The effectiveness of industrial policy in developing countries

Gebrewolde, Tewodros; Rockey, James

DOI:
10.1080/19439342.2022.2090997

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Gebrewolde, T & Rockey, J 2022, 'The effectiveness of industrial policy in developing countries: causal evidence from Ethiopian manufacturing firms', *Journal of Development Effectiveness*, vol. 2022.
https://doi.org/10.1080/19439342.2022.2090997

Routledge
Taylor & Francis Group

Journal of Development Effectiveness

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rjde20

The effectiveness of industrial policy in developing countries: causal evidence from Ethiopian manufacturing firms

Tewodros Makonnen Gebrewolde & James Rockey

To cite this article: Tewodros Makonnen Gebrewolde & James Rockey (2022): The effectiveness of industrial policy in developing countries: causal evidence from Ethiopian manufacturing firms, Journal of Development Effectiveness, DOI: 10.1080/19439342.2022.2090997

To link to this article: https://doi.org/10.1080/19439342.2022.2090997

Published online: 15 Jul 2022.

JOURNAL OF DEVELOPMENT EFFECTIVENESS
https://doi.org/10.1080/19439342.2022.2090997

Routledge
Taylor & Francis Group

RESEARCH ARTICLE

OPEN ACCESS Check for updates

The effectiveness of industrial policy in developing countries: causal evidence from Ethiopian manufacturing firms

Tewodros Makonnen Gebrewolde[a] and James Rockey[b]

[a]IGC Ethiopia, Addis Ababa, Ethiopia; [b]Department of Economics, University of Birmingham, Birmingham, UK

ABSTRACT

Prioritising the growth of particular sectors or regions is often part of a low-income country's growth strategy. We study a prototypical example of such policies in Ethiopia, exploiting geographic and sectoral variation in the form and scale of the policy for identification. Using product-level data on Ethiopian manufacturing firms, we show that the policy was unsuccessful: in the best case scenario its benefits were around one-tenth of its cost. Subsidised loans did not improve productivity, leading only to an increase in fungible assets not machinery. Tax-breaks improved productivity but reduced firms' capital levels. Further results suggest that these were both the consequence of volatility and the lack of effective bankruptcy protection. There are two key policy implications of our findings. Firstly, we highlight that ineffective industrial policies can be extremely expensive and thus may impede rather than promote countries' pursuit of their development objectives, given that 'blunt' industrial policies like the one we study are common. Second, our results suggest that policies that rely on improving access to capital will be more successful in a stable economic environment with effective bankruptcy protection and that access to capital is not necessarily the key constraint to improving productivity in many of the firms we study.

ARTICLE HISTORY
Submission 05 May 2019
Received 22 April 2022
Accepted 5 May 2022

KEYWORDS
Industrial policy; growth strategy; Ethiopia; manufacturing

1. Introduction

Giving firms cheap loans and tax breaks is a common form of Industrial Policy (IP) in low-income countries (LICs). Despite their prevalence, the effectiveness of this form of IP is not well understood. This paper uses a product-level dataset for the universe of small and medium-sized Ethiopian manufacturing firms to study a typical policy in order to address this gap.

This policy, which ran from 2002 to 2010, provided subsidised loans to small and medium-sized manufacturing firms in sectors chosen because of their intensive use of Ethiopian agricultural produce. It also provided tax breaks to firms more than 100 *km* outside Addis Ababa. Despite the scepticism of many development economists, policies like this are common in LICs. However, there is little causal evidence as to whether and when they work.

The policy we study had two components designed to reduce the cost of the capital, the first via subsidised loans, the second through tax-breaks. We show that neither arm of the policy improved productivity. We show that while the loans increased investment, this was in stores of value, such as vehicles or buildings, rather than production equipment. However, the tax breaks reduced capital levels, perhaps as entrepreneurs took the opportunity to take profits. Finally, while both arms of the policy led to the entry of new firms, these were too few and insufficiently productive to generate sufficient agglomeration externalities to increase average productivity. Firms' eligibility for tax-

CONTACT James Rockey jamesrockeyecon@gmail.com University of Birmingham, Birmingham, UK

breaks and loans depended on their location and sector, respectively. These differences in the eligibility criteria mean that we are able to separately identify the effects of tax breaks and access to credit.

To estimate the effect of estimate the effect of the tax breaks we exploit the fact that the government imposed an eligibility criteria only for firms more than 100 *km* from the capital. Using a difference-in-difference (DiD) type approach we compare firms more than 100 *km* away with those closer to the city. We identify the effect of the policy, under the assumption that firms closer to the city were not on a different trajectory, prior to the introduction of the programme. Similarly, to estimate the effect of the subsidised loans we compare firms in eligible sectors to other similar firms, again given the assumption that the firms were on similar trajectories. Combining these two approaches gives us a triple difference estimator, which also provides estimates of the combined impacts of the two arms of the policy.

Additional results show that this behaviour reflected local conditions. High inflation meant real interest rates on the concessionary loans were often negative, but the trading environment was volatile and there was no effective bankruptcy protection. Thus, a failed business might leave owners with a debt they were unable to pay back. A second factor is that our estimates suggest that the marginal product of capital was low, meaning that firms were not constrained by a lack of capital – but by other factors.

Thus, this policy led to no increase in employment, or the stock of machinery, and only a small increase in productivity. Yet, it was expensive. Forgone tax revenues alone were equivalent to 0.5% of GDP or 5% of annual government spending. For comparison, the entire manufacturing sector in Ethiopia accounts only for 5% of GDP. This is true even assuming that the true effect of the policy was given by the upper 99% confidence bound of our estimate. We focus on Ethiopia, but the policy we study, as we show in Appendix C, is similar in form to those implemented in several other countries in Sub-Saharan Africa (SSA).

The most relevant paper to this one in terms of the nature of the policy at hand is the landmark paper of Kline and Moretti (2014) which demonstrated a persistent effect of the Tennessee Valley Authority (TVA) on manufacturing employment, but only a transitory impact on agriculture. They show that this effect is consistent with the existence of agglomeration externalities in the manufacturing sector of the kind documented by Greenstone, Hornbeck, and Moretti (2010), and their absence in the agriculture sector. Like the policy we study, the TVA represented a considerable net transfer, and a substantial share of the federal budget. Also, like the policy we study the TVA was designed to accelerate development rather than solely to provide a short-term increase in job creation or wages. However, there are substantial differences in context and given the focus of the Ethiopian policy on encouraging manufacturing firms by reducing the cost of capital rather than by improving infrastructure.

Chaurey (2017) studies a similar placed-based policy aimed at reducing regional disparities in India. A key difference between the policy studied by Chaurey (2017) and the one we study is scope. The policy Chaurey (2017) studies, like the rich country place-based policies studied by Busso, Gregory, and Kline (2013), Neumark and Kolko (2010), Criscuolo et al. (2016), aimed at improving outcomes in a areas that comprise a small fraction of the nation as a whole. Such policies need not be self-financing and can be thought of as on efficient transfers of income to poor areas or workers. However, the policy we study aimed at encouraging the development of Ethiopia as a whole and as such the aim is to achieve accelerated growth through raising TFP, rather than a low-cost transfer.[1] One way to think about this, given the cost of the policy we study was equivalent to at least 5% of government spending, is that to be sustainable LIC IP needs to generate sufficient growth to pay for itself. We reject this possibility for the policy we study.

Our focus on productivity is in common with the literature on another form of IP, protectionism and the cultivation of infant industries, which also has often focussed on less-developed countries. Topalova and Khandelwal (2011) provide causal evidence that reduced tariffs in India led to improved firm-level productivity. Goldberg et al. (2010) show that the same reduction in tariffs led

to an increase in the number of products available. Recent work has sought to pin down the consequences of protectionism (Blonigen (2015), Liu (2017)) and highlight cases where well-designed policy has been successful (Martin, Nataraj, and Harrison (2017), Nunn and Trefler (2010), Aghion et al. (2015), Lane (2017), Giorcelli (2019))

This paper thus makes four main contributions. First, this is the first paper to assess a place-based policy as a source of long-term growth, not as a system of transfers. Secondly, it contributes to the literature by assessing a type of policy that was very common and which has accounted for a lot of government spending in SSA. Thirdly, it also contributes to the literature by comparing two different ways of reducing the cost of capital, tax breaks and cheap loans. It shows how their effects differed, and why. Fourth, to our knowledge it offers the first causal analysis for Ethiopia.

2. Industrial policy in Ethiopia

Ethiopia has become known for its distinctive approach to industrial policy, emphasising Agricultural Development Led Industrialization (ADLI), with a central role for the 'developmental state'. In 2000 began a series of five-year plans, the first of which was called the Sustainable Development and Poverty Reduction Plan (SDPRP). The subject of this paper is specific aspects of the SDPRP to enhance private sector development. Specifically, in 2002, the government announced a revised schedule of incentives and tax breaks. The strategy was explicitly designed to encourage manufacturing sectors that were labour intensive and that utilised Ethiopian agricultural products (see, Ministry of Finance and Economic Development 2002).[2]

The policy we study comprised two overlapping components. The first was based on geography and awarded (additional) tax-exemptions for firms more than 100 km from Addis-Ababa, we will refer to this as the *tax-breaks* policy. This meant a three-year tax-break rather than the two firms nearer to Addis-Ababa received.

The policy also extended additional tax-breaks to firms exporting more than half of their production directly, or 75% indirectly. There are very few such firms and these firms are almost exclusively long standing and government owned. We exclude the small number of such firms from our analysis. Thus, none of the firms we study were eligible for the export-related tax-breaks.

The second component was focused on particular sectors, and we refer to this as the *credit* policy. As the text of the Ministry of Finance and Economic Development (2002) makes explicit, on the basis that they are labour intensive and make use of Ethiopian agricultural produce. It is clear that all of the targeted sectors; Meat and Leather, Textiles, Agro Business, and Construction fit this description. The key feature of this policy is that firms in these sectors were eligible for concessionary loans.[3] Loans were provided by The Development Bank of Ethiopia, a state-owned bank established to facilitate investment with loans up to 70% of the initial capital to private sector firms in the four treated sectors. The policy also sought to promote the four sectors by establishing technology support and improving the supply of trained workers but these came into effect after the period we study.[4]

2.1. Theory of change

Thus, the policy (and others like it) were designed to encourage development of the manufacturing sector, by facilitating the expansion of existing firms and encouraging new ones, and thus both development and employment. Prior work discussed above incarnates two competing intuitions for the effects of IP. On one hand, support for specific sectors may lower average productivity as previously non-viable firms enter the market. On the other hand, there may be increasing returns to scale due to increased output and competition as well as agglomeration externalities. For example, Soderbom (2012) provides evidence that larger Ethiopian firms are more productive at producing the same product as smaller ones. Similarly, Gebreeyesus and Mohnen (2013) document the role of the importance of networks of similar firms for innovation in Ethiopia. Mbate (2017), studying Ethiopia's leather industry, emphasises the need for public support of the private sector. We

capture these two intuitions in our theory of change, a simple economic model with which to to better understand how lowering the cost of capital through tax-breaks and concessionary loans can encourage development, and under what circumstances.

