Time delays at the border: Macroeconomic consequences for Sub-saharan African economies

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Introduction I

- The literature has documented a strong positive correlation between border administration efficiency and economic development (Djankov et al., 2010; Blonigen and Wilson, 2007; WEF, 2012, 2016).
- Question: how does border administration efficiency affect economic development ?
- The literature answer: through trade.
- In this paper I highlight another mechanism: border administration efficiency can relate to the supply capacity of the economy.

Introduction II

- Using the WBES and the UNCOMTRADE data, I document that:
  - Important proportion of inputs is imported in Sub-saharan Africa.
  - Most of which is material and intermediate goods.
  - It takes longer time to clear inputs through customs in SSA.
- Why do we care ?

"*As a manufacturer, one of our biggest headache is with the supply chain. We have a situation where we have to order materials three months or six months ahead* ***because of clearing delays***." (The Business year, 2018).

- Delays can prove costly because of:
  - Inputs disruption;
  - Uncertainty.
  - ...

Introduction III

- I show indeed that there is a negative correlation between average border delay and GDP per capita.

Objective

Assess the effect of time delays at customs on inputs (employment and capital), production and welfare (consumption).

Strategy

- Build a general equilibrium model of heterogenous firms with accumulation of capital (inputs generally).
- Capital motion is subject to random delivery process.
- Calibrate the model to the data: the benchmark model is the one with time delays observed in the data.
- Then simulate the scenario in which time delays are eliminated.

Introduction IV

Findings

- Inputs delays lower the NPV of investment in foreign inputs; the higher the interest rate the worse the effect.
- Inputs hoarding in the short run, and negative aggregate effect in the long run equilibrium due to disruptions.
- The effect spills over to other factors like local capital and labor, depending on their substitutability with the foreign capital.
- The effects are quantitatively important: eliminating border delays induce output increase: $min = 0.06\%$ (Angola), $med = 2.63\%$ (Burkina Faso & Uganda), $max = 10.16\%$ (Chad).

Related literature I

- **Time to build (and time to plan) literature:**
  - **Kydland and Prescott (1982)**: *Time to Build and Aggregate Fluctuations*; **Christiano and Todd (1996)**: *Time to plan and aggregate fluctuations*;
  - Other papers in this line are **Altug (1989), Rouwenhorst (1991), Chang (1994), Casares (2006)**.
- **Production chains and inputs disruption literature:**

  Meier (2020): *Supply Chain disruption, time to build, and the business cycle*: 1 month delay depresses GDP by 1% (U.S.); **Boehm et al. (2019)**: *Input Linkages and the Transmission of Shocks*; **Barrot and Sauvagnat (2016)**: *Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks*

Related literature II

- **Investment specific shocks**:
  - In US: Ma (2018); Chen and Wemy (2015); Ben Zeev and Khan (2015); Justiniano et al. (2010); Guerrieri et al. (2010); Greenwood et al.(2000, 1997);
  - In dev. countries (Mexico; Brazil): Dogan (2019); Araujo (2012).
- **In international trade literature**:
  - **Hummels and Schaur (2013)**: $1D$ delay $\Longrightarrow \downarrow$ final goods demand by 0.6% to 2.1%, and components by 60% more.
  - **Hoffman et al. (2016)**: $\downarrow 1D$ delay $\Longrightarrow \uparrow$ SADC's exports by 1%
  - **Valensisi and Lisinge (2013)** generalization to SSA.
  - **OECD (2012)**: the most significant trade facilitation measures in SSA are related to border administration efficiency.

Outline

- Introduction
- Data and facts
- Model
- Results
  - Analytical results
  - Quantitative results
- Conclusion
  - Overview on a complementary project: Inputs' delay at borders, firms dynamics and misallocation (with Immo Schott).

