$, at which

point the firm starts accumulating cash again. The case $\underline{k} = 0$ is a particular case in which the firm only distributes dividends and never invests, allowing capital to depreciate to 0.

Using Proposition 2, we employ the following strategy to compute the firm's solution. First, we compute the firm's value for a range of steady state cycles of the above form, varying (a) the threshold level $\underline{k}$ from which the firm begins the accumulation of cash reserves; and (b) the number of indivisible investment goods that the firm invests in each cycle. Starting from the initial conditions, we then compute the value of the firm's transition towards each cycle, and choose the path that maximizes the firm's value at $t = 0$. We verify that the firm's optimal path has an interior solution for $\underline{k}$ (in fact, in all numerical simulations, the firm's value is single peaked with respect to $\underline{k}$). The simulations suggest that it is optimal for the firm to invest one unit of the indivisible investment good at a time, as opposed to accumulating sufficient reserves to finance more than one unit at once.

Standard parameters. We use the following standard parameters for the simulations. Firms discount future profits at 3% annually, and capital depreciation is 10% annually. The production function is specified as $f(k) = k^\alpha$, where $\alpha = 0.33$.

For simplicity, we specify the initial capital stock to be 10 times the steady state capital level of the divisible-investment neoclassical growth model.³ This simplifies the analysis, as it guarantees that the firm converges to $\underline{k}$ from above.⁴ The range of possible $\underline{k}$ is specified as $[0.25k^{ss}, 1.5k^{ss}]$, where $k^{ss} = k^{ss}(n = \infty, \pi)$ is the steady state capital level of the neoclassical growth

³In the standard neoclassical growth model, capital converges to a steady state level given by: $\alpha k^{\alpha-1} = \rho + \delta$.

⁴Since we cannot rule out that the firm optimally invests more than one indivisible investment good at a time, computing the optimal path in which the firm converges to $\underline{k}$ from below is potentially cumbersome, as there are many different transition paths to consider; convergence from above is more straightforward computationally as, given Proposition 2, the transition path is pinned down by $s_t = 0$ as long as $k > \underline{k}$.

model. We consider values of $\underline{k}$ that correspond to 100 equally spaced points in this range.

The size of the indivisible investment. As our focus is on small firms, we calibrate the size of the indivisible investment to match the 99th percentile of the ratio of investment over sales in small firms, using the World Bank Enterprise Survey, which consists of firm level data for a sample of developing economies (and is described in detail in the next section). By Table 2, the 99th percentile of investment over sales in small firms is 1.373 for machinery and 2.25 for land and buildings. The average inflation rate in our sample of developing countries is 7.4%. We choose the size of the indivisible investment, C , so that, in the steady state cycle of a country with average inflation ($\pi = 7.4\%$), the maximum ratio of investment over sales matches the data (we consider two specifications: one in which the maximum level of investment over sales is targeted at 1.373, corresponding to machinery investment, and one in which it is targeted at 2.25, corresponding to investment in land and buildings).

We run the simulation for the following levels of inflation: -3%, corresponding, in this case, to the Friedman rule; 7.4%, corresponding to the average inflation rate in our sample; 15.7% and 24%, corresponding to one and two standard deviations above the mean, respectively (the standard deviation of inflation is 8.3%); and 30% and 40%, which are on the high end of our sample.

The results are presented in table 1. In the Friedman rule economy ($\pi = -3\%$ annually), the average capital stock of the firm in its steady state cycle is actually somewhat higher than the steady state capital level of the continuous-investment economy (k^{ss}). This results from the indivisibility of capital and the concavity of the production function.⁵

⁵Note that, due to the concavity of the production function, it is more costly for the firm to have one unit less of capital than one unit more - thus, optimally, the average capital level at the steady state cycle is higher than in the continuous-investment economy.

The average level of inflation in our sample (7.4%) is associated with a substantial reduction in the average capital stock: for machinery investment, capital is about 7% lower than in the Friedman rule economy, and for land and buildings, capital is about 11% lower. Machinery investment continues to decline with inflation. For an inflation rate of 40%, machinery investment is 33% lower than in the Friedman rule economy.

Land and building investment exhibits an interesting non-monotonicity with respect to inflation: the average steady state capital level is higher with 30% inflation than with 7.4% inflation. This non-monotonicity arises because of the complementarity between the firm's cash flows and investment: the returns to investment increase since additional capital raises future cash flows, which reduce the average holding period of reserves necessary in order to finance the indivisible investment. This non-monotonicity is an insight generated by the extension to McKinnon's original argument, that allows cash flows to be endogenously determined by past investment. Of course, at higher levels of inflation, it is no longer optimal for the firm to maintain a higher capital stock, as replacing depreciated capital through the accumulation of retained earnings is too costly. At a 40% inflation rate, firms find it optimal not to invest at all and simply allow their capital stocks to depreciate to 0.

The calibration suggests that, for reasonable parameters, inflation generates substantial declines in indivisible investment through McKinnon's channel. A simple regression of $\ln(E(k))$ (where $E(k)$ is the average capital stock of the firm during its steady state cycle) on inflation in the sample of simulation results delivers a negative relationship, with a coefficient of about -0.007 for machinery and -0.004 for land and buildings (excluding the simulation with $\pi = 40\%$). This suggests that a 1% increase in inflation causes a decline in investment of about 0.4-0.7%. As the simulation illustrates, for sufficiently large inflation rates, investment may drop to 0, which would imply an even larger coefficient.