For simplicity, we do not distinguish between a firm that makes multiple products and multiple firms that make a single product. For our purposes it is sufficient to conflate economies of scale or scope in the former case with agglomeration externalities in the latter. We thus consider a highly stylised economy comprised a continuum of atomless firm-specific products $i \in \mathcal{I}$ which are all produced using the same Cobb-Douglas technology differing only in their TFP A_i. Thus, the output of firm i is given by:

$$Y_i = A_i K_i^{\alpha} L_i^{\beta} \text{ such that } A_i \in (0, A^+), K_i \geq 0, L_i \geq 0, 0 < \alpha, \beta < 1 \tag{1}$$

Each firm-product (henceforth, firm) faces identical factor prices and production $C[Y_i] = \rho K_i + \psi L_i$, where $\rho > 0$ is the cost of capital and $\psi > 0$ is the wage rate. Firms pay a sales tax γ and face identical demand functions for each product $P[Y_i] = p - kY_i$. We assume a competitive equilibrium in which only weakly profitable products are produced and thus in equilibrium not all firms choose to produce all, or indeed any, of their potential products. In particular, i is produced iff it makes weakly positive profits:

$$\Pi_i = (1-\gamma) A_i K^{\alpha} L^{\beta} P[Y_i] - (\rho K_i \psi L_i) \geq 0 \tag{2}$$

In words, this equation simply says that the post-tax profits of firm i need to be sufficient to cover the costs of the associated labour and capital inputs. We denote the level of productivity, A_i, that satisfies this condition exactly as A^*. That is,

$$A^* = \frac{C[Y]}{P[Y](1-\gamma) K^{\alpha} L^{\beta}} \tag{3}$$

We assume that each firm's TFP, A_i, is given by the combination of the firm's individual technology $B_i > 0$, the level of TFP of firm i that would obtain in the absence of agglomeration externalities, and the effects of any agglomeration externalities. Specifically, we assume A_i is the sum of the two:

$$A_i = B_i + (B^+ - B^*)\phi, \tag{4}$$

where $B^+ - B^*$ is the number of firms choosing to produce and $\phi > 0$, implies that there are positive agglomeration externalities. $\phi < 0$ would imply congestion externalities. We can define B^+ as the productivity level of the most productive firm in the absence of agglomeration externalities. This formulation makes it straightforward to restate (3) in terms of B_i:

$$B^* = \frac{C[Y]}{P[Y](1-\gamma) K^{\alpha} L^{\beta} (1-\phi)} - \frac{\phi}{1-\phi} B^+ \tag{5}$$

It follows that total output is given by:

$$Y = \int_{A^*}^{A^+} A_i K_i^{\alpha} L_i^{\beta} \, di \tag{6}$$

and average productivity is similarly:

$$\overline{A} = \frac{1}{A^+ - A^*} \int_{A^*}^{A^+} A_i \, di. \tag{7}$$

For simplicity, we treat the funding for any tax reduction as being obtained from elsewhere, in the context of Ethiopia perhaps from development assistance. It follows immediately that a tax relief or concessionary loan policy, i.e. a policy that reduces γ has the following consequences:

(1) Lower Productivity firms enter the market:

$$\frac{\partial B^*}{\partial \gamma} > 0$$

Intuitively, this follows from the fact that a reduction in the tax rate will lower A^* and equivalently B^*, and cause new firms to enter and produce. Mathematically, we have that

$$\frac{\partial B^*}{\partial \gamma} = \frac{C[Y]}{(1-\gamma)^2 P[Y] K^{\alpha} L^{\beta}(1-\phi)} = \chi[\gamma] > 0.$$

(2) Output increases:

$$\frac{\partial Y}{\partial \gamma} < 0.$$

This has the same intuition as above – a reduction in γ causes new firms to enter. Mathematically, we have that

$$Y = \int_{B^*}^{B^+} (B_i + (B^+ - B^*)\phi) K_i^{\alpha} L_i^{\beta} \, di.$$

Then differentiating under the integral gives

$$\frac{dY}{d\gamma} = -B^* K^{\alpha} L^{\beta} \chi[\gamma] + \int_{B^*}^{B^+} - \chi[\gamma]\phi \, di$$

of which both terms are negative and thus output increases following a reduction in the cost of capital.

(3) The effect on average productivity is uncertain. On one hand, the entry of additional, less productive firms, will increase agglomeration externalities, and thus the productivity of all firms. On the other by introducing a number of less productive firms the average productivity will mechanically fall.

(4) Employment Increases. This follows directly from differentiating (3) to show $\frac{\delta A^*}{\delta \gamma} > 0$ implying that a reduction in γ to γ' leads to a reduction in A^* to A^{**} this leads to an increase in production of $\Delta Y = \int_{A^{**}}^{A^*} y_i \, di > 0$ implying, given (1), an increase in L.

(5) Capital utilisation increases. This follows immediately from the argument above. It is useful to note the intimate relationship between capital utilisation and employment here. If one goes up, so does the other. Thus, an increase in capital utilisation should imply an increase in employment. On the other hand, if for some reason an increase in capital were invested in an asset unrelated to production, then we should not expect much increase in employment. We shall see that this is the case below.

This simple model makes clear that the consequences of the policy will depend on the distribution of B_i, the (latent) productivities of firms, the relative importance of agglomeration externalities, and the skill with which additional capital is invested. We shall see that in the case we

study, that agglomeration externalities were insufficient to offset the lower productivity of entering firms, and that capital tends to be directed towards assets that are more fungible rather than productive.

Here we ignore how the tax breaks or loans are financed. This is reasonable if they are paid for by cuts to non-productive expenditure elsewhere, from additional foreign aid, or deficit spending. The generalisation to a general equilibrium model, where the policy must be financed from other taxation, or cuts in productive government expenditure in the tradition of Barro (1990) produces the same qualitative predictions at the cost of some additional complication. We also ignore differences between tax breaks and cheap loans.

3. Methodology

The data used in this study were obtained from the Ethiopian Large and Medium Scale Manufacturing Enterprises Census that is conducted annually by the Central Statistics Agency of Ethiopia. It contains the universe, and is hence an unbalanced panel, of firms for 14 years from 1996 to 2010. Initially, there are close to 600 firms in 1996. By 2010, there are around 1900. The firms are categorised into 54 industrial classification (ISIC) codes. Table I.1 in the Appendix reports the number of firms in each category in 1996 and 2010. As well as being available for all firms, the data are extremely rich, containing detailed information on both the establishment and ownership details of each firm. We make use of much of this information, and summarise the information we use in Appendix B.

Following our argument that the policy must increase TFP if it is to be sustainable, our empirical approach will be similar to that of Topalova and Khandelwal (2011) in that we will use firm-specific, time-varying estimates, of TFP as our dependent variable. This will allow us to capture direct effects of the policy on firms reflecting changes in manufacturing processes, etc., as well as any effects of agglomeration externalities.

3.1. Production function estimates

A key feature of the Ethiopian economy in the period we study is its rapid growth and even more rapid inflation. This dynamic environment is a useful laboratory for studying IP, but also necessitates particular care in the estimation of firm productivities. As is common we estimate firms' total factor productivities using panel-data regressions in which we regress sales on the quantity of capital, labour, and intermediate goods employed, treating productivity as the sales beyond those explained by the inputs also allowing for a random idiosyncratic shock. The dynamic nature of the Ethiopian economy during the period at hand means that the concerns about simultaneity (that firms' choices of inputs such as labour or capital may not be independent of their unobserved productivities) and selection (that firms do not enter or exit a given market at random, but depending upon their productivities), emphasised by Olley and Pakes (1996) (OP), are of particular concern. To address these concerns we use the recent estimator of Ackerberg, Caves, and Frazer (2015) (ACF); this builds on the approach of OP and Levinsohn and Petrin (2003) (LP) but does not suffer from the same functional dependence problem ACF identify. An important advantage of the data we use is that we are able to use information on the quantities of inputs used and products produced (and their prices). De Loecker (2011) emphasised that using data on (deflated) sales rather than production quantities could lead to bias if errors in the assumed prices were correlated with the choice of inputs.

In Appendix E we provide a brief outline of the ACF estimator and a detailed discussion of the results, reported in Table 1. In summary all estimates suggest firms have low marginal product of capital, of around 0.09 compared to an estimate of 0.44 for labour. Moreover, we cannot reject that firms exhibit diminishing returns to scale. This suggests that the effects of a policy, such as the one at hand, designed to boost productivity and output through reducing the cost of capital may be inherently limited. The results are discussed in more detail in Appendix E.

Table 1. Summary statistics by treatment status.

	Pre-Treatment											
	Credit						Tax-breaks					
	Untreated		Treated		Difference		Untreated		Treated		Difference	
	mean	sd	mean	sd	b	t	mean	sd	mean	sd	b	t
Total Factor Productivity	4.10	0.81	4.22	0.81	− 0.12 **	(−3.23)	4.09	0.80	4.30	0.81	− 0.21 ***	(−5.59)
Government Owned	0.16	0.37	0.25	0.43	− 0.09 ***	(−4.72)	0.18	0.39	0.26	0.44	− 0.08 ***	(−3.85)
(log) Total Book Capital	13.28	2.69	13.29	3.25	− 0.01	(−0.08)	13.21	3.02	13.40	3.08	− 0.18	(−1.28)
(log) Value of Inputs	7.88	3.74	9.02	3.13	− 1.14 ***	(−6.81)	8.76	3.31	8.32	3.57	0.43 **	(2.66)
(log) Total Wages	12.00	1.71	11.97	1.96	0.03	(0.34)	12.08	1.70	11.85	2.07	0.22 *	(2.48)
(log) Machinery Capital	12.41	2.87	12.19	3.40	0.22	(1.47)	12.31	3.08	12.22	3.38	0.08	(0.55)
Observations	719		1148		867		1101		766		1867	
	Post-Treatment											
Total Factor Productivity	3.58	0.81	3.72	0.89	− 0.14 ***	(−5.79)	3.57	0.84	3.80	0.86	− 0.23 ***	(−9.23)
Government Owned	0.12	0.33	0.15	0.36	− 0.03 **	(−3.01)	0.13	0.34	0.15	0.36	− 0.02 *	(−2.22)
(log) Total Book Capital	14.08	2.75	13.74	3.25	0.34 ***	(3.93)	13.99	3.13	13.71	2.99	0.27 **	(3.12)
(log) Value of Inputs	8.49	3.78	9.02	2.86	− 0.54 ***	(−5.27)	9.13	3.15	8.40	3.33	0.73 ***	(7.77)
(log) Total Wages	13.72	1.77	13.26	1.97	0.46 ***	(8.46)	13.68	1.83	13.12	1.96	0.56 ***	(10.19)
(log) Machinery Capital	12.67	2.69	12.28	3.05	0.39 ***	(4.62)	12.63	2.92	12.17	2.90	0.46 ***	(5.39)
Observations	1867		3040		4907		2815		2092		4907	

Table 2. Production function estimates.

	Sales	Single Product Firms	Sales8	Sales 2nd	Output	Machinery	Private Firms
(log) Total Book Capital	0.04***	0.05***	0.07***	0.08***	0.01*		0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)		(0.01)
(log) Value of Inputs	0.43***	0.26***	0.12***	0.13	0.36***	0.17**	0.39***
	(0.03)	(0.09)	(0.01)	(0.08)	(0.09)	(0.07)	(0.05)
(log) Total Wages	0.42***	0.63***	0.67***	0.59***	0.65***	0.59***	0.43***
	(0.02)	(0.08)	(0.02)	(0.05)	(0.08)	(0.05)	(0.04)
(log) Machinery Capital						0.09***	
						(0.01)	
Observations	8616	1697	5508	8616	9691	8390	7376
Wald(CRS)	0.000	0.207	0.000	0.000	0.437	0.000	0.000

All results are from the estimator of Ackerberg, Caves, and Frazer (2015) which includes firm and year-fixed effects. Column 2 restricts the sample to firms producing only a single product. Column 3 restricts the sample to pre-existing firms. Column 4 uses a second degree polynomial rather than the alternative of a 3rd degree. Column 5 uses Output instead of Sales as the dependent variable. Column 6 restricts the definition of Capital to include only production equipment, Column 7 excludes firms owned by the government. Wald(CRS) reports the p-value of the null hypothesis that the estimated production function exhibits constant returns to scale. Robust standard errors are in parentheses.

3.2. Unconditional effects of the policy

As a first step we report unconditional results in Table 2. These make clear that there were consistent differences between firms in treated and untreated sectors and firms in treated and untreated regions. Firms eligible for the credit policy were less productive, less likely to be government owned, and used less inputs. Firms eligible for the tax-break policy were also less productive, less likely to be government owned, and consumed more inputs, but they had higher wage bills than those ineligible. Comparison with the post-treatment period suggests that these differences were largely unaltered. The key difference is that both book and machinery capital is now significantly higher for firms treated by either policy, suggesting the policy successfully improved capital levels, but not TFP. Given the existence of systematic pre-policy differences, we control for firm fixed-effects throughout, and discuss the other necessary assumptions below.