Data and facts I

- Data sources: WBES, UNCOMTRADE, WDI.
- Important proportion of inputs is imported in Africa.
  - For 41 SSAC between 2009 and 2018: proportion ranges 14% - 63%; *Avg*. $= 39\%$ and *med*. $= 41\%$. ▸ Avg. prop.
  - $\rightarrow$ Inputs linkages.
  - Avg. prop. of materials and intermediates within imported inputs ranges 43% - 78%, *Avg*. $= 63\%$ and *Med*. $= 62\%$. ▸ Inputs struct.
- However, it takes longer time to clear inputs through customs.

"*In the last fiscal year, when this establishment imported material inputs or supplies, how many days did it take on average from the time these goods arrived to their point of entry (e.g. port, airport) until the time these goods could be claimed from customs?* "

Data and facts II

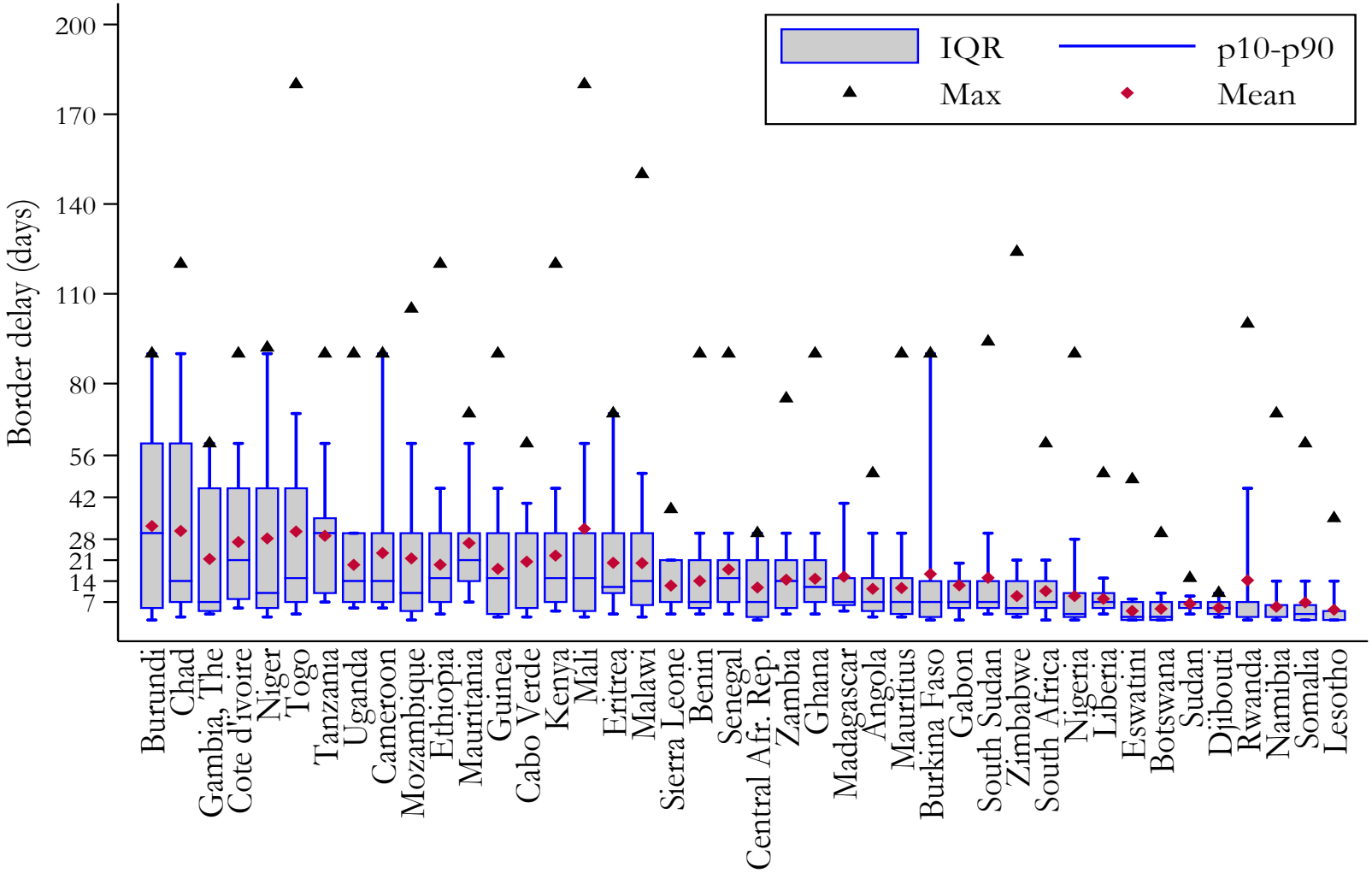