Table 1: The average capital stock as a fraction of k^{ss} for different levels of inflation

Inflation	$\frac{E(k)}{k^{ss}}$: Machinery investment	$\frac{E(k)}{k^{ss}}$: Land and building investment
-3%	1.01	1.04
7.4%	0.94	0.93
15.7%	0.86	0.86
24%	0.84	0.84
30%	0.76	0.945
40%	0.77	0

$E(k)$ is the average capital stock of the firm during its steady state cycle; k^{ss} is given by the condition $\alpha k^{\alpha-1} = \rho + \delta$, and corresponds to the steady state capital level of the standard neoclassical growth model with divisible investment (which, in this model, can be achieved by taking the limit $C \rightarrow 0$). The length of a period is specified as a day, and annual discount, inflation and depreciation rates are adjusted accordingly. For the case of machinery, the size of the indivisible investment is calibrated to match a steady state with 7.4% inflation and a maximum ratio of investment over sales of 1.373. Similarly, for land and buildings, the indivisible investment is calibrated to match a maximum ratio of investment over sales of 2.25.

4 Suggestive evidence

In this section, we present some evidence from firm level data that is broadly consistent with McKinnon’s mechanism. We begin by describing the data used for the analysis. We use the World Bank Enterprise Survey (WBES), a rich firm-level survey database that provides information about firms’ characteristics such as ownership, size, sector and their activities such as employment, investment and sales. Other information such as the degree of access to finance and the interactions with government agencies is also collected. In our sample, there are 41,602 observations (consisting of 33,012 unique firms) in 57 countries, spanning from 2002 to 2011. The sample was selected using stratified random sampling. Three levels of stratification were used in all countries: industry, establishment size, and region.⁶

⁶Sampling details can be found at “BEEPS 2008-2009: A report on methodology and Observations”.

Inflation in these countries is quite high compared to developed countries' standard. The simple average inflation for the countries in the years of the survey is 7.4% with the standard deviation of 8.3%. If we consider only country-year with positive inflation only, the average is 8.2% with the standard deviation of 7.9%. Figure 1 below shows the histogram of inflation for country-year pairs. The majority of inflation rates fall between 0-10%. The countries that have inflation higher than 40% are Belarus and Uzbekistan in 2002 and Venezuela in 2010.

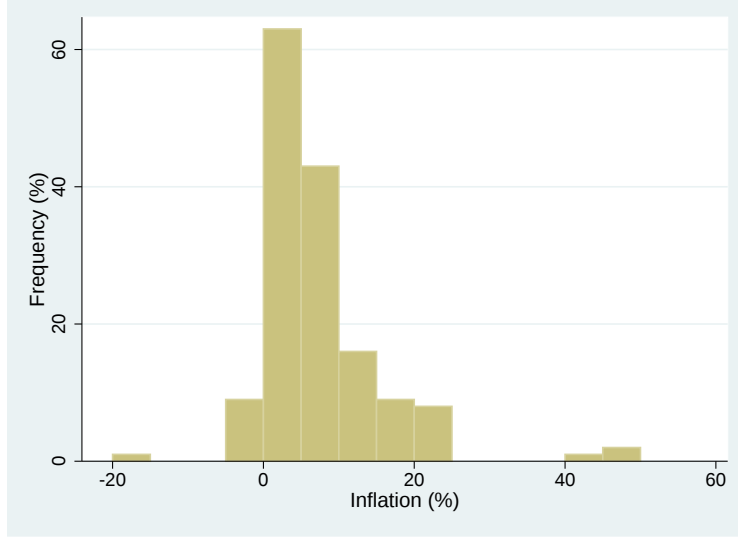


Figure 1: The distribution of inflation

We focus on the following variables:

Investment by the firm in the fiscal year in local currency: investment is divided into two categories: the first is machinery, vehicles and equipment (henceforth referred to as “machinery investment” for short); the second is land and buildings (referred to as “land investment”). There are 43,499 observations that report their machinery, vehicles and equipment investment activities and 42,602 observations that report their land and building investment activities.

Access to finance: we focus on two proxies for access to finance. The first is whether the firm has a checking or saving account. This captures, crudely, whether the firm has access to an inflation-protected store of value. The second is whether a firm currently has a credit line from a financial institution. Note that this is an imperfect proxy for the firm’s access to credit, as firms who report having no credit line may not need credit at the time of the survey. All of the proxies are dummy variables. Please see Table A2 in the Appendix for the summary statistics of the variables.

Firm size: Following the definition of the WBES, we define small firms as those that have less than 20 workers. Firms that have 20 or more workers are large firms.

Other control variables: firm age and manager’s experience.

In addition to the WBES, we collect annual investment and GDP deflator at the country level. The data are from the World Development Indicators. With the GDP deflator data, we calculate for each firm the real value of machinery and land investment.

In terms of frequency, not surprisingly, large firms make machinery investment more frequently than small firms. From the sample, we observe that 36.8% of small firms report no machinery and equipment investment, whereas only 14.7% of large firms report so. The fact that large firms make more frequent machinery and equipment investment suggests that machinery and equipment investment is less of an indivisible investment to large firms, compared to small firms. When it comes to land and building investment, the difference is similar but not as stark: 72.5% of small firms report no land and building investment, compared to 61.8% of large firms who report no land and building investment.