3.3. Identification

Our empirical strategy is to assess the impacts of credit and tax break arms of the policy using a Difference-in-Difference and Triple Difference type strategy. This necessitates the normal assumptions of ignorability, parallel trends, and SUTVA. In the context of the *credit* policy, ignorability requires that our estimates of the policy's effectiveness are not biased due to how the treated areas were chosen. In particular, to be sure that they are not biased upwards, we need to be sure that the policy was not targeted at firms most likely to benefit from it. Similarly, to avoid the concern of Rodrik (2009) that estimates may be biased downwards because aid goes to firms that most need it, we must be sure that the policy was also not targeted on this basis. Inspection of the policy proclamation (Ministry of Finance and Economic Development (2002)) shows that the overall objective of these measures is clear: it is to increase the linkages between agriculture and industry; to increase employment, and to increase exports. Thus, the sectors targeted were chosen solely on the basis of whether they make use of Ethiopian agricultural produce, or are labour intensive. It is clear that all of the targeted sectors; Meat and Leather, Textiles, Agro Business, and Construction fit this description. Thus, whilst the government must be keen to boost productivity there is no evidence that the choice of targeted sectors was made on the basis of maximising TFP growth. Indeed, such a strategy of 'picking winners' is always fraught with difficulty, and particularly so given the context of Ethiopia at the turn of the century. Moreover, the reverse strategy of supporting losers is not consistent with the Ethiopian political context, or affordable given its budget constraints.

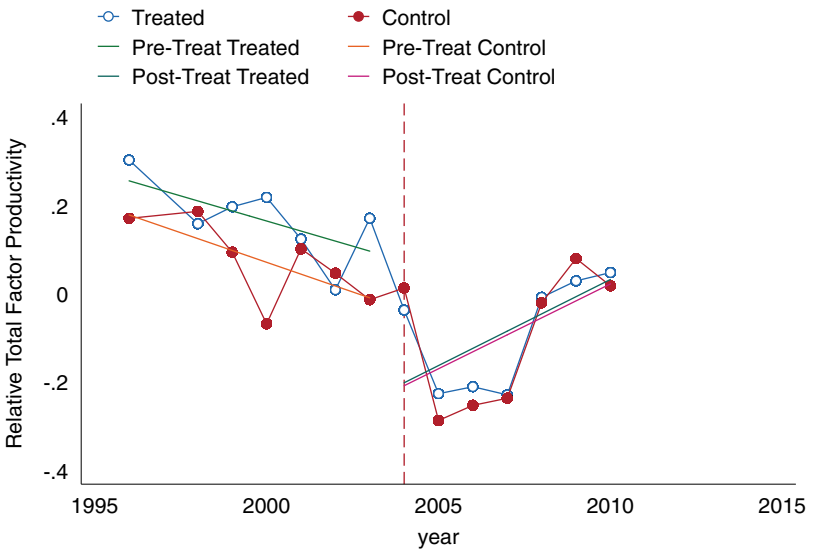

Figure 1. Trends in average productivity for treated and non-treated sectors pre- and post-treatment.

If there are not systematic differences between treated and untreated sectors then the parallel trend assumption should be met. We test this in the conventional way by plotting in Figure 1 the pre-treatment trends in average productivity for treated and untreated sectors to verify that the parallel trends assumption is valid. We can see both the overall trend pre and post treatments are indeed parallel, although the two series have different dynamics there is nothing that calls the parallel trends assumption into question.[5] Notable, however, is the substantial drop in average productivity around the time of the treatment, with a consistent decline before that. This drop is similar across treated and untreated sectors and potentially reflects substantial increases in commodity prices during that period. We address this in our regression specification by including year-fixed effects to capture the average effects of changes in the macroeconomic environment. Any concern that our findings are driven by the basis on which the Ethiopian government chose which sectors to target, or other sources of correlation are assuaged by the results of robustness checks including a variety of richer specifications and estimating each treated sector. Finally, the SUTVA assumption may be violated if there are spillover effects from treated to untreated firms violating the SUTVA assumption. Indeed, such spillovers may be part of the rationale for IP. However, as described below we are able to test for existence of these spillovers and are able to rule out any large effects of this type.

In the case of the *tax-breaks* policy, ignorability is the key concern. An obvious way in which this assumption may be violated is if there were sorting of firms around the 100 km threshold, or that more distant firms are systematically different (and hence the geographic arm of the policy). Inspection of a map of the region around Addis Ababa shows that the 100 km threshold is outside of the city and of no obvious geographical importance – it clearly reflects the usual preference for round numbers than any particular economic or geographic reality. Our distance data are non-continuous (as may be seen in Figure 2) and this precludes the use of the local linear regression as in a formal McCrary (2008) type test.[6] Instead, Figure 2 provides alternative informal evidence for this claim, by plotting, both a kernel density estimate and a histogram of the number of establishments by distance from Addis Ababa. Note that we use the square-root of the distance as the distance describes the radius of a circle and we should expect, other things equal, the number of firms to increase linearly in area not distance. We can see that there are indeed no firms on the boundary and no obvious pattern either side. There are also relatively few firms near the threshold that might be expected to relocate. Secondly, property rights are technically all held by the Government in Ethiopia and thus the opportunity of firms to relocate is

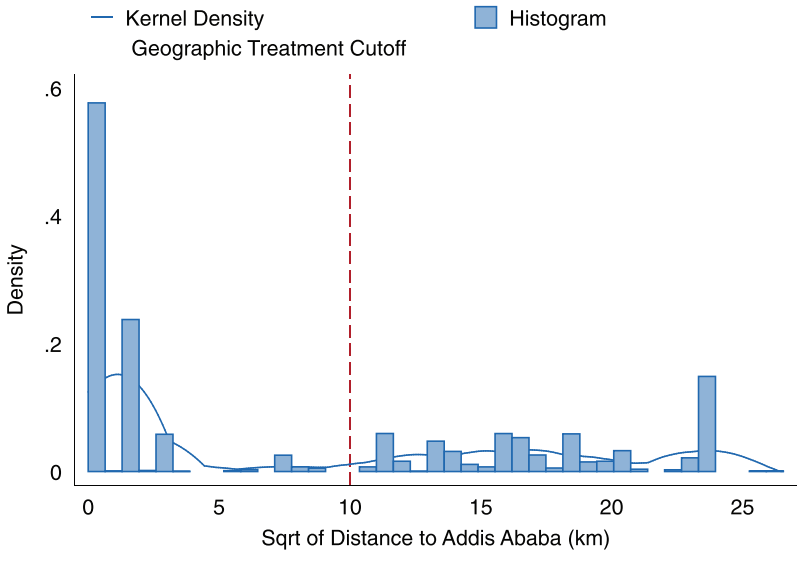

Figure 2. McCrary-type plot of establishment density and distance from Addis Ababa.

extremely limited. Thus, there is no reason to suspect that the choice of threshold geographic threshold was endogenous. Finally, one might be concerned that the firms subject to the tax-breaks are systematically different. There is little reason to believe this to be the case as most firms are engaged in low value added production using homogenous agricultural produce as inputs. Moreover, as discussed, below our regression specification will include firm-fixed effects and in the Appendix show that our results are robust to controlling for region-specific time trends. Thus, for substantive reasons and on the basis of diagnostic tests, we are confident that we are able to obtain causal estimates.

Given these estimates, the effect of the policy can be recovered by regressing our productivity estimates on dummy variables describing the two arms of the policy described in Section 2, and their interaction. We augment this regression with firm and year-fixed effects, and a vector of time-varying controls. Thus, our benchmark specification is:

$$y_{ijt} = \tau_0 d_t + \tau_1 (d_i \cdot d_t) + \tau_2 (d_j \cdot d_t) + \tau_3 (d_i \cdot d_j \cdot d_t) + \beta \mathbf{X_{ijt}} + \mu_i + \lambda_t + \epsilon_{ijt}, \tag{8}$$

where y_{it} is the productivity estimated above and later will alternatively be employment, investment and product diversification. d_t captures the introduction of the policy and is defined as $d_t = \mathbf{1}[year \geq 2002]$. The credit policy is captured with $d_i = 1[s \in \{Agroindustry, Construction, MeatandLeather, Textiles\}]$. The tax-breaks policy is given by $d_j = \mathbf{1}[distance \geq 100]$. $\mathbf{X_{it}}$ is a vector of controls discussed below. Note that we cannot disentangle the average effect of sector and location d_i and d_j from the firm fixed effects. Nor, since firms do not change sectors can we estimate the effect of their interaction $(d_i \cdot d_j)$. Thus, the coefficients of interest are the difference in difference estimates: τ_1, τ_2, and particularly the triple difference estimate: τ_3. Similarly, τ_0 will be conflated with λ_t. If, as indicated in Section 2 the policy has been successful we expect positive and significant coefficients. To allow for autocorrelation our standard errors are clustered by firm, as discussed below our results are robust to clustering by treatment.

4. Results

This section begins by showing that the empirical evidence suggests that there was no productivity improvement associated with the policy. We then demonstrate the reasons for this result. We begin by showing the effects of how the entry of new firms lowered average productivity, and moreover, that these additional firms only generated limited agglomeration externalities. We then show the

Table 3. The effects of the policy on total factor productivity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
	All	Prexisting	Single Product	Firms	Quadratic	Output	Private	New	
τ_1 : Credit	− 0.08	− 0.06	− 0.08	− 0.06	− 0.12 **	− 0.13 **	− 0.27 ***	− 0.04	
	(0.08)	(0.07)	(0.08)	(0.21)	(0.05)	(0.05)	(0.10)	(0.08)	
τ_2 : Tax−breaks	0.05	− 0.03	0.00	− 0.20 *	− 0.00	− 0.01	− 0.05	− 0.02	
	(0.08)	(0.05)	(0.06)	(0.12)	(0.04)	(0.04)	(0.07)	(0.05)	
τ_3 : Tax−breaks & Credit	− 0.06	− 0.00	− 0.06	0.04	− 0.03	− 0.02	0.03	− 0.00	
	(0.10)	(0.10)	(0.12)	(0.26)	(0.07)	(0.07)	(0.11)	(0.11)	
$\beta^{\Delta}_{\tau_1}$									0.14
									(0.77)
$\beta^{\Delta}_{\tau_2}$									0.18
									(0.65)
$\beta^{\Delta}_{\tau_3}$									0.40
									(0.52)
Observations	12,262	6774	3882	1291	6774	6774	6774	5692	10,721

All results are from the estimator of Ackerberg, Caves, and Frazer (2015) which includes firm and year-fixed effects. Column 2 restricts the sample to firms producing only a single product. Column 3 restricts the sample to pre-existing firms. Column 4 uses a second degree polynomial rather than the alternative of a 3rd degree. Column 5 uses Output instead of Sales as the dependent variable. Column 6 restricts the definition of Capital to include only production equipment, Column 7 excludes firms owned by the government. Wald(CRS) reports the p-value of the null hypothesis that the estimated production function exhibits constant returns to scale. Robust standard errors are in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01

other ways in which the policy altered (existing) firms' behaviour shedding light on why we find no positive effect on existing firms. We see that the policy led to additional diversification in existing firms, also lowering productivity. We then drill down in to the form of the additional capital investments caused by the policy, and relate these to the volatile economic environment. In doing so we note that the policy is also unsuccessful if success were defined in terms of employment or capital growth as in Busso, Gregory, and Kline (2013) or Gobillon, Magnac, and Selod (2012).

4.1. Effects on productivity

The results are presented in Table 3. Column 1 shows the effect of the policy on all firms. We see that there is no evidence for any effect of the credit policy, either in those areas also eligible for the tax breaks or elsewhere as each of τ_1, τ_2 and τ_3 are insignificant. However, the interpretation of these results is complicated by the conflation of firms that pre-date the policy and those that do not.

Column 2 reports results for our preferred sample of pre-existing firms. Our estimates of the effects of the credit and tax break policies are both close to zero. Moreover, given the estimated standard errors, we are able to rule out large effects of the policy. The 95% upper confidence limits $U(\tau)$ for Column 1, are $U(\tau_1) = 0.20$, $U(\tau_2) = 0.08$, and $U(\tau_3) = 0.10$.[7] This is important as it implies that the policy was genuinely ineffective. That is we find a precisely estimated zero effect. If it were the the case that our estimates were large, but noisy, then we may have been concerned that this noise reflected heterogeneity or measurement error, and that the true effect of the policy was substantial. Here, we may be confident that is not the case. As elsewhere, these results are robust to alternatively clustering standard errors by Zone to allow for unrestricted spatial correlation across geographic units.