Figure 1: Inputs border delays in Sub-Saharan Africa

- Why are border delays so long in SSA ? ▸ Causes

Data and facts III

- Average border delay is negatively correlated to GDP per capita

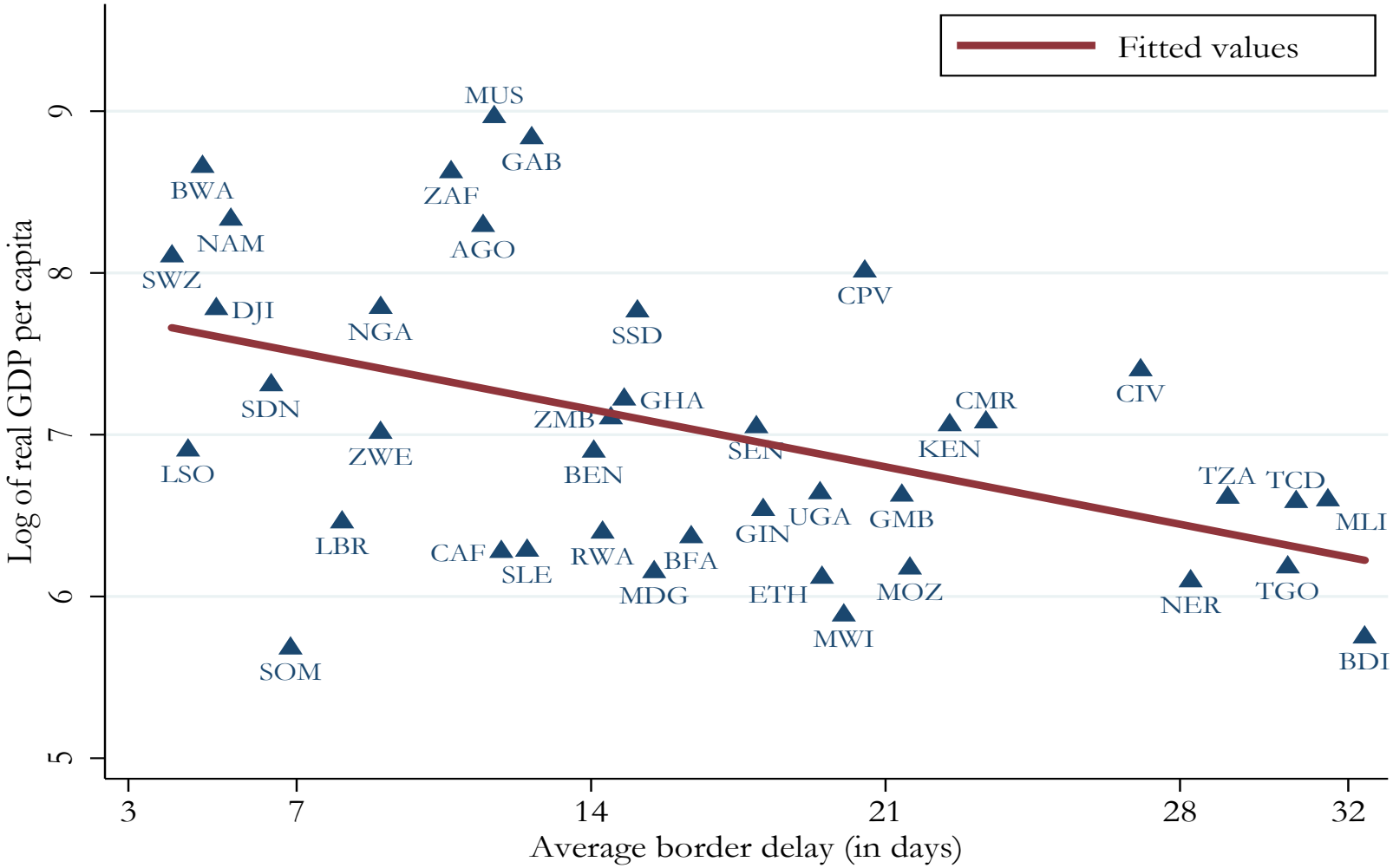

Figure 2: Border delay and real GDP per capita (2010, in constant 2015 US $).

The model I

- A constant unit mass of firms produce a homogeneous good by using foreign capital which they import, local capital and labor.
- Foreign inputs should be cleared at border before the firms can pick them.
- During the process of clearance, inputs may be delayed: due to administrative burderns, red tape and corruption.
- At the moment of investment the firm does not know when it would be delivered for sure,
- but has imperfect knowledge represented by a probability distribution G of the time delay τ