In terms of magnitude, small firms that invest strictly positive amounts tend to make larger investments relative to their annual sales. This is directly consistent with the intuition regarding “indivisible investment” above: small firms take longer to invest than larger firms, and when they do, their invest-

ment compared to their sales is larger. Table 2 below shows the percentile distribution of both equipment investment and land and building investment (as fractions of annual sales). Note that we only include firms that make positive investment. We see that investment as a fraction of annual sales are larger for small firms at every percentile position, and this is true for both types of investment.⁷

Percentiles		5%	25%	50%	75%	95%	99%	Number of Observations
Equipment Investment/Sales	Large firms	0.002	0.010	0.027	0.071	0.300	1.167	19983
	Small firms	0.003	0.020	0.050	0.115	0.450	1.373	10882
Land and Building Investment/Sales	Large firms	0.001	0.010	0.030	0.083	0.308	1.111	8626
	Small firms	0.005	0.023	0.053	0.125	0.500	2.250	4630

Table 2: The distribution of inflation

4.1 Empirical models

The main difficulty when assessing the impact of inflation on investment is the endogeneity issue. Inflation can affect investment, but at the same time, aggregate investment can also affect inflation (for example, through the central bank's decision making process). Alternatively, both inflation and investment can be driven by a third variable, such as productivity. Therefore it is difficult to assert a causality relationship between inflation and investment.

As we are interested in the differential effect of inflation on investment in small and large firms, we can try to circumvent this endogeneity issue by using the Rajan and Zingales (1998) approach and controlling for aggregate variables in two different ways. In the first specification, we use aggregate investment as a control. In the second specification, we use country*year fixed effects to capture country-specific macroeconomic conditions in that year. In

⁷Unfortunately, since the data for firm sales are very spotty, the number of observations drops sharply and therefore the statistics should be taken with caution.

both specifications, the identifying assumption is that changes in inflation are exogenous to changes in the difference between investment in small and large firms (conditional on access to finance and other controls). As all identifying assumptions, this too can be challenged: for example, if changes in inflation are driven by changes in informality that make it more difficult for the government to collect revenue in ways other than seigniorage, our exogeneity assumption may be violated, as small firms are disproportionately informal (see Gordon and Li (2009) for a development of this idea). In light of these concerns, we interpret our empirical evidence as suggestive rather than conclusive.

We are interested in the extensive and intensive margins of the impact of inflation on the investment wedge between large and small firms. The extensive margin refers to whether a firm invests or not (a binary decision). The intensive margin refers to how much a firm invests, if it decides to do so. For both margins, we are looking for changes within a firm. In other words, we run an OLS panel regression with firm fixed effects. With the extensive margin, we decide to opt for the simple OLS panel regression instead of probit or logit regressions. This is because probit and logit regressions have difficulties running with firm fixed effects. In addition, when the mean of the dependent variable is not close to 1 or 0, OLS gives qualitatively similar results to logit with the advantage of easier interpretation.⁸

We begin with the intensive margin, using the following specification:

$$\begin{aligned}
DInv_{ijt} = & c + \beta_2 Inflation_{jt} + \beta_3 Small_i * Inflation_{jt} + \beta_4 NoFinance_{ijt} \\
& + \beta_5 NoFinance_{ijt} * Infl_{jt} + \beta_6 Small_i * NoFinance_{ijt} \\
& + \beta_7 Small_i * NoFinance_{ijt} * Infl_{jt} + \beta_8 country_j + \beta_9 year_t + \beta_{10} firm_i(9)
\end{aligned}$$

where i is a firm index, j is a country index, t is year, and $firm_i$ is the firm fixed effect. $DInv_{ijt}$ is a dummy variable: it takes the value of 1 if

⁸For the logit regressions that converge, the results are qualitatively similar to OLS.

the firm invests, and 0 otherwise. *NoFinance_i* is a set of control variables representing the lack of access to finance, including the lack of access to saving instruments and the lack of access to credit. We have the double and triple interactions between *Small*, *NoFinance*, and *Inflation*. The ultimate coefficient of interest is β_3 : the interaction between the small firm dummy and inflation.

We also consider the following alternative specification:

$$\begin{aligned} DInv_{itj} = & c + \beta_3 Small_i * Inflation_{jt} + \beta_4 NoFinance_{ijt} \\ & + \beta_5 NoFinance_{ijt} * Infl_{jt} + \beta_6 Small_i * NoFinance_{ijt} \\ & + \beta_7 Small_i * NoFinance_{ijt} * Infl_{jt} + \beta_8 country_j * year_t + \beta_9 firm_i \end{aligned} \quad (10)$$

In this specification, we substitute the aggregate investment and inflation by country*year dummies. The idea is that country*year fixed effects capture the common country-year specific component of firms' investment. The interpretation then is the following: what is the additional impact inflation has on small firms' investment, over and above the overall macroeconomic condition?

For the intensive margin, we follow a similar approach. We test for the impact of inflation on investment within a firm, using OLS panel regressions with firm fixed effects.

The specifications are as follows:

$$\begin{aligned} Log(Inv_{itj}) = & c + \beta_1 log(AggInv_{jt}) + \beta_2 Inflation_{jt} + \beta_3 Small_i * Inflation_{jt} \\ & + \beta_4 NoFinance_{ijt} + \beta_5 NoFinance_{ijt} * Infl_{jt} + \beta_6 Small_i * NoFinance_{ijt} \\ & + \beta_7 Small_i * NoFinance_{ijt} * Infl_{jt} + \beta_8 country_j + \beta_9 year_t + \beta_{10} firm_i \end{aligned} \quad (11)$$

and:

$$\begin{aligned}
\text{Log}(Inv_{itj}) = & c + \beta_3 \text{Small}_i * \text{Inflation}_{jt} + \beta_4 \text{NoFinance}_{ijt} \\
& + \beta_5 \text{NoFinance}_{ijt} * \text{Infl}_{jt} + \beta_6 \text{Small}_i * \text{NoFinance}_{ijt} \\
& + \beta_7 \text{Small}_i * \text{NoFinance}_{ijt} * \text{Infl}_{jt} + \beta_8 \text{country}_j * \text{year}_t + \beta_9 \text{firm}_i \quad (12)
\end{aligned}$$