Our preferred specification in Column 2 is not a particularly demanding one, deliberately so to avoid concerns that the lack of evidence of a positive effect of the policy reflects us asking too much of the data. However, we obtain similar results from more demanding specifications, discussed in Appendix A.

Column 3 reports results considering only single-product firms *à la* De Loecker et al. (2016). Again, we find no evidence that either the credit or tax break policies were effective. Below we find that the tax breaks led to increased diversification, suggesting this may have been a key mechanism through which it improved productivity. If this is the case, and given that it does not apply to single product firms, it is perhaps less than surprising that our estimates suggest the policy was ineffective.

Columns 4-7 report results for the same specification as Column 2 with the alternative measures of TFP as the dependent variable introduced above. In each specification τ_2 and τ_3 are again small and insignificant. These alternative specifications suggest some evidence of a negative estimate of τ_1 of between -0.12 and -0.27. This would be consistent with existing firms diversifying into additional, less productive, products perhaps trading efficiency for lower risk. However, the results in Table A.2 show that this result is not robust to alternative, more demanding specifications, and thus we do not pursue this argument further.

Other results are also in line with our expectations. *Government Ownership* measures the impact, given our fixed effects, of becoming government owned. The effect is positive but and relatively large at around 43%.[8]

Decrease in productivity due to entry

We now consider the policy's extensive margin: its inducement of entry by new firms. A key prediction of the theory of change in Section 2.1 is that a reduction in the tax rate will allow firms to enter the market that would have otherwise been unprofitable. It further predicts that unless agglomeration externalities are large then average TFP will fall. That is, while the policy will increase output due to the entry of new firms that because the new firms are on average less productive than existing ones the effect of the policy on TFP through the extensive margin will be negative.

To test this we develop an estimator of the effect of new firms on average productivity. To do this, we note that this will be the difference between the effect of the policy on TFP measured on all firms, and the effect just on existing firm as in our previous estimates. Thus, we can obtain it by suitably computing both estimates and calculating the difference. We denote these differences, $\beta^{\Delta}_{\tau^1}$, $\beta^{\Delta}_{\tau^2}$, and $\beta^{\Delta}_{\tau^3}$ respectively. We provide a formal statement of our approach in Appendix F, but it amounts to taking the difference between estimates based on only pre-existing firms and those including entering firms. Standard errors are obtained via the bootstrap.

Column 8 of Table 3 presents the results of and shows that the credit policy led to the entry of new firms that were much less productive than the incumbents. There is no effect of the tax breaks, but new firms that were eligible for both credit and tax-breaks were significantly more productive than firms only eligible for cheap credit.

Note that whilst productivity has not increased, output has. In the long-run, the presence of additional low-productivity firms may eventually impede growth, but the associated increase in output may be important in the short-run. However, the cost estimates presented in Section 5 suggest that this output increase has come at a substantial fiscal cost.

Indirect increases in productivity due to spillovers

As discussed in our theory of change, one margin on which IP might improve productivity is through spill-over effects. For example, more or larger companies operating in an industry locally may mean there are more innovations to emulate. This is especially true in Ethiopia where production techniques are improving rapidly from a low base.

We estimate the extent of agglomeration externalities by measuring the effects of the presence of treated firms on those local in untreated sectors. Using the precise locations of firms, we can contrast productivity growth in untreated sectors in those Zones with few treated firms to those with more. We use Zones as our unit of analysis, to ensure that the number of geographic units is sufficiently small compared to the number of firms, as firms tend not to be located in very rural areas this choice loses little information.[9] For each nontreated firm we compute the the number of treated firms in the

Table 4. Why did the policy have no effect?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TFP	TFP	Divers	Book Capital	MPK	$\frac{\text{Machinery}}{\text{Capital}}$	$\frac{\text{Machinery}}{\text{Capital}}$	Prod. Labour
Number of treated firms in Zone	0.07	0.03						
	(0.05)	(0.03)						
τ_1 : Credit			0.01	0.20**	0.00	− 0.05***		− 0.12***
			(0.01)	(0.09)	(0.00)	(0.02)		(0.04)
τ_2 : Tax−breaks			− 0.01**	− 0.16**	0.00	0.07***		− 0.04
			(0.00)	(0.07)	(0.00)	(0.02)		(0.03)
τ_3 : Tax−breaks & Credit			− 0.01	0.15	− 0.00	− 0.04		0.04
			(0.01)	(0.14)	(0.00)	(0.03)		(0.06)
(log) Total Book Capital							− 0.03***	0.10***
							(0.00)	(0.01)
$\sigma^2(\ln(ToT))_i$							− 0.01***	
							(0.00)	
Observations	1983	1270	6774	6154	6154	5761	7772	5761

Machinery is equipment directly used in the manufacturing process. Prod. Labour are workers directly involved in the production process. $\sigma^2(\ln(ToT))_i$ is the volatility of the ratio of each firm's sales price index to its input price index as defined in (10). All other details are as for Table 3.

same Zone, N_{zt}, and standardise for ease of interpretation. We restrict the sample to those areas which did not receive the tax-break treatment and to firms not in sectors treated by the credit policy, for the post-treatment period. Thus, we are comparing the productivity growth of untreated firms near a greater or lesser number of treated firms. Thus now we are obtaining identification from the variation within the *credit* policy. The identification assumption, given that we include firm-fixed effects, is that the number of treated firms in a given Zone $\times$ year is not caused by the productivity growth of an individual untreated firm. There is no reason not to think this is true given that we are focussed on small and medium-sized firms, and treated sectors do not use the produce of untreated firms as inputs.

To capture other sources of productivity growth we include region-specific time trends, ψ_{rt}, and a vector of controls $\mathbf{X_{it}}$ as in (8). Standard errors are clustered by Zone. Our regression model is then:

$$y_{it} = \kappa N_{zt} + \beta \mathbf{X_{it}} + \Psi_{rt} + \mu_i + \epsilon_{it}. \tag{9}$$

Looking at Column 1 of Table 4 we see there is some evidence of a agglomeration externalities on on firms in untreated sectors. Specifically, a 1 standard deviation increase in the number of treated firms increases the productivities of firms in other sectors by 7%, although this is not significant at conventional levels it is suggestive. However, when we exclude entering firms in Column 2, the estimated effect is slightly smaller and relatively less precise. Thus, whilst there is evidence that agglomeration externalities lead to faster productivity growth in entering firms, there is no evidence that these would be sufficient to offset the deleterious effects of the policy on average productivity. There are several reasons why spill-over effects may not be larger. For example, it may be that local markets could not absorb additional production, or that the low existing density of manufacturing firms limited agglomeration externalities.

Decreases in productivity due to diversification

One important way in which firms grow is through diversification (Berry 1971). The model does not differentiate between new products produced by existing firms and new firms, suggesting that the policy will lead to firms diversifying reducing average productivity. On the other hand, given that the production function estimates in Table 2 suggests decreasing returns to scale, the same logic would suggest diversification could lead to an improvement in productivity. We measure diversification using a Herfindahl index. Let p_{itj} denote the share of product j of the output of firm i in year t. Then, Diversification is calculated at the firm level as $Divers_{it} = \sum_j p_{itj}^2$. Column 3 reports the results of

estimating a similar specification as in (8) except now $Divers_{it}$ is the dependent variable. We find that τ_2 is negative and significant suggesting that one consequence of the policy, was to increase diversification. As above, this may account for the growth in productivity due to the tax-break policy observed in Table 3, and that it is only found in multi-product firms.

4.2. Effects on capital

We have now seen that the policy was unsuccessful in encouraging productivity growth. We have also seen that this is because as predicted by our theory of change, the new firms were less productive, and there were insufficient spillovers to offset this. We now consider the key mechanism by through which the policy operated – the provision of cheap capital. We find evidence for the key causal mechanism through which the policy was intended to operate: the provision of tax breaks and subsidised loans did indeed increase capital levels. However, our theory of change suggests that increases in capital should be accompanied by increases in employment. But, this was not the case. Analysing detailed information on firms' assets we find that the additional capital was often invested in buildings or vehicles rather than new machinery necessary for greater or more efficient production. Furthermore, we show, by constructing firm-specific price-volatility indices that this can be understood as a hedge against inflation and changes in market conditions given rampant inflation and a dynamic but challenging business environment. We then show, that as suggested by the theory, the lack of investment in productive assets limited employment growth due to the policy.

Direct increases in capital due to subsidies

We expect treated firms will increase investment as the policy lowers the cost of capital. Column 4 of Table 4 reports the results of again estimating (8); but, now with firms' total book capital on the left-hand side. The results suggest very different impacts of the tax breaks compared to credit policy. The tax-break policy led to a reduction in firms' capital by 16%, while the effect of the credit policy suggests that it increased it by around 17%. Then total effect for those firms treated by both arms of the policy, is an increase of 17% ($\tau_1 + \tau_2 + \tau_3 = 0.17 - 0.16 + 0.16 = -0.17$) but again, τ_3 is not significant.

One explanation for the negative effect of the tax breaks is that given the tax breaks firms' owners preferred to take additional dividends rather than reinvest profits. Perhaps, because the tax regime had previously led them to accumulate excess or unproductive capital. This suggests that the credit policy was more effective at increasing capital levels. This highlights the challenges faced by policy-makers in designing effective IP.

Increases in capital are not invested in machinery

Column 5 reports that despite the increases and reductions in Book Capital that the estimated effect on the Marginal Product of Capital is small and imprecise; this is surprising as we would expect that a large increase in the capital stock should be reflected in a decrease, other things equal, in the marginal product (and vice versa).[10] Column 6 reports estimates with the ratio of machinery to overall capital on the left-hand side and documents that the credit policy led to a decrease in this ratio. This implies that new investments occasioned by the policy were in other forms of capital such as buildings and vehicles. Why might firms prefer not to invest in additional machinery? One explanation is that whilst they are keen to benefit from the subsidised loan, especially as high inflation rates mean the real interest rate is negative, that they adopt a portfolio approach and choose to diversify their risk. By buying buildings and vehicles they are investing in assets that whilst offering a comparatively low return are weakly correlated with the profitability of their current product lines. Such a strategy makes most sense; however, if a firm is particularly uncertain about its future. One feature of the business environment for the firms we study is rapidly changing input prices and shifting demand. It also explains why the additional tax breaks reduced capital levels – entrepreneurs used them as an opportunity to reduce the share of their wealth accounted for by

their business. They instead took the funds as additional profits or reinvested in vehicles, for instance. The consequences of uncertainty about the future are magnified by the lack of of an effective bankruptcy procedure or a system of limited companies, meaning individuals are disinclined to take risks with borrowed capital.[11]

We take the hypothesis that the lack of productive investment is due to uncertainty to the data by calculating firm-year specific 'terms of trade' indices. Specifically, we calculate a price index for the input prices for each of the four best-selling products, as well as a price index for their sales price. We define the 'terms of trade' as the ratio of the sum of these indices across the four products:

$$ToT_{it} = \frac{\sum_k SalesPriceIndex_{it}^k}{\sum_k InputPriceIndex_{it}^k} = \frac{\frac{\sum_{d=1}^4 Q_{j0}^d P_{kit}}{\sum_{k=1}^k P_{i0}^d Q_{i0}^d}}{\frac{\sum_{k=1}^k Q_{j0}^d P_{kit}}{\sum_{k=1}^k P_{i0}^d Q_{i0}^d}}. \tag{10}$$

We then compute the a (time-invariant) firm-specific measure of uncertainty as the variance for each firm of the 'terms of trade'. That is, $\sigma^2(ToT_i)$ We do not adjust for quantities sold of these products to avoid potential endogeneity bias due to responses in production decisions due to changes in prices or vice versa. We then estimate the following regression, where we control for total capital to allow for the fact that organisations of different sizes:

$$\frac{\ln(machinery)_{it}}{\ln(bookcapital)_{it}} = v\sigma^2(\ln(ToT))_i + \beta \ln(bookcapital)_{it} + \epsilon_{it}. \tag{11}$$

The results are reported in Column 7. In line with our hypothesis we find that the ratio of capital in machines, etc., to total book capital is lower when uncertainty, as measured by $\sigma^2(ToT_i)$, of a particular firm is higher. This highlights the challenges in designing successful IP – this behaviour is the upshot of several interrelated features of the particular context. Firstly, the high-growth high-inflation environment means that firms will seek to avoid holding cash whilst being willing to incur debt. Second, entrepreneurs will be more risk-averse due to the lack of effective bankruptcy protection.