The model II

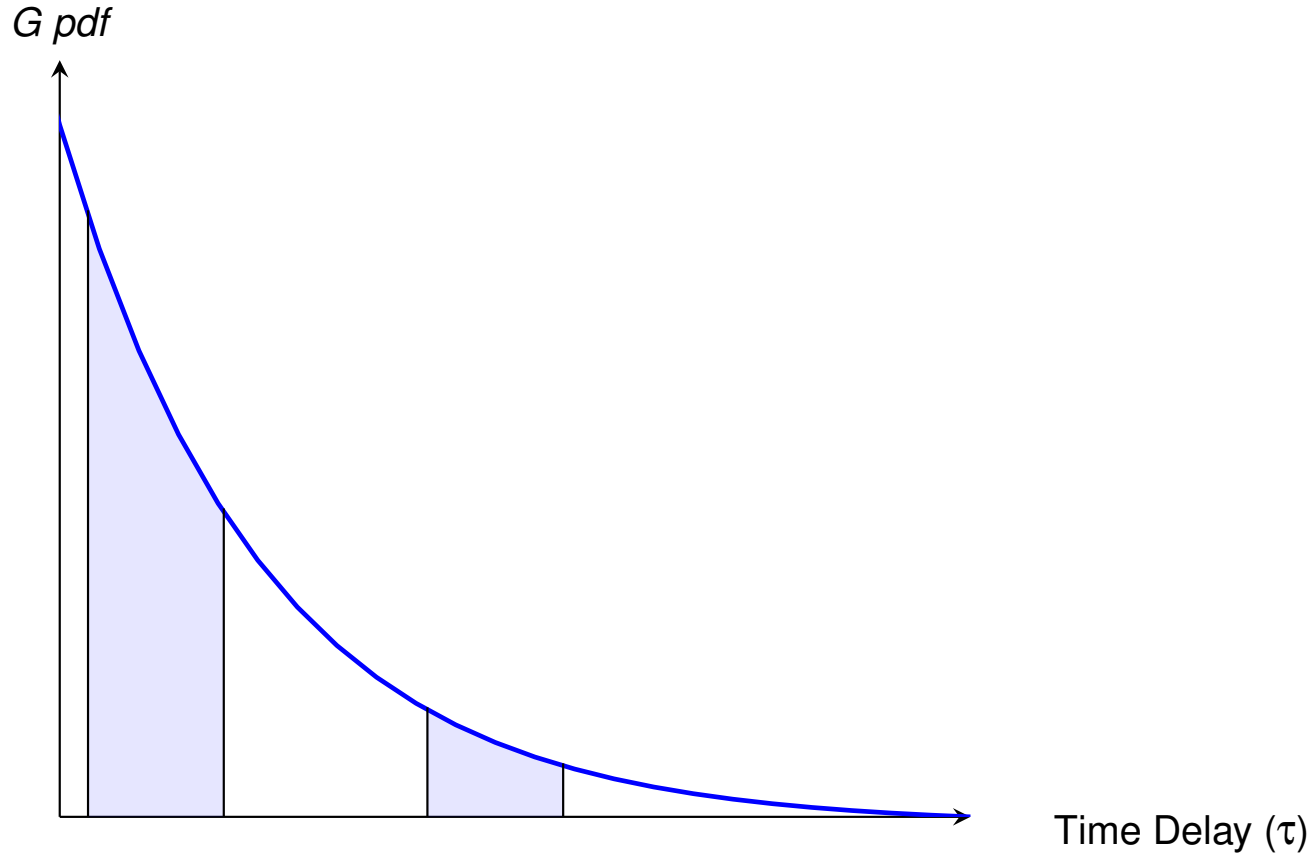

Figure 3: Prior knowledge on delivery process

▸ Propositions

The model III

- Timing

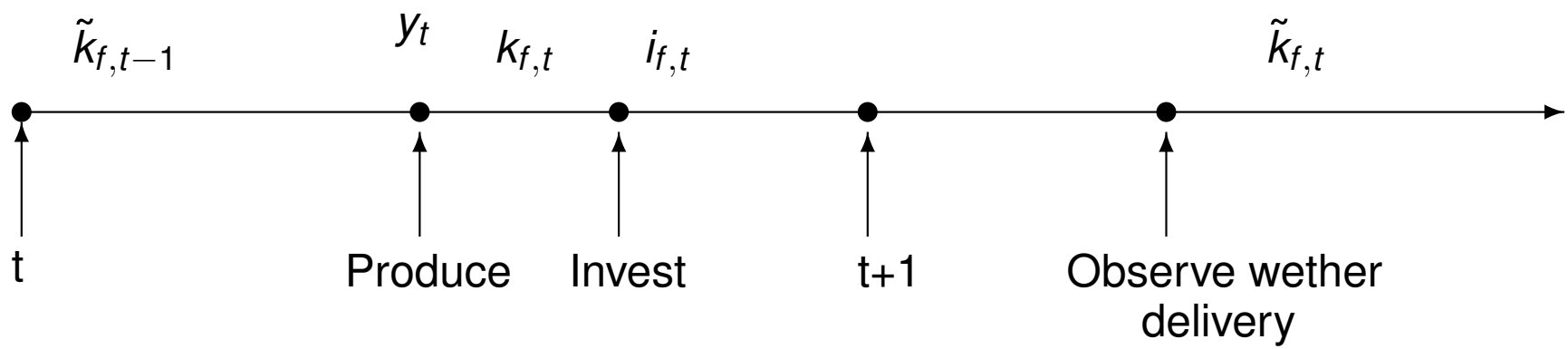

Figure 4: Timing

- **Assumption:** At a given period, a firm receives all its outstanding order or does not receive anything at all. (Meier, 2020).
- Then $(O_{f,t}, \theta)$ characterize the delivery process.

The model IV

- **Technology**: $y = k^{\alpha} n^{\nu}$ (DRS), $k = \left[\psi k_l^{\rho} + (1-\psi) k_f^{\rho}\right]^{\frac{1}{\rho}}$, where the firms accumulate both types of capital.
- Inputs motions:

$$k_{l,t+1} = (1-\delta_l) k_{l,t} + i_{l,t},$$

$$k_{f,t+1} = (1-\delta_f) \underbrace{[k_{f,t} + z_{t+1}(O_t + i_{f,t})]}_{\tilde{k}_{f,t}},$$

$$O_{t+1} = (1 - z_{t+1})(O_t + i_{f,t})$$

$$z_t \in \{0;1\} \text{ with } \mathbb{P}(z_t = 1) = \theta$$

- $\Longrightarrow$ Heterogeneous firms.