The intensive margin deals with the difference in investment levels between large and small investing firms. Therefore, the dependent variable for the intensive margin is the log of real investment. Firms that do not invest drop out of the sample. These regressions aim at assessing whether, conditional on investing, inflation has a differential impact on investment in large and small firms. In the first specification, AggInv_{jt} is the real aggregate investment of country j . The AggInv_{jt} and Inflation_{jt} variables control for macroeconomic condition of country j at time t . In the second specification, the $\text{country}_j * \text{year}_t$ fixed effects capture macroeconomic condition of country j at time t .

In all specifications and regressions, we weight the firms by their representative weights (recall that the sample is collected by a stratified random sampling strategy), so that the weighted sample is truly representative. We also cluster the standard error at the country level, since investment of firms in a country can be correlated, and adopt robust standard errors (i.e. allowing the variance of the error terms to vary).

4.2 Results: Extensive margin

This section present the results for the extensive margin: we calculate the differential impact of inflation on the decision to invest in small and large firms. The dependent variable is the dummy variable which takes the value of 1 if the firm invests. We are mostly interested in the coefficients of the SmallInflation interaction, and we highlight significant coefficients. Overall, we see that higher inflation disproportionately discourages small firms to

invest in both types of investment. We see a stronger and more consistent effect of inflation.

Table C-1 in the Appendix shows the impact of inflation on the machinery investment decision of large firms and small firms. The first five regressions follow the first specification, while the last five follow the second one. The *SmallInflation* coefficients are significant across most of the regressions. The coefficient value of -0.023 implies that an additional 1% inflation makes small firms 2.3% less likely to invest in machinery and equipment, relative to large firms.

Table C-2 shows the impact of inflation on the land investment decisions. Overall, we see some evidence that small firms are relatively less prone to invest in land and buildings at higher rates of inflation. Most of the significant coefficients range from -0.018 to -0.034 , implying that an additional 1% inflation makes small firms 1.8-3.4% less likely to invest in land and buildings relative to large firms. However, note that in two regressions - the ones with NoCredit (columns 3 and 8) - the *SmallInflation* coefficients have positive values which are highly significant. It is probably driven by the addition of *SmallNoCreditInfl* variable, which has large, negative and significant coefficients (-0.053). The sum of the *SmallInflation* and *SmallNoCreditInfl* is still negative, implying that in high inflation environments, small firms with no credit line are less likely to invest than large firms with no credit line.

4.3 Results: Intensive margin

We now proceed in investigating the differential impact of inflation on investment in large and small firms, conditional on positive investment. The dependent variable is therefore the log of investment (in real local currency). We gradually add control variables and access to finance variables interacted with inflation. We are mostly interested in the coefficients of the interaction, and we highlight significant coefficients. Overall, we see that inflation

disproportionately hurts both types of investment of small firms.

Table C-3 shows that overall, inflation hurts machinery investment of small firms more than large firms. The *SmallInflation* coefficients are largely negative and significant. The coefficient value of -0.093 implies that with an additional 1% increase in inflation, the declines in small firms' machinery investment is on average 9.3% more than the large firms' average decline.

Similar results are obtained with the land and building investment (Table C-4). Inflation disproportionately hurts small firms' land and building investment. The coefficients of interest are mostly significant and have the correct signs. The magnitude of the impact is also quite larger, it ranges from -0.094 to -0.187 , which means that with an additional 1% increase in inflation, the declines in small firms' land and building investment is on average 9.4% to 18.7% more than the large firms' average decline.

With caution, we treat these magnitude as the upper-bound impacts of inflation on investment misallocation between large and small firms. This is because other factors can affect the investment wedge. For example, the periods of high inflation are usually accompanied by volatile economic activities. Other disadvantages of small firms—such as the lack of connection to authorities and politicians—may hurt their investment and output.

5 Conclusion

In the presence of indivisible investment, the rate of return on saving plays a crucial role in investment decisions of firms with inadequate access to finance, who must finance investment by accumulating retained earnings. McKinnon (1973) argues that, by increasing the costs associated with accumulating retained earnings, inflation reduces indivisible investment. In this paper, we study McKinnon's argument in a dynamic continuous time framework, in which firms' cash flows are endogenously determined by past investment deci-

sions. We establish that, for sufficiently low capital stocks, there is a negative relationship between investment and inflation, consistent with McKinnon's original argument. However, our calibration of the model illustrates that this relationship is non-monotone, due to the feedback between investment and cash flows in inflationary environments.

At the same time, our calibration suggests that, especially for average levels of inflation in developing countries, McKinnon's mechanism generates a substantial reduction in indivisible investment by small firms. Moving from 7.4% inflation (which is the average in our sample) to -3% inflation (which, in our calibration, corresponds to the Friedman rule) results in about a 10% increase in steady state capital stocks.

We show some suggestive empirical evidence, based on our finding that, in McKinnon's environment, inflation creates a misallocation of investment between small and large firms, as lower-cash-flow firms must accumulate retained earnings for longer periods of time in order to finance a given size of investment. We find that small firms are likely to invest less than large firms in the presence of inflation; however, the magnitudes of the effects are substantially larger than those suggested by our calibration, implying perhaps that other mechanisms may be contributing to this wedge.