4.3. Effects on employment

The final outcome variable we consider is employment. The theoretical framework discussed above suggests that the firm-level effects of the IP on employment will depend on the relative magnitudes of the substitution and scale effects. Column 8 of Table 4 shows that the credit policy led to a reduction in employment, other things equal. The positive and significant coefficient on (log) Total Book Capital suggests that this may reflect a substitution effect away from labour to capital. τ_3 is positive, although insignificant, suggesting that this effect is concentrated on regions not subject to the tax-break policy.

5. The cost of the policy

Rigorous policy evaluation techniques are by now routinely applied to assessing the effectiveness of different forms of aid at both a macroeconomic level, and also at the level of individual policies. Many development agencies and charities are committed to funding projects only based on evidence that they represent value for money. This suggests that IP should be evaluated on a similar benefit–cost basis. Given that we find little evidence of any positive effects of the policy, we could assume the policy had no benefits and focus on its costs. Instead, more conservatively, we prefer to assume the policy had the maximum plausible impact – the maximum of the 99% confidence interval of each of τ_1, τ_2, τ_3 (i.e. we take a point on the bounding set of the confidence ellipsoid). Thus, we evaluate the policy on the premise, that contrary to our results, it achieved an

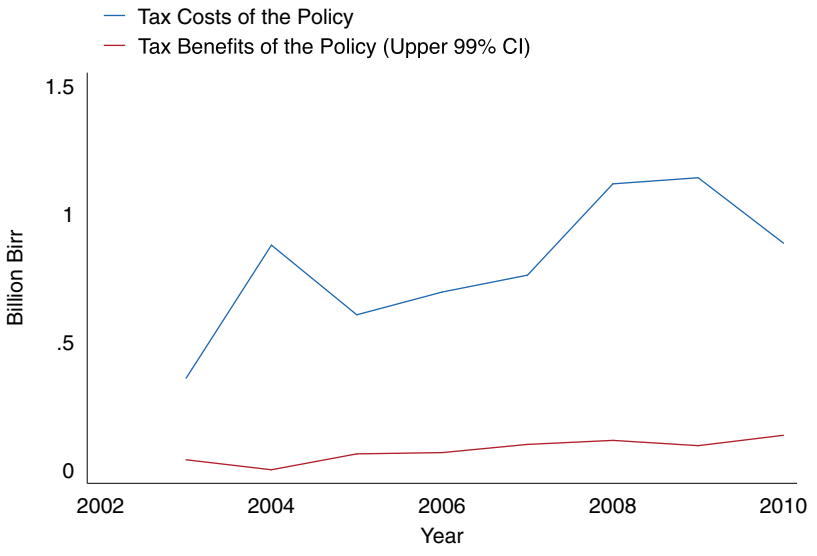

Figure 3. The tax costs of the policy.

83% increase in TFP. We also take into account the increase in output, and hence the tax base, due to additional entry of firms due to the policy. We do this by comparing the number of firms that entered in treated sectors to untreated sectors and use the difference as the number of firms caused by the policy. Again conservatively, we assume that all of the additional new firms in treated sectors are because of the policy. One might consider that there is an additional benefit beyond immediate changes in output from inducing workers to move from low productivity agricultural work to higher productivity occupations in the manufacturing sector. This is hard to measure, but should be captured one and another by our optimistic calculations of the benefits and conservative calculations of the costs. Certainly, it should not be larger than the increase in output that we optimistically assign as a benefit to the policy. Following the the arguments in Section 2.1, and the results in the previous section, we assume that the least productive entrants are those induced by the policy. Thus, following the notation in Section 2.1, the profit of firm i is Π_i. Denote the set of existing firms as X and the set of additional entering firms as E, gains from the policy in year t, G_t are given by:

$$G_t = \gamma_1^t \left\{ \sum_{i \in X} \Pi_{it} - \frac{\sum_{i \in X} \Pi_{it}}{1 + \Phi^{-1}(0.995)(\tau_1 + \tau_2 + \tau_3)} + \sum_{i \in E} \Pi_{it} \right\} \tag{12}$$

where γ_1 is the tax rate for firms treated by the policy and γ_0 is the tax rate without it. We take a similarly conservative approach to the costs of the policy. We focus only on the loss of tax revenue although this focus will understate the cost of the policy substantially as it ignores the costs of concessionary loans and the investment in sector-specific training and technology transfer programmes. In particular, the costs of the loans will be substantial, given real interest rates were far below zero. We ignore both of these other costs as the cost of the loans will depend on future delinquency rates as well as future inflation, and there is no data on the costs of training and technology transfer. Costs are given by the loss of tax revenues on existing firms:

$$C_t = (\gamma_0 - \gamma_1) \sum_{i \in X} \Pi_{it}. \tag{13}$$

Figure 3 plots the lost tax receipts due to the policy – the blue line – and the additional tax due to TFP growth and firm entry – the red line – by year. The cost ranges from $ 39.4 Million (358 Million Birr) to over $ 121 Million (1100 Million Birr). Put differently, the average cost over the period was 0.5% of GDP or 5% of total Government spending. The benefits, meanwhile, even taken at the 99% Confidence Interval, are less than 10% of the costs. Given that the manufacturing sector only accounts for 5% of Ethiopian GDP and that these numbers are very much lower bounds on the costs and upper bounds on the benefits, this is a substantial stimulus. This highlights the high-stakes nature of IP: whilst potentially transformative the costs are also substantial, both in fiscal terms, and also in terms of investments in health, education, and/or infrastructure forgone. Given this scale, it is hard to credit the lack of success of Ethiopia's development strategy to a lack of ambition or insufficient courage.

6. Conclusion

Industrial policy is ubiquitous both in more and less-developed countries. But its goal in rich countries, tacitly the redirection of economic activity to poorer populations and regions, is easier to achieve than those of accelerated or sustained growth in LICs. One reason for this is that tax breaks or subsidised loans, designed to encourage investment, will encourage entry by previously non-viable firms. On the other hand agglomeration externalities, for instance, may lead to a virtuous upwards spiral. To investigate this possibility, this paper analysed the causal effects of a policy typical of modern IP in LICs. Exploiting detailed firm-level data for the universe of Ethiopian manufacturing firms, we find that the policy was ineffective in raising productivity. Any gains in productivity due to the policy were more than offset by the lower quality of entering firms.

An interesting question for future research is whether the success of the programme we study was determined by the prevailing macroeconomic climate. In 2002 the Ethiopian economy contracted by 2.2%, albeit rebounding strongly in 2003 with growth of 13.6%. Given our findings that firms in more volatile sectors were less likely to invest in machinery, perhaps in the absence of the initial recession firms would have behaved differently and the policy may have been more successful. It would be interesting for future research to compare the success of IP as a function of overall economic conditions or investors' confidence.

It would also be interesting for future research to evaluate a similar policy over a longer time horizon. As it is, we cannot explicitly rule out that there were not longer term-positive effects of the policy. For example, one possibility is that – despite their average productivity being lower – in the fullness of time a subset of the firms that entered due to the policy grow larger and more productive creating positive spillovers.

One limitation of our approach is that we are unable to address the possibility that the sectors and regions eligible for the policy could have been chosen reasons other than those stated. It would be valuable for future work to use an RCT approach so that the selection mechanism is explicitly controlled. However, we don't believe this is a substantial problem here. This is firstly because the policy is similar to that in other SSA countries, and as was promoted by NGOs at the time (Table C.1). Secondly, because if the implementation of the policy was systematically affected by other factors then we should not expect to the results robust to additional geographic or sectoral controls. Nor would we expect to find effects, such as increases in capital, consistent with the policy operating as intended. An RCT would also ensure there were no baseline differences between firms which would simplify inference.

Notes

1. IP could also be effective if it led to growth through the reallocation of capital to more productive activities. In Section 4 we test for this and find no evidence of such effects.

2. For a comprehensive discussion of Ethiopian IP see Oqubay (2015, 2019a,b), Shiferaw and Söderbom (2019).
3. Additionally, firms in the Agro-industrial sector were also able to lease land at a concessionary rate.
4. The details of this support are described in the Section G of the Appendix.
5. A regression based test suggests there is no significant difference between the two.
6. See, Lee and Card (2008).
7. Note, our failure to find an effect does not represent a lack of power given our sample size and also because we work with the Universe of small and medium manufacturing firms.
8. We obtain similar results excluding *Government Ownership* as reported in Column 1 of Table A.3.
9. We provide a precis of Ethiopian administrative geography in Appendix H.
10. This results also suggests that the policy is not encouraging growth by reallocating capital. If it were we would expect a large positive and significant coefficient here.
11. As discussed by Lencho (2008), Ethiopian Law does provide a Bankruptcy procedure; but, the law has rarely been applied since 1960, and most lawyers are unfamiliar with it.

Acknowledgments

We thank Martin Foureaux Koppensteiner, Sourafel Girma, Jesse Matheson, Jochen Mierau, and Jonathan Temple for their comments. We also thank seminar participants at the CSAE Conference 2015; the 13th International Conference on the Ethiopian Economy; Royal Economic Society Sussex; Leicester; Nottingham; Queen's Belfast; Sheffield; and the Centre Emile Bernheim, Solvay Brussels School. Any errors are ours alone.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Ackerberg, D. A., K. Caves, and G. Frazer. 2015. "Identification Properties of Recent Production Function Estimators." *Econometrica* 83 (6): 2411–2451. https://www.econometricsociety.org/doi/10.3982/ECTA13408 .

Aghion, P., J. Cai, M. Dewatripont, L. Du, A. Harrison, and P. Legros. 2015. "Industrial Policy and Competition." *American Economic Journal: Macroeconomics* 7 (4): 1–32. http://ideas.repec.org/p/nbr/nberwo/18048.html.

Barro, R. J. 1990. "Government Spending in a Simple Model of Endogeneous Growth." *Journal of Political Economy* 98 (5): S103–S125. http://www.jstor.org/stable/2937633?seq=1{#}page{_}scan{_}tab{_}contents .

Berry, C. H. 1971. "Corporate Growth and Diversification." *The Journal of Law and Economics* 14 (2): 371–383. doi:10.1086/466714.

Blonigen, B. A. 2015. "Industrial Policy and Downstream Export Performance". *The Economic Journal*. http://ideas.repec.org/p/nbr/nberwo/18694.html

Busso, M., J. Gregory, and P. Kline. 2013. "Assessing the Incidence and Efficiency of a Prominent Place Based Policy." *American Economic Review* 103 (2): 897–947. doi:10.1257/aer.103.2.897.

Chaurey, R. 2017. "Location-based Tax Incentives: Evidence from India." *Journal of Public Economics* 156: 101–120. doi:10.1016/j.jpubeco.2016.08.013.

Criscuolo, C., R. Martin, H. Overman, and J. Van Reenen. 2016. "CEP Discussion Paper No 1113 January 2012 the Causal Effects of an Industrial Policy."

De Loecker, J. 2011. "Product Differentiation, Multiproduct Firms, and Estimating the Impact of Trade Liberalization on Productivity." *Econometrica* 79 (5): 1407–1451. http://wiley.com/10.3982/ECTA7617.

De Loecker, J., P. K. Goldberg, A. K. Khandelwal, and N. Pavcnik. 2016. "Prices, Markups, and Trade Reform." *Econometrica* 84 (2): 445–510. http://www.nber.org/papers/w17925.

Deaton, A. 1985. "Panel Data from a Times Series of Cross-Sections." *Journal of Econometrics* 30: 109–126. doi:10.1016/0304-4076(85)90134-4.

Gebreeyesus, M., and P. Mohnen. 2013. "Innovation Performance and Embeddedness in Networks: Evidence from the Ethiopian Footwear Cluster." *World Development* 41 (1): 302–316. doi:10.1016/j.worlddev.2012.05.029.

Giorcelli, M. 2019. "The Long-Term Effects of Management and Technology Transfers." *American Economic Review* 109 (1): 121–152. doi:10.1257/aer.20170619.

Gobillon, L., T. Magnac, and H. Selod. 2012. "Do Unemployed Workers Benefit from Enterprise Zones? The French Experience." *Journal of Public Economics* 96 (9–10): 881–892. doi:10.1016/j.jpubeco.2012.06.003.