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A Proof of Proposition 1

To prove this result, note that, for $k_0 > 0$ sufficiently small, $k^{ss}(n_s, \pi_h) = 0$. To see this, consider the range $k_0 < k_{\min}(\pi_h)$, where $k_{\min}(\pi_h)$ is defined as follows. Let $k_0(s, \pi_h)$ be defined by:

$$n_s \int_0^s p_t f(e^{-\delta t} k_0(s, \pi_h)) dt = p_s C \quad (13)$$

Note that $k_0(s, \pi_h)$ is defined so that, if initial capital levels are $k_0(s, \pi_h)$ and inflation is π_h , a small firm that accumulates all of its retained earnings will be able to purchase an indivisible investment good after exactly s units of time. The left hand side of the equation is the nominal value of the firm's retained earnings: at period t , each of the n_s production unit has $e^{-\delta t} k_0(s, \pi_h)$ units of depreciated capital, and output is sold at the nominal price p_t . The right hand side is the nominal price of the indivisible investment good at time s . Using the assumption that $\pi = \pi_h$ the above equation can be rewritten as:

$$n_s \int_0^s e^{\pi_h(t-s)} f(e^{-\delta t} k_0(s, \pi_h)) dt = C \quad (14)$$

Note that $k_0(s, \pi_h)$ is decreasing in s : trivially, if the firm can accumulate enough retained earnings in s units of time with $k_0(s, \pi_h)$, it can do so with any larger initial capital stock. Thus, if the firm has a lower initial capital level, it takes longer to accumulate the necessary reserves to finance the indivisible investment.

Thus, since $k_0(s, \pi_h)$ is decreasing in s , the limit $k_{\min}(\pi_h) = \lim_{s \rightarrow \infty} k_0(s, \pi_h)$

exists (and, is strictly positive for $\pi_h \geq 0$ ⁹). In other words, for $k_0 \leq k_{\min}(\pi_h)$, a small firm is unable to finance an indivisible investment good, even if it never distributes any dividends.

Of course, if $k_0 \leq k_{\min}(\pi_h)$, small firms do not invest when $\pi = \pi_h$ and $k^{ss}(n_s, \pi_h) = 0$. Thus, the weak inequality in equation 7 trivially holds, as $k^{ss}(n, \pi) \geq 0$ for any n and π . However, it is important to show that the inequality may, at times, be strict. To see this, note that for low levels of inflation (π_l), it is optimal both for small and large firms to invest, given k_0 sufficiently small. This is because the marginal product of capital is high, and, given low values of π_l , it may be relatively cheap (and feasible) to accumulate capital, both for small and for large firms. Thus, it is possible that $k^{ss}(n_s, \pi_l), k^{ss}(n_l, \pi_l) > 0$. Finally, note that in high inflation environments, investment in the indivisible good may be feasible for large firms, as for any s :

$$n_l \int_0^s e^{\pi_h(t-s)} f(e^{-\delta t} k_0(s, \pi_h)) dt > n_s \int_0^s e^{\pi_h(t-s)} f(e^{-\delta t} k_0(s, \pi_h)) dt = C \quad (15)$$

Thus, large firms may find it optimal (and feasible) to invest in high inflation environments, when investment is not feasible for small firms.

⁹To see this, note that, when $\pi_h = 0$, we can solve for $k_{\min}(\pi = 0)$ as:

$$n_s \int_0^\infty f(e^{-\delta t} k_{\min}(\pi = 0)) dt = C$$

Which obviously yields a strictly positive solution for $k_{\min}(\pi = 0)$ (since, otherwise, the left hand side is 0). Trivially, this result extends for $\pi_h \geq 0$. Otherwise, if retained earnings earn a strictly positive return that is sufficiently high, the limit $k_{\min}(\pi < 0)$ may be 0.

B Proof of Proposition 2

The discrete time approximation of the firm's problem can be written as follows (for $\epsilon > 0$, small):

$$V(k, M, p) = \max_{M', k', s, i} (f(k) - s)\epsilon + e^{-\rho\epsilon} V(k', M', e^{\pi\epsilon} p) \quad (16)$$

s.t.

$$k' = e^{-\delta\epsilon} k + C \lfloor \frac{i}{C} \rfloor \quad (17)$$

$$M' = M + p s \epsilon - p i \quad (18)$$

$$p i \leq M \quad (19)$$

$$0 \leq s \leq f(k) \quad (20)$$

The first order condition of the firm's problem with respect to s yields:

$$-\epsilon + e^{-\rho\epsilon} \frac{\partial V(k', M', e^{\pi\epsilon} p)}{\partial M'} p \epsilon - \lambda_1 - \lambda_2 = 0 \quad (21)$$

where λ_1 is the Lagrange multiplier on the constraint $0 \leq s$ and λ_2 is the Lagrange multiplier on the constraint $s \leq f(k)$. To see that there is almost always a corner solution, note that if $\lambda_1 = \lambda_2 = 0$, it must be the case that:

$$e^{-\rho\epsilon} \frac{\partial V(k', M', e^{\pi\epsilon} p)}{\partial M'} p = 1 \quad (22)$$

Taking $\epsilon \rightarrow 0$, there is an interior solution only when $\frac{\partial V(k, M, p)}{\partial M} p = 1$. Note that:

$$\frac{\partial V(k, M, p)}{\partial M} = e^{-\rho\epsilon} \frac{\partial V(k', M', p')}{\partial M'} - \lambda_{cia} \quad (23)$$

where λ_{cia} is the Lagrange multiplier on the cash in advance constraint (equation 19). Note that equation 3 is binding only when $i \geq 0$, which, as $\epsilon \rightarrow 0$, happens in an increasingly small frequency (at the limit, $i \geq 0$ happens in a measure 0 of periods). Thus, if there is an interior solution for s_t in a

positive measure of time, it must be the case that there is a positive measure of time in which there is an interior solution for s_t and $\lambda_{cia} = 0$. But this is a contradiction, as it would require that during that measure of time (using equations 22 and 24 with $\lambda_{cia} = 0$):

$$1 = e^{-\rho\epsilon} \quad (24)$$

Which, for any $\epsilon > 0$, is a contradiction. Thus, an interior solution for s_t exists for only a 0 measure of time periods.

Next, I establish that $s_t = 0$ if and only if $M = 0$. To see this, note that, by equation 24 (when $\lambda_{cia} = 0$), $\frac{\partial V(k', M', p')}{\partial M'} > \frac{\partial V(k, M, p)}{\partial M}$. Thus, as long as $\lambda_{cia} = 0$ (no investment), if it is optimal for the firm to accumulate cash reserves at some time t , it is optimal for it to accumulate cash reserves until it makes some investment. Since the firm's initial stock of cash is $M = 0$, it follows that the firm holds non-zero cash reserves only in periods in which it is accumulating cash for the purpose of investment.

If $s_t = 0$ for all t , the firm accumulates dividends and lets capital depreciate. Otherwise, there exists a positive measure of periods in which $s_t = f(k_t)$. Let t_0 be the first period of time in which the firm sets $s_t = f(k_t)$ (for some $\delta > 0$). Let:

$$t_1 = \inf\{t \geq t_0 | s_t = 0\} \quad (25)$$

Trivially, $t_1 < \infty$, as it is never optimal for the firm to accumulate capital without consuming any dividends in the future (given that $\pi \geq -\rho$, which rules out accumulation of reserves for the sole purpose of consuming their returns). Since there is an interior solution for s_t for only a 0 measure of time periods, it must be the case that for a positive measure of time $s_t = 0$.

Similarly, let t_2 be given by:

$$t_2 = \inf\{t \geq t_1 | s_t = f(k_t)\} \quad (26)$$

The fact that $t_2 < \infty$ follows from the recursive nature of the firm's problem:

otherwise, the firm's capital depreciates and at some point reaches k_{t_0} ; given the firm's optimality of accumulating cash reserves when $k = k_{t_0}$ and $M = 0$, it follows that the firm begins accumulating cash reserves at this point (note that, with $M = 0$ as initial conditions, the firm's problem is unaffected by changes in the initial level of p).

Let $\underline{k} = k_{t_2}$. We claim that the firm enters a steady state cycle in which the firm accumulates cash reserves starting from $\underline{k}$ and then, after investing, lets capital depreciate to $\underline{k}$ before accumulating reserves again. To see this, note that, since the firm optimally decides to start accumulating reserves at t_2 , it is not optimal for the firm to accumulate reserves whenever $M = 0$ and $k > k_{t_2}$. Thus, in periods after the firm invests and consumes dividends, since $M = 0$, it is not optimal for the firm to accumulate cash reserves until $k = k_{t_2}$.

C Regression Tables

Firm fixed effects	Specification 1 : Time and country fixed effects					Specification 2: Country*Time fixed effects				
Machinery Investment Extensive Margin	No Controls	All Controls	No Credit	No Savings	No Savings No Credit	No Controls	All Controls	No Credit	No Savings	No Savings No Credit
Inflation	0.003 [0.005]	0.048*** [0.016]	0.019 [0.016]	0.049*** [0.015]	0.062*** [0.014]					
SmallInflation	-0.006*** [0.002]	-0.023** [0.009]	-0.001 [0.001]	-0.023*** [0.008]	-0.019** [0.008]	-0.005** [0.002]	-0.019** [0.009]	-0.001 [0.002]	-0.019** [0.007]	-0.020** [0.009]
NoSavings		-0.131*** [0.045]		-0.031 [0.118]	-0.256 [0.270]		-0.122*** [0.035]		-0.222** [0.107]	-0.586** [0.251]
NoSavingsInfl				-0.043* [0.024]	0.003 [0.052]				-0.007 [0.019]	0.064 [0.053]
SmallNoSavings				0.242 [0.187]	0.540* [0.298]				0.366** [0.178]	0.726*** [0.265]
SmallNoSavingsInfl				-0.005 [0.023]	-0.119 [0.073]				-0.024 [0.022]	-0.150** [0.066]
NoCredit		-0.101*** [0.030]	-0.068*** [0.025]		0.056 [0.099]		-0.027 [0.024]	-0.038** [0.017]		0.068 [0.094]
NoCreditInfl			0.005** [0.002]		-0.025** [0.012]			0.003 [0.002]		-0.020* [0.012]
SmallNoCredit			-0.007 [0.050]		-0.084 [0.106]			0.020 [0.053]		-0.071 [0.107]
SmallNoCreditInfl			-0.006 [0.008]		0.003 [0.018]			-0.006 [0.006]		0.004 [0.018]
NoSavNoCre					0.103 [0.357]					0.363 [0.312]
SmallNoSavNoCre					-0.093 [0.324]					-0.261 [0.318]
NoSavNoCredInf					-0.039 [0.065]					-0.083 [0.060]
SmallNoSavNoCreInfl					0.110 [0.071]					0.135** [0.065]
Firm age		0.001 [0.002]	0.001 [0.002]	0.000 [0.002]	0.001 [0.002]		0.001 [0.002]	0.000 [0.001]	-0.000 [0.002]	0.001 [0.002]
Managerexp		-0.003 [0.004]	-0.000 [0.001]	-0.001 [0.003]	-0.002 [0.004]		-0.002 [0.004]	-0.000 [0.001]	-0.001 [0.003]	-0.002 [0.004]
Constant	0.652*** [0.061]	1.030*** [0.129]	0.507** [0.194]	0.804*** [0.139]	0.939*** [0.133]	1.012*** [0.009]	1.079*** [0.126]	0.996*** [0.040]	1.084*** [0.101]	1.108*** [0.121]
Observations	16,241	10,697	12,176	11,246	10,697	16,241	10,697	12,176	11,246	10,697
R-squared	0.247	0.463	0.422	0.459	0.489	0.334	0.497	0.467	0.494	0.517
Number of id	8,195	7,817	7,870	7,979	7,817	8,195	7,817	7,870	7,979	7,817