Goldberg, P. K., A. Kumar Khandelwal, N. Pavcnik, and P. Topalova. 2010. "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India." *The Quarterly Journal of Economics* 125 (4): 1727–1767. doi:10.1162/qjec.2010.125.4.1727.

Greenstone, M., R. Hornbeck, and E. Moretti. 2010. "Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings." *Journal of Political Economy* 118 (3): 536–598. doi:10.1086/653714.

Kline, P., and E. Moretti. 2014. "Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennesse Valley Authority." *The Quarterly Journal of Economics* 129 (1): 275–331. doi:10.1093/qje/qjt034.

Lane, N. 2017. "Manufacturing Revolutions

Lee, D. S., and D. Card. 2008. "Regression Discontinuity Inference with Specification Error." *Journal of Econometrics* 142 (2): 655–674. doi:10.1016/j.jeconom.2007.05.003.

Lencho, T. 2008. "Ethiopian Bankruptcy Law: A Commentary (Part I)." *Journal of Ethiopian Law* XXII (2): 57–95.

Levinsohn, J., and A. Petrin. 2003. "Production Functions Estimating to Control for Using Inputs Unobservables." *The Review of Economic Studies* 70 (2): 317–341. doi:10.1111/1467-937X.00246.

Liu, E. 2017. "Industrial Policies in Production Networks." https://www.ssrn.com/abstract=2962695.

Marti, D. F., and I. Ssenkubuge. 2009. *Industrialization and Industrial Policy in Africa: Is It a Policy Priority*. Technical Report 20. South Center.

Martin, L. A., S. Nataraj, and A. E. Harrison. 2017. "In with the Big, Out with the Small: Removing Small-Scale Reservations in India." *American Economic Review* 107 (2): 354–386. http://pubs.aeaweb.org/doi/10.1257/aer.20141335.

Mbate, M. 2017. "Structural Change and Industrial Policy: A Case Study of Ethiopia's Leather Sector." *Journal of African Trade* 3 (1–2): 85. doi:10.1016/j.joat.2017.01.001

McCrary, J. 2008. "Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test." *Journal of Econometrics* 142 (2): 698–714. doi:10.1016/j.jeconom.2007.05.005.

Ministry of Finance and Economic Development. 2002. *Sustainable Development and Poverty Reduction Program*. Technical Report. Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia.

Moffitt, R. 1993. "Identification and Estimation of Dynamic Models with a Time Series of Repeated cross-sections." *Journal of Econometrics* 59 (1–2): 99–123. doi:10.1016/0304-4076(93)90041-3.

Neumark, D., and J. Kolko. 2010. "Do Enterprise Zones Create Jobs? Evidence from California's Enterprise Zone Program." *Journal of Urban Economics* 68 (1): 1–19. doi:10.1016/j.jue.2010.01.002.

Nunn, N., and D. Trefler. 2010. "The Structure of Tariffs and Long-Term Growth." *American Economic Journal: Macroeconomics* 2 (4): 158–194.

Olley, G. S., and A. Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica* 64 (6): 1263–1297. doi:10.2307/2171831.

Oqubay, A. 2015. *Made in Africa: Industrial Policy in Ethiopia*. Oxford University Press. http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198739890.001.0001/acprof-9780198739890.

Oqubay, A. 2019a. "Industrial Policy and Late Industrialization in Ethiopia". In *The Oxford Handbook of the Ethiopian Economy*, edited by F. Cheru, C. Cramer, and A. Oqubay, 604–629. Oxford University Press. http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780198814986.001.0001/oxfordhb-9780198814986-e-31.

Oqubay, A. 2019b. "The Structure and Performance of the Ethiopian Manufacturing Sector". In *The Oxford Handbook of the Ethiopian Economy*, edited by F. Cheru, C. Cramer, and A. Oqubay, 629–650. Oxford University Press. http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780198814986.001.0001/oxfordhb-9780198814986-e-48.

Rodrik, D. 2009. "Industrial Policy: Don't Ask Why, Ask How." *Middle East Development Journal* 1 (1): 1–29. doi:10.1142/S1793812009000024.

Shiferaw, A., and M. Söderbom. 2019. "The Ethiopian Manufacturing Sector Productivity, Export, and Competitiveness". In *The Oxford Handbook of the Ethiopian Economy*, edited by F. Cheru, C. Cramer, and A. Oqubay, 650–668. Oxford University Press. http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780198814986.001.0001/oxfordhb-9780198814986-e-32.

Soderbom, M. 2012. "Firm Size and Structural Change: A Case Study of Ethiopia." *Journal of African Economies* 21 (suppl 2): ii126–ii151. doi:10.1093/jae/ejr046.

Topalova, P., and A. Khandelwal. 2011. "Trade Liberalization and Firm Productivity: The Case of India." *Review of Economics and Statistics* 93 (3): 995–1009. doi:10.1162/REST_a_00095.

Verbeek, M. 2008. "Pseudo Panels and Repeated cross-sections." In *The Econometrics of Panel Data: Fundamentals and Recent Developments in Theory and Practice*, edited by P. S. L. Màtyàs, 3rd ed. Advanced Studies in Theoretical and Applied Econometrics 46, Chap. 11, 369–385. Heidelberg: Springer.

Appendix A. Additional Results

Table A1 reports results additionally including linear time-trends for both policies and their interaction. This approach will capture any violation of the parallel trend assumptions by controlling for any (linear) differences in trends between treated sectors or regions. Comparison with Table 3 shows that the results are qualitatively and quantitatively extremely similar.

Table A2 reports similar results for specifications additionally including geographic fixed effects or time trends for Regions or Zones. Columns 2-4 of Table A3 test whether our results are driven by unaccounted for geographic differences. Firstly, we allow for a direct effect of proximity to Addis Ababa, including a quadratic in the distance in column 2, column 3 includes quadratics either side of the 100 km threshold, in both cases the coefficients are unchanged and the policy estimates are unchanged, perhaps reflecting that firms are not geographically mobile. Another possibility is that there was a growing divergence between rural and urban firms, and we allow for this in column 4. We see that firms in urban areas were less productive after the policy, but allowing for this doesn't alter our main results. Columns 5 and 6 report results including industry specific trends to allow for broader sector specific trends that may be confounding our results, but again there is no difference in our estimates of interest. Column 7 includes both the additional industry and geographical controls simultaneously and again the results are unaffected. Thus, it is clear that we obtain similar results from a much more demanding specification.

Table A1. The effects of the policy on total factor productivity: trends.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
	All	Prexisting	Single Product	Firms	Quadratic	Output	Private	New	
τ_1 : Credit	− 0.08	− 0.08	0.01	− 0.14	−0.08	− 0.09	− 0.42 ***	− 0.12	
	(0.08)	(0.10)	(0.12)	(0.35)	(0.07)	(0.07)	(0.15)	(0.11)	
τ_2 : Tax − breaks	0.05	− 0.03	0.01	− 0.01	−0.06	− 0.06	− 0.30 **	− 0.07	
	(0.08)	(0.09)	(0.10)	(0.30)	(0.07)	(0.07)	(0.14)	(0.09)	
τ_3 : Tax − breaks & Credit	− 0.06	0.01	− 0.07	0.04	0.02	0.01	0.23	0.05	
	(0.10)	(0.12)	(0.14)	(0.34)	(0.09)	(0.09)	(0.16)	(0.13)	
$\beta^{\Delta}_{\tau_1}$									− 0.86
									(0.84)
$\beta^{\Delta}_{\tau_2}$									− 1.60 **
									(0.66)
$\beta^{\Delta}_{\tau_3}$									0.57
									(0.54)
Observations	12,262	6774	3882	1291	6774	6774	6774	5692	6148

τ_0, τ_1, τ_2 and τ_3 are the DDD coefficients defined in (8). All specifications also include linear time trends for both policies and their interaction. Government Ownership is a dummy variable describing whether the firm is state owned. Column 1 contains all firms, both those operational before the policy and those that entered subsequent to it. Column 2 restricts attention only to those that pre-exist the policy. Column 3 considers only firms that make a single-product to avoid the concerns of bias discussed by De Loecker et al. (2016). Column 4 reports results for the same sample as column 2 but using TFP estimates obtained restricting the sample to these firms, and as reported in column 3 of Table 3. Column 5 reports results using TFP estimates with a second degree polynomial rather than one of the 3rd degree. Column 6 uses TFP estimates obtained using Output instead of Sales as the dependent variable, and Column 7 uses estimates for (and restricts the sample to) private firms only. $\beta^{\Delta}_{\tau_3}, \beta^{\Delta}_{\tau_1}$, and $\beta^{\Delta}_{\tau_2}$ are the differences in the productivity of new firms entering due to the policy defined in (F2). Columns 1-7 also include firm and year fixed effects. Standard errors in parentheses are clustered by firm. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2. Alternative estimates of the effects of the policy on productivity.

	(1)	(2)	(3)	(4)
τ_0 : Post2002	0.05	0.06	− 1.35 **	0.08
	(0.09)	(0.09)	(0.67)	(0.13)
τ_1 : Credit	− 0.05	− 0.06	− 0.06	− 0.03
	(0.07)	(0.07)	(0.08)	(0.08)
τ_2 : Tax–breaks	− 0.02	− 0.02	− 0.09	− 0.14
	(0.05)	(0.05)	(0.12)	(0.11)
τ_3 : Tax–breaks & Credit	− 0.00	0.01	0.05	0.06
	(0.10)	(0.10)	(0.12)	(0.13)
Government Ownership	0.05	0.05	0.06	0.06
	(0.10)	(0.10)	(0.11)	(0.11)
Year Effects	Yes	Yes	Yes	Yes
Geography Fixed Effects	No	Region	Region × Year	Zone
N	6714	6714	6714	6092

Notes as for Table 3.

Table A3. Sensitivity tests of the effects of the policy on productivity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
τ_1 : Credit	− 0.06	− 0.07	− 0.07	− 0.05	−0.09	− 0.09	− 0.08
	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)	(0.09)	(0.10)
τ_2 : Tax–breaks	− 0.03	− 0.07	− 0.05	− 0.04	0.00	0.01	0.05
	(0.05)	(0.10)	(0.10)	(0.05)	(0.05)	(0.05)	(0.11)
τ_3 : Tax–breaks & Credit	− 0.00	0.11	0.10	− 0.01	0.03	0.04	0.02
	(0.10)	(0.13)	(0.13)	(0.10)	(0.10)	(0.10)	(0.13)
Government Ownership		0.08	0.08	0.05			
		(0.11)	(0.11)	(0.10)			
Distance from Addis		0.00					0.00
		(0.00)					(0.00)
Distance from Addis^2		− 0.00					− 0.00
		(0.00)					(0.00)
[Distance < 100] × Distance			0.01				
			(0.01)				
[Distance ≥ 100] × Distance			0.00				
			(0.00)				
[Distance < 100] × Distance^2			− 0.02				
			(0.02)				
[Distance ≥ 100] × Distance^2			− 0.00				
			(0.00)				
Post2002 × urban				− 0.09 *			− 0.18 ***
				(0.05)			(0.06)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Trends	No	No	No	No	No	Yes	Yes
Industry Trends	No	No	No	No	Yes	Yes	Yes
N	6774	6179	6179	6774	6774	6774	6179

Notes as for Table 3.

Appendix B Data

The data used in this study were obtained from the Ethiopian Large and Medium Scale Manufacturing Enterprises Census that is conducted annually by the Central Statistics Agency of Ethiopia. It contains the universe, and is hence an unbalanced panel, of firms for 14 years from 1996–2010. Initially, there are close to 600 firms in 1996. By 2010, there are around 1900. The firms are categorised into 54 industrial classification (ISIC) codes. Table I.1 in the Appendix reports the number of firms in each category in 1996 and 2010.

As well as being available for all firms, the data are extremely rich, containing detailed information on both the establishment and ownership details of each firm. We make use of much of this information, and summarise the information we use below:

- **Ownership**: Gender of the proprietors, and the proportion of a firm's capital in public, private, or foreign ownership.

Table B1. Summary statistics (whole sample).