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table C-1: Machinery Investment- Extensive Margin

Firm fixed effects	Specification 1 : Time and country fixed effects					Specification 2: Country*Time fixed effects				
Land Investment Extensive Margin	No Controls	All Controls	No Credit	No Savings	No Savings No Credit	No Controls	All Controls	No Credit	No Savings	No Savings No Credit
Inflation	0.005 [0.005]	0.099*** [0.032]	0.055** [0.028]	0.104*** [0.030]	0.129*** [0.035]					
SmallInflation	-0.002 [0.005]	-0.024* [0.012]	0.028*** [0.005]	-0.022* [0.012]	-0.034*** [0.012]	0.001 [0.005]	-0.018 [0.011]	0.029*** [0.005]	-0.018* [0.010]	-0.029*** [0.010]
NoSavings		0.087*** [0.029]		-0.138 [0.156]	-0.543 [0.666]		0.046 [0.029]		-0.052 [0.157]	-0.448 [0.549]
NoSavingsInfl				-0.007 [0.034]	0.124 [0.142]				-0.030 [0.039]	0.104 [0.117]
SmallNoSavings				0.615*** [0.198]	0.960 [0.649]				0.458** [0.173]	0.813 [0.706]
SmallNoSavingsInfl				-0.045 [0.033]	-0.167 [0.137]				-0.021 [0.025]	-0.141 [0.145]
NoCredit		0.093* [0.053]	0.008 [0.043]		0.139 [0.143]		0.050 [0.030]	-0.027 [0.044]		-0.023 [0.119]
NoCreditInfl			0.012*** [0.004]		-0.032 [0.020]			0.015*** [0.003]		-0.013 [0.014]
SmallNoCredit			0.311** [0.147]		0.282 [0.176]			0.290* [0.161]		0.327* [0.181]
SmallNoCreditInfl			-0.053*** [0.014]		-0.006 [0.024]			-0.053*** [0.014]		-0.015 [0.025]
NoSavNoCre					0.064 [0.596]					0.020 [0.543]
SmallNoSavNoCre					-0.113 [0.534]					-0.074 [0.574]
NoSavNoCredInf					-0.096 [0.142]					-0.095 [0.127]
SmallNoSavNoCreInf					0.097 [0.127]					0.092 [0.133]
Firm age		0.001 [0.002]	-0.005** [0.002]	-0.001 [0.001]	-0.001 [0.002]		0.000 [0.002]	-0.005** [0.002]	-0.001 [0.002]	-0.002 [0.001]
Managerexp		-0.007 [0.005]	0.004** [0.002]	-0.005 [0.004]	-0.006 [0.004]		-0.010* [0.005]	0.004 [0.002]	-0.008** [0.004]	-0.009** [0.004]
Constant	0.821*** [0.193]	0.078 [0.202]	-0.470 [0.299]	-0.262* [0.156]	-0.138 [0.255]	0.684*** [0.017]	0.766*** [0.096]	0.477*** [0.016]	0.779*** [0.068]	0.842*** [0.109]
Observations	16,241	10,697	12,176	11,246	10,697	16,241	10,697	12,176	11,246	10,697
R-squared	0.326	0.269	0.503	0.296	0.317	0.376	0.334	0.528	0.359	0.376
Number of id	8,195	7,817	7,870	7,979	7,817	8,195	7,817	7,870	7,979	7,817

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table C-2: Land and Building Investment- Extensive Margin

Firm fixed effects	Specification 1 : Time and country fixed effects					Specification 2: Country*Time fixed effects				
Machinery Investment Intensive Margin	No Controls	All Controls	No Credit	No Savings	No Savings No Credit	No Controls	All Controls	No Credit	No Savings	No Savings No Credit
Log(AggInvestment)	0.199 [1.308]	0.330 [0.520]	0.693 [0.575]	-0.341 [0.447]	0.588 [0.493]					
Inflation	-0.017 [0.089]	-0.010 [0.050]	-0.055 [0.042]	-0.001 [0.051]	-0.021 [0.048]					
SmallInflation	-0.031 [0.062]	-0.093* [0.055]	0.015 [0.057]	-0.113* [0.062]	-0.098 [0.079]	-0.099*** [0.031]	-0.086 [0.057]	0.012 [0.058]	-0.116* [0.067]	-0.099 [0.082]
NoSavings		-0.076 [0.208]		1.287* [0.666]	2.660** [1.067]		-0.031 [0.233]		0.759 [0.512]	1.246 [0.944]
NoSavingsInfl				-0.260** [0.105]	-0.489** [0.188]				-0.173* [0.088]	-0.211 [0.149]
SmallNoSavings				-2.808*** [0.878]	-1.748 [1.168]				-1.786*** [0.616]	0.966 [0.885]
SmallNoSavingsInfl				0.389*** [0.136]	0.334 [0.214]				0.267** [0.107]	-0.143 [0.148]
NoCredit		-0.517** [0.243]	3.939* [2.041]		-0.082 [0.488]		-0.511** [0.241]	3.999* [2.028]		-0.241 [0.420]
NoCreditInfl			-0.282* [0.153]		-0.034 [0.063]			-0.286* [0.152]		-0.006 [0.050]
SmallNoCredit			-4.447** [2.091]		-1.321*** [0.457]			-4.548** [2.072]		-1.421*** [0.400]
SmallNoCreditInfl			0.222 [0.134]		0.137* [0.073]			0.232* [0.131]		0.144** [0.064]
NoSavNoCre					-2.344* [1.226]					-0.882 [1.166]
SmallNoSavNoCre					1.088 [1.596]					-1.108 [1.291]
NoSavNoCredInfl					0.376** [0.186]					0.061 [0.181]
SmallNoSavNoCreInfl					-0.179 [0.265]					0.305* [0.179]
Firm age		0.004 [0.005]	0.011 [0.007]	0.021** [0.009]	0.002 [0.005]		0.004 [0.004]	0.012 [0.008]	0.018* [0.009]	0.002 [0.005]
Managerexp		0.006* [0.004]	0.029*** [0.003]	0.008 [0.010]	0.008* [0.005]		0.004 [0.005]	0.029*** [0.003]	0.006 [0.011]	0.005 [0.006]
Constant	1.642 [33.743]	-0.833 [13.314]	-11.213 [15.171]	16.160 [11.371]	-7.359 [12.557]	6.842*** [0.070]	7.611*** [0.175]	5.723*** [0.316]	7.172*** [0.339]	7.686*** [0.175]
Observations	7,499	5,209	5,592	5,460	5,209	7,859	5,486	5,894	5,738	5,486
R-squared	0.287	0.058	0.434	0.081	0.082	0.459	0.104	0.437	0.119	0.131
Number of id	5,438	4,335	4,475	4,544	4,335	5,696	4,586	4,739	4,795	4,586

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table C-3: Machinery Investment- Intensive Margin

Firm fixed effects	Specification 1 : Time and country fixed effects					Specification 2: Country*Time fixed effects				
Land Investment Intensive Margin	No Controls	All Controls	No Credit	No Savings	No Savings No Credit	No Controls	All Controls	No Credit	No Savings	No Savings No Credit
Log(AggInvestment)	0.628 [1.254]	-0.312 [1.518]	-2.442 [2.589]	-0.093 [1.586]	-0.413 [1.677]					
Inflation	-0.078 [0.047]	-0.056 [0.183]	-0.372** [0.164]	-0.044 [0.187]	0.058 [0.179]					
SmallInflation	0.023 [0.050]	-0.094*** [0.026]	-0.187*** [0.057]	-0.096*** [0.024]	-0.128*** [0.030]	-0.024 [0.021]	-0.131*** [0.008]	-0.183*** [0.027]	-0.129*** [0.007]	-0.158*** [0.005]
NoSavings		1.498* [0.781]		3.364 [3.117]	11.704*** [3.251]		-0.738 [0.503]		1.576* [0.841]	3.168*** [0.698]
NoSavingsInfl				-0.307 [0.530]	-3.351*** [0.816]				-0.620*** [0.154]	-0.983*** [0.260]
SmallNoSavingsInfl				-0.327 [0.206]	1.491*** [0.441]				0.213*** [0.071]	0.320* [0.187]
DNoCredit		0.258 [0.498]	-7.430*** [0.351]		-2.017 [2.268]		-0.089 [0.168]	-7.323*** [0.272]		-1.585 [2.051]
NoCreditInfl			0.644*** [0.034]		0.180 [0.202]			0.636*** [0.029]		0.175 [0.205]
SmallNoCredit			-0.932 [2.979]		-0.804 [2.689]			5.885*** [0.862]		-1.012 [2.247]
SmallNoCreditInfl			0.061 [0.246]		0.195 [0.268]			-0.406*** [0.063]		0.158 [0.235]
NoSavNoCredInfl					1.884*** [0.423]					0.717*** [0.148]
Firm age		-0.061*** [0.015]	0.019* [0.009]	-0.063*** [0.014]	-0.071*** [0.017]		-0.041*** [0.008]	0.016*** [0.005]	-0.046*** [0.006]	-0.039*** [0.007]
managerexp		0.097*** [0.027]	-0.075*** [0.024]	0.098*** [0.026]	0.112*** [0.028]		0.100*** [0.023]	-0.083*** [0.020]	0.106*** [0.019]	0.096*** [0.020]
Constant	-6.998 [32.510]	16.593 [39.262]	75.162 [68.047]	10.739 [39.964]	18.583 [43.644]	8.096*** [0.090]	8.377*** [0.263]	12.393*** [0.407]	8.251*** [0.252]	8.446*** [0.217]
Observations	2,833	1,215	1,450	1,276	1,215	2,973	1,291	1,542	1,353	1,291
R-squared	0.724	0.661	0.931	0.688	0.728	0.823	0.821	0.941	0.824	0.830
Number of id	2,453	1,137	1,337	1,191	1,137	2,572	1,213	1,427	1,268	1,213

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table C-4: Land and Building Investment- Intensive Margin