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
Total Factor Productivity	12,174	4.73	1.09	1.16	9.74	4.69
Value of Sales (US36 Millions)	12,174	.22	.89	0	27.25	.02
Production Labour)	12,174	89.43	261.08	0	9103.25	21
Total Capital (US36 Millions)	12,174	.19	.82	0	27.35	.01
Value of Machinery (US36 Millions)	11,833	.06	.33	0	11.94	0
Prod Diversification	12,174	.17	.09	0	1	.16
Competition	12,174	.17	.16	.02	1	.12
Government Owned	12,174	.12	.32	0	1	0
Age	12,174	20.01	17.03	0	99	14

• **Establishment**: Detailed information on the month and year of establishment as well as a firm's initial capital are available.

• **Employment**: Classified by gender, salary group and occupation on a quarterly basis. Information on wages and other benefits for workers is also included.

• **Products**: Data are on up to 12 products. This includes the unit price, beginning stock, production quantity and production value, and we use these data to construct our output index and productivity measures. Data on sales and exports are also available at the product level.

• **Investments**: A firm's assets are aggregated into different categories such as fixed assets, furniture, machinery and vehicles. The levels of each are detailed with the beginning stock, annual changes and ending stock.

• **Intermediate inputs**: These are at the level of the firm rather than the product. They include unit price, quantity, value, source (local versus imported) of the input.

• **Expenses**: Production expenses, such as utilities, energy, and tax, are available at the firm level.

Importantly, as discussed below, these data contain detailed information about both quantities of products produced and the quantities of the inputs used to do so. This unusual level of detail allows us to understand precisely how the policy affected treated firms. Table B.1 provides the usual summary of our key variables pooling over the whole period. In the rightmost column, to provide additional intuition about the complexity, scale, and nature of the manufacturing firms we study, we also describe a particular firm chosen to be representative of the median Ethiopian manufacturing firm.

We can see that the average firm employs 89 people, the median firm only 21. Yet, the Value of Sales is high (mean $0.22 Million (10.35 Million Ethiopian Birr), median $0.02 Million) compared to both the amount of capital (mean, $0.19 Million, median firm $0.01 Million, and even more so compared to the book value of the machinery used which on average is only $0.06 Million, and $3,760 in the median firm. This, along with the high ratio of the Value of Output to the cost of the intermediate inputs, reflects the labour-intensive nature of production. Of the $2,134 capital per worker only around one tenth of that is in machinery, with the rest being inventories of (cheap) raw materials. These small amounts of capital are perhaps more surprising given that these are not small firms, and often they are not new – the sample firm we consider is slightly older than average at 19 years. The oldest firm is by now over a hundred years old, but firms that pre-date the downfall of the Derg will have been previously, and often still are, completely state owned.

Results are for the all firms in all years. TFP refers to the estimated productivity of firms obtained using the estimator of Ackerberg, Caves, and Frazer (2015) as discussed in Section 3. Monetary quantities in millions of USD at an assumed exchange rate of 1USD:45EBR. *Competition* and *Diversification* are calculated as described in Section 4. *Production Labour* is labour directly involved in production, as measured using temporary production workers (who account for almost all employment in our data). *Government Owned* is a dummy for government ownership. To preserve anonymity, the Age of firms is truncated at 99 years as there are only a very small number of older firms.

Appendix C Industrial Policy in Subsaharan Africa

Table 100.1 summarises the structure of the Industrial Policy of a selection of eight SSA countries as described by Marti and Ssenkubuge (2009). The table separates IP into three categories: Trade related policies, the literature on which is discussed below; Sector-Specific-Support, which is the focus of this paper; and inducements for Foreign Direct Investment, itself the subject of a large literature. Each of these policies is then categorised on the basis of whether it has a substantial Tax or Duty/Tariff component, and whether other forms of government support were provided. Considering the table as a whole reveals the broad consistency in the forms of IP implemented in these eight countries. Specifics of these policies are provided in Table 9 in Appendix A.2. Focussing on sectoral support, all of the countries other than Cameroon provided support other than tax breaks to specific sectors. The precise form of the 'other' support varies; but it normally involves, as in Ethiopia, a combination of concessionary loans, alongside infrastructure and training support. Ethiopia is unusual in that it provides different reductions in tax depending on location. This is important as it means we can separate the effects of each aspect of the policy.

Table C1. Summary of industrial policy in eight subsaharan Africa countries.

Country	Trade		Sectoral		FDI	
	Duty & Tariff	Other	Tax	Other	Tax	Other
Botswana	✓			✓	✓	✓
Cameroon	✓	✓	✓			✓
Ethiopia	✓	✓	✓	✓	✓	✓
Ghana	✓		✓	✓	✓	✓
Kenya	✓	✓	✓	✓	✓	✓
Rwanda	✓			✓	✓	✓
South Africa	✓	✓		✓		✓
Uganda	✓			✓	✓	✓

Source: Marti and Ssenkubuge (2009)

Appendix D Further Examples of Industrial Policy in Sub-Saharan Africa

Table D1. Industrial Policy in Sub-Saharan Africa.

Country	Description
Botswana	**National**: Policy aimed at enhancing productivity through highly skilled labour, export orientation and attraction of FDI. **Trade**: Customs Duty rebates on raw materials, tariff protection of infant industries and concessional import duty rebate and low tax rates. **Sectoral**: Motor Industry prioritised. Also textiles, foods and beverages benefited from support. **Other**: FDI attraction through tax incentives, human development, enterprise development and R&D support.
Cameroon	**National**: Guided by 5 year plans from 1961–1991 that focus on both import substitution and export promotion. **Trade**: Free trade zones where 80 % of production is exported. Part of the Central African Economic and Monetary Community that guides the tariff rates. **Sectoral**: Textiles, wood, energy, some cereals, cocoa, coffee, shipbuilding, ICT and pharmaceuticals received exemption from personal income tax. **Other**: FDI attraction through Investment promotion and infrastructure development.
Ethiopia	**National**: Industrial Development Strategy in 2002 focussed on Agricultural development led industrialisation. **Trade**: Customs duty rebates and Export promotion measures. **Sectoral**: Meat, Textile, Construction and Agro-industry benefited from technology, financial and human capital support. **Other**: Attraction of FDI through various incentives including tax exemptions.
Ghana	**National**: Broad Growth and Poverty Reduction strategy aimed at competitiveness of private sector, human resource development and public sector reform. **Trade**: Higher tariff rates for more processed goods like textile, apparel, furniture and beverage. Part of ECOWAS customs union. **Sectoral**: ICT is a big priority. Others include biotechnology, cassava, textiles, palm oil and salt. **Other**: Established Institute of Industrial Research, FDI attracting through tax holiday (also depending on location).
Kenya	**National**: 1996 Policy: 'Industrial Transformation to the Year 2020' focussing on export orientation. **Trade**: Export Processing Zones and Export promotion council, duty remission facility. Part of EAC FTA. Firms in these zones benefit from tax holiday. **Sectoral**: Agro-industries, textile, coffee, tea, construction. **Other**: Investment Authority to attract FDI through tax holiday, Industrial Research and Development Institute.
Rwanda	**National**: Included in three programmes, Growth for Jobs and Exports, Vision 2020 and Governance focussing on infrastructure, reducing cost of doing business, promoting innovation and financial sector development. **Trade**: Higher Duty on more processed goods. Part of the EAC FTA that guides Duty rates. **Sectoral**: Information and Communication Technology supported through human capital, infrastructure. Coffee and tea also received support. **Other**: Rwanda investment and export promotion agency, one of the most open FDI regimes through exemption of corporate income tax.
South Africa	**National**: Included in the 'Accelerated and Shared Growth Initiative' focusing on manufacturing exports. This is Complemented by National Industrial Policy Framework. **Trade**: Export marketing and investment assistance, export credit incentive, export credit insurance and customs duty refunds. **Sectoral**: Capital equipment, transport equipment, automotive assembly, chemicals, plastics and pharmaceuticals, textile and footwear received support. **Other**: Government supports science and technology research, assistance on global value chain, clusters and efficiency.
Uganda	**National**: National industrial policy included in 'Medium Term Competitiveness Strategies' with the objectives of improving business environment. **Trade**: Fixed duty drawback scheme for exports. Member of EAC FTA that guides tariff bands. **Sectoral**: Promotion of linkages between ICT, construction, textile, agro processing and energy. **Other**: Infrastructure, financial sector, institutional and human development are part of the broader strategy. FDI attraction prioritised through tax exemptions.

Appendix E Productivity Estimation

Defining y_{it} as the log of sales Y_{it} (or alternatively output) by firm i in year t and the same Cobb-Douglas technology as in Section 2.1 we have:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \omega_{it} + \in_{it} \tag{E1}$$

Where, in the notation of Section 2.1 $\beta_1 = \rho$, $\beta_2 = \psi$ and $\omega_{it} = A$. However, direct estimation of E1 will not provide consistent estimates given that choices of k_{it} and l_{it} will be driven by ω_{it} which cannot be directly observed. Like OP and LP, ACF address this problem by arguing that that firms' investment decisions as in OP or the purchase of intermediate goods LP should be a monotonic function of ω and the (observed) capital stock. Thus, inverting this function will provide an estimate of ω_{it} based on observables. Whilst unknown, the inverse function may be estimated semi-parametrically. In particular, ACF assume that the demand for intermediate goods m_{it} may be written as

$$m_{it} = f_t[k_{it}, \omega_{it}, l_{it}] \tag{E2}$$

Substituting f_t^{-1} into E1 gives the first stage of the ACF procedure:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + f_t^{-1}[k_{it}, m_{it}, l_{it}] + \in_{it} \tag{E3}$$

While it is clear that neither coefficient β_1 or β_2 is identified, ACF note that the composite term $\hat{y}_{it} = \beta_0 + \beta_1 k_{it} + \widehat{\beta_2 l_{it}} + \omega_{it}$ is. It then remains to identify β_1 and β_2 which will, given E1, imply ω_{it}.

OP show that if ω_{it} follows a Markovian process, such that $\omega_{it} = g(\omega_{it-1}) + \xi_{it}$, e.g. ω_{it} is an AR(1) process, and capital investment decisions in period $t-1$ affects output only in period t then the innovations in ω_{it}, ξ_{it}, should be independent of current capital levels k_{it}. ACF extend this to a second condition that ξ_{it} should be independent of lagged labour levels l_{it-1}. Imposing these conditions empirically provides a means to recover β_1 and β_2, since $\hat{x}i_{it}$ depends on both and OP and ACF prove identification results such that it can only be independent of k_{it} and l_{it-1} for the correct values of β_1 and β_2. Hence, intuitively, we can recover β_1 and β_2 by 'guessing' their values such that independence conditions hold. In practice, this amounts to solving for $\hat{\beta}_1$ and $\hat{\beta}_2$ such that:

$$\frac{1}{N}\frac{1}{T}\sum_i \sum_t \begin{pmatrix} \hat{\xi}_{it}\left[\hat{\beta}_1, \hat{\beta}_2\right] k_{it} \\ \hat{\xi}_{it}\left[\hat{\beta}_1, \hat{\beta}_2\right] l_{it-1} \end{pmatrix} = 0 \tag{E4}$$

We use intermediate goods as our proxy variable, given the concerns of LP about irregular investment are relevant in the case we study. We will present results using both sales and output, but as above we use sales in our preferred specifications.

The production function estimation results are presented in Table 3. The preferred estimates in column 1 use sales (actual rather than deflated) as the measure of output, with total book capital and total wages as measures of capital and labour inputs respectively. The first thing to notice is that the sum of the coefficients is 0.89 suggesting decreasing returns to scale. This is in common with all of the other specifications considered discussed in turn below, firms seem to exhibit diminishing returns to scale, as confirmed by the results of a Wald Test in all but two cases. In the first of these two cases, this seemingly reflects the relative lack of precision in the estimates due to the smaller sample. In the case of column (5), the coefficients in fact imply increasing returns to scale if anything but are again imprecise.

Also noteworthy is that Ethiopian firms, although labour intensive, have a lower marginal product of capital than of labour with the marginal product of labour being 0.44 in the preferred specification compared to 0.09 for capital. These coefficients are again qualitatively consistent across all of the specifications. Moreover, this finding is consistent with the literature. Specifically, we might expect the low levels of capital in Ethiopian firms to lead to high marginal products. But, De Loecker et al. 2016, obtain similar marginal products for Indian firms using product level data. Bigsten (2004,) obtained similar results with firm level data for Kenya, Ghana, Cameroon and Zimbabwe. While, Siba (2012,) also studies Ethiopian firms, and finds the marginal product of capital to be below 10 percent.

Given the concerns of De Loecker et al. (2016) of a *'bias stemming from the unobserved allocation of inputs across products within multi-product firms'* Column 2 restricts the sample to single-product firms. Whilst there is an expected reduction in precision, the estimates are assign greater importance to labour compared to intermediate goods but are otherwise qualitatively similar. Column 3 contains results restricting our attention to firms in business for at least 8 years suggesting that our results are not being driven by differences in the behaviour of newer firms. Column 4 uses a 3^{nd} degree polynomial instead one of the 2^{nd} degree used in the other columns, to ensure that our estimates are robust to how the non-parametric part is specified. Column 5 uses output rather than sales. Note, that given we observe sales and sale prices directly the key difference here is in inventories. Column 6 uses the book value of machinery used in

production rather than total capital as our measure of firms' capital stock. Again, there is no qualitative change in the estimated production function. Column 7 restricts the sample to those firms not owned by the government; here we see a somewhat lower use of intermediate inputs and labour. This may reflect differences in the industries in which the government owns firms. Thus, whilst there is some variation the marginal products of capital, intermediate goods, and labour are broadly consistent.

Appendix F Pseudo-Panel Estimator

We note that an alternative estimator of (8) would be a pseudo-panel estimator as discussed by Verbeek (2008). Estimators of this type are most commonly applied to datasets that are a repeated cross section, and for which it is possible to identify subsets of the population with membership fixed over time – 'cohorts'. The data are then the set of averages of each variable by period and cohort observations, and a conventional estimation procedure (but with suitable corrections to the variance matrix) may be employed. Our strategy hinges on the fact that this approach will be inconsistent to the extent that membership of cohorts is not fixed. In our case this means entry by new firms. Then, the excess entry of new firms in treated sectors and their impact on average productivity will be given by the difference between the pseudo-panel estimates and the firm-level estimates of the difference in difference coefficients.

More precisely, averaging (8) by sector and Zone, and indexing these cohorts as $c \in \{1, \ldots, C\}$ with asterisks denoting population quantities (see, Deaton 1985) we have:

$$\bar{y}^*_{ct} = \tau_1(d^*_c \cdot d^*_t) + \tau_2(d^*_j \cdot d^*_t) + \tau_3(d^*_c \cdot d^*_j \cdot d^*_t) + \zeta d^*_t + \beta \bar{X}^*_{ct} + \mu^*_{cj} + \in^*_{ct}. \tag{F1}$$

For clarity, we rewrite this using $\mathbf{Z} = [\, d_c \quad d_t \quad d_j \quad X_{it} \quad \mu_c \,]$ and Λ as the associated vector of coefficients. Moffitt (1993) showed that Λ can be estimated using the interaction of cohort and time dummies as instruments. This makes the requirements for the consistency of the estimator clear – if the composition of the cohorts is not fixed then this is equivalent to the exclusion assumption being violated. If the productivities did not vary over time then the instrument relevance assumption would also be violated. Thus, assuming the measurement error is distributed as follows:

$$\begin{pmatrix} \bar{y}_{ct} - y^*_{ct} \\ \bar{\mathbf{Z}}_{ct} - \mathbf{Z}^*_{ct} \end{pmatrix} \sim i.i.d. \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{00} & \sigma' \\ \sigma & \Sigma \end{pmatrix} \right]$$

then, the estimator employed is:

$$\tilde{\Lambda} = (M_{zz} - \tau\hat{\Sigma})^{-1}(m_{zy} - \tau\hat{\sigma}) \tag{F2}$$

where:

$$M_{zz} = \frac{1}{CT}\sum_{c=1}^{C}\sum_{t=1}^{T}(\bar{z}_{ct} - \bar{z}_c)(\bar{z}_{ct} - \bar{z}_c)' \tag{F3}$$

$$m_{zy} = \frac{1}{CT}\sum_{c=1}^{C}\sum_{t=1}^{T}(\bar{z}_{ct} - \bar{z}_c)(\bar{y}_{ct} - \bar{y}_c). \tag{F4}$$

Given our sample is relatively large, and contains the universe of manufacturing firms, it is reasonable to expect $\beta^{\Delta} = \tilde{\Lambda} - \hat{\beta} \approx 0$ if there were no firm entry. Thus $\beta^{\Delta} > 0$ (conversely, $\beta^{\Delta} < 0$) implies entering firms are more (less) productive than existing firms. Standard errors are obtained via the bootstrap.

Appendix G Specific Sector Support

PASDEP prioritised industrial development in four sectors, and these sectors received support from the government to achieve more non-agricultural employment, investment and production. These sectors are the textile and garment sector; meat and leather producers; agro industry, and the construction industry. The government has implemented specific measures in support of these industries since 2003/04. These sectors were chosen for their direct linkages to the agricultural sector, labour intensiveness and export potential. These priority sectors have been subject to several benchmarking exercises and the establishment of industry-wide targets. Notable targets in PASDEP were that by the end of 2009/10 the export earnings from the textile sector would reach USD 500 million as a result of investment in the sector worth USD 1.6 billion. The majority of the additional investment was planned to come from the private sector. However, the government also planned to invest jointly with foreign investors. For the meat and leather industries it was envisaged for that export earning would increase to USD 178 million by establishing 74 firms by 2009/10. These

targets highlight the continuing strong role of the state envisaged during the PASDEP period. To achieve these specific targets a host of measures have been taken related to training, input market interventions, establishing sector development institutes, public private partnerships and the scaling up of sectoral pilot projects.

All four sectors were given priority access to foreign currency. As discussed in the main text, they also all had access to concessionary loans via The Development Bank of Ethiopia, a state owned bank established facilitate investment with loans up to 70 percent of the initial capital to private sector firms investing in the four treated sectors. Sector specific support included:

- **Textiles**: The government started textile engineering training programme in one of the government universities (Bahirdar University). The first class graduated in 2002. In 2010 the government established the Ethiopian Textile Development Institute to organise all the support in one institution. The institute supports existing firms and entrants in the sector on selection of technology, negotiation, construction, erection and commissioning. It also provides practical training on technology and marketing.
- **Leather and Leather Products**: Additional export support via inclusion in the Prime Minister's Committee to Promote Exports. Also, similarly to the support provided to the textile sector, the Ethiopian Leather Industry Development Institute was established in 2010.
- **Agro-processing**: Firms in the Agro industry sector have access to cheaper leases for land.
- **Construction**: Other than the concessionary loans and priority access to foreign exchange the construction sector received little other specific support.

Appendix H Ethiopian Administrative Geography

Ethiopia is divided in 9 administrative regions. This division is based on ethnicity. These regions are further divided into 68 administrative zones which are in turn divided into 560 *woredas* (districts). Figure H1 plots these different regions and a central circle depicts the 100 km zone that defines the *credit* policy. This shows that even though Addis Ababa is the key locus of economic activity, this area is small given the size of the country. This also helps to udnerstand the scale of the different geographical units. The smallest administrative division is called a Kebele that divides the woredas but in this data it is woreda level information that is relatively well measured. The following figures show the approximate size of regions, zones and woredas. Figure 3 describes the administrative geography of Ethiopia

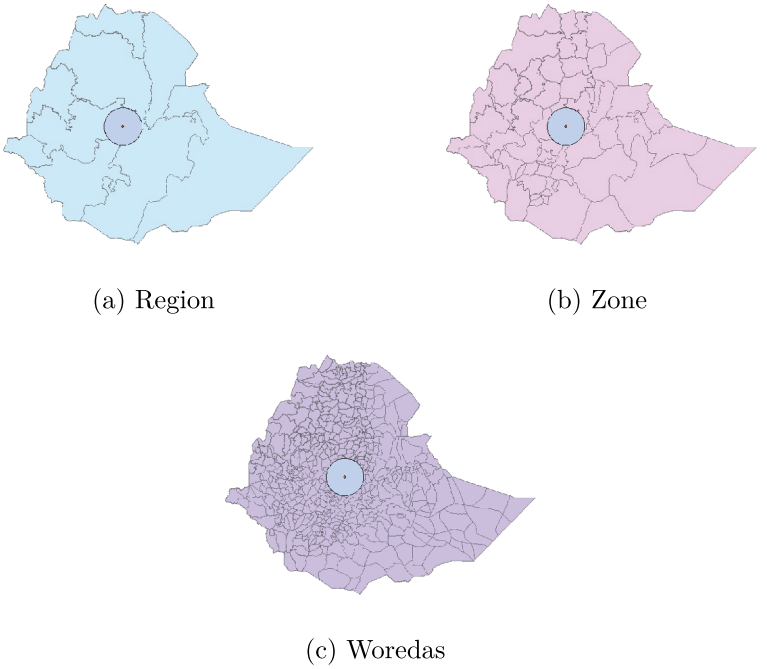

Figure H1 Ethiopia: administrative divisions

Appendix I The Number of Firms by Industrial Classification

Table I1. Number of firms in 1996 and 2010 in each ISIC category.

ISIC Classification	1996	2010	Treatment
1511 Production, processing and preserving of meat, fruit and veg	6	9	Treated (Agro)
1514 Manufacture of edible oil	25	31	Treated(Agro)
1520 Manufacture of dairy products	1	20	Treated(Agro)
1531 Manufacture of flour	17	154	Treated(Agro)
1533 Manufacture of animal feed	2	6	Treated(Agro)
1541 Manufacture of bakery	63	142	Treated(Agro)
1542 Manufacture of sugar and confectionary	5	17	Treated(Agro)
1544 Manufacture of pasta and macaroni	3	13	Treated(Agro)
1549 Manufacture of food NEC	4	8	Treated(Agro)
1551 Distilling rectifying and blending of spirit	6	12	Treated(Agro)
1552 Manufacture of wine	1	1	Treated(Agro)
1553 Malt liquors and malt	5	7	Treated(Agro)
1554 Manufacture of soft drinks	6	21	Not Treated
1600 Manufacture of tobacco	1	1	Not Treated
1710 Spinning, weaving and finishing	18	28	Treated(Textile)
1723 Manufacture of cordage rope and twine	3	1	Treated(Textile)
1730 Knitting mills	9	0	Treated(Textile)
1810 Manufacture of wearing apparel except fur	23	40	Treated(Textile)
1910 Tanning and dressing of leather	8	27	Treated(Leather)
1920 Manufacture of footwear	50	66	Treated(Leather)
2000 Manufacture wood and wood products	25	41	Treated(Agro)
2100 Manufacture of paper and paper products	5	17	Treated(Agro)
2200 Publishing and printing services	27	65	Not Treated
2411 Manufacture of basic chemicals except fertilisers	2	19	Not Treated
2422 Manufacture of paints varnishes	5	8	Not Treated
2423 Manufacture of pharmaceutical, medicinal	1	9	Not Treated
2424 Manufacture of soap detergents, perfumes.	20	33	Not Treated
2429 Manufacture of chemical products NEC	3	4	Not Treated
2510 Manufacture of rubber	4	3	Not Treated
2520 Manufacture of plastics	10	107	Not Treated
2610 Manufacture of glass and glass products	2	2	Not Treated
2693 Manufacture of structural clay products	7	4	Not Treated
2694 Manufacture of cement,lime and plaster	6	20	Treated(Constr.)
2695 Manufacture of articles of concrete, cement	62	223	Treated(Constr.)
2699 Manufacture of non-metallic NEC	3	136	Not Treated
2710 Manufacture of basic iron and steel	1	28	Not Treated
2811 Manufacture of structural metal products	27	99	Treated(Constr.)
2892 Manufacture of cutlery hand tools	0	6	Not Treated
2893 Manufacture of other fabricated metal products	4	3	Not Treated
2899 Manufacture of pumps,compressors, valves and taps	5	8	Not Treated
2914 Manufacture of ovens	5	12	Not Treated
2925 Manufacture of other general purpose machinery	6	1	Not Treated
3140 Manufacture of batteries	0	1	Not Treated
3420 Manufacture of bodies for motor vehicles	7	8	Not Treated
3430 Manufacture of parts and accessaries	1	1	Not Treated
3610 Manufacture of furniture	62	227	Not Treated
ISIC Classification	1996	2010	Treatment