The model V

- The firm problem:

$$
\begin{aligned}
V(k_f, O_f) = \max_{k_I, i_f} \; & \{[-1 + \beta(1-\delta_I)]\, k_I - i_f + \\
& \beta \mathbb{E}_z \left[\pi(k_I, k_f + z'(O_f + i_f)) + V(k_f', O_f')\right]\} \\
\text{s.t. } & k_f' = (1-\delta_f)\left[k_f + z'(O_f + i_f)\right] \qquad (1) \\
& O_f' = (1 - z')(O_f + i_f) \\
& k_I,\ i_f \geq 0
\end{aligned}
$$

- **Households**: One representative household.

$$
\begin{aligned}
\max_{C_t, N_t} \quad & \{U(C_t, N_t) = Log(C_t) - \chi N_t\} \\
\text{s.t. } & C_t = wN_t + \int (\pi_{it} - i_{it,f} - i_{it,I})di
\end{aligned}
$$

- **Equilibrium definition is standard.**

Analytical results I

- Pose $k_l = 0$, $n = 1$ and get $y_t = k_{f,t}^{\alpha}$. Then consider, one stream of investment $i_{f,t}$, and define its NPV:

$$NPV_0(i_{f,t}) = -i_{f,t} + \sum_{j=1}^{\infty} \beta^j \left[(1-\delta_f)^{j-1} i_{f,t}\right]^{\alpha}$$

Under delivery hazard $m = (p_1, p_2, ...,)$, with $p_k \geq 0 \; \forall \; k = 1, 2, ...,$ and $\sum_{k=1}^{\infty} p_k = 1$,

$$NPV_m(i_{f,t}) = -i_{f,t} + \sum_{k=1}^{\infty} p_k \beta^{k-1} \sum_{j=1}^{\infty} \beta^j \left[(1-\delta_f)^{j-1} i_{f,t}\right]^{\alpha},$$

Proposition 1: If $\beta < 1$, then:

(i) the net present value of an investment is lower when it is subject to delays than when it is not subject to delays: $NPV_m \leq NPV_0$, $\forall$ m and $NPV_m < NPV_0$, if $m \neq m_1$.

Analytical results II

(ii) the farther m places higher weights the lower the NPV_m. ◂ Process.

(iii) $NPV_m(i_{f,t})$ is increasing in the discounting factor β (so decreasing in the interest rate) for all probability distribution $m \neq m_1$.

Proposition 2: If the discounting factor is $\beta = 1$, then delays do not matter whatever the probability distribution: $NPV_0 = NPV_m$, $\forall m$.

- Local and foreign capital, and labor:

$y = k^{\alpha} n^{\nu}$ (DRS), $k = \left[\psi k_l^{\rho} + (1-\psi) k_f^{\rho}\right]^{\frac{1}{\rho}}$

Propositions 3: If $\beta < 1$ then the optimum **local** input is lower under the delivery delays if local and foreign capital are complements, and higher if they are substitutes.

Calibration I

- A period in the model is a week.

Table 1: External calibration

Parameter	Symbol	Value
Capital inputs share	α	0.2833
Labor share	ν	0.5667
Depreciation rate	$\delta_f = \delta_l = \omega_k \delta_k + \omega_m \delta_m$	0.1454
Discounting factor	β	0.9985
Elasticity of substitution between local and foreign capital	$\frac{1}{1-\rho}$	0.8

Table 2: Internal calibration (Cameroon)

Parameter	Value	Moment	Target	Model
ψ	0.6250	Foreign inputs intensity	32.8%	32.99%
χ	2.3817	Working time fraction	$1/3$	0.3258

Calibration II

Calibrating θ.

$$\theta(\mu) = min\left(1; \frac{7}{\mu}\right)$$

- Resolution: **VFI**; and **Monte Carlo** ...
- Counterfactual: $\theta = 1$ (Benchmark is the frictional model: $\theta < 1$).

Quantitative results I

- Hoarding of foreign inputs in the short run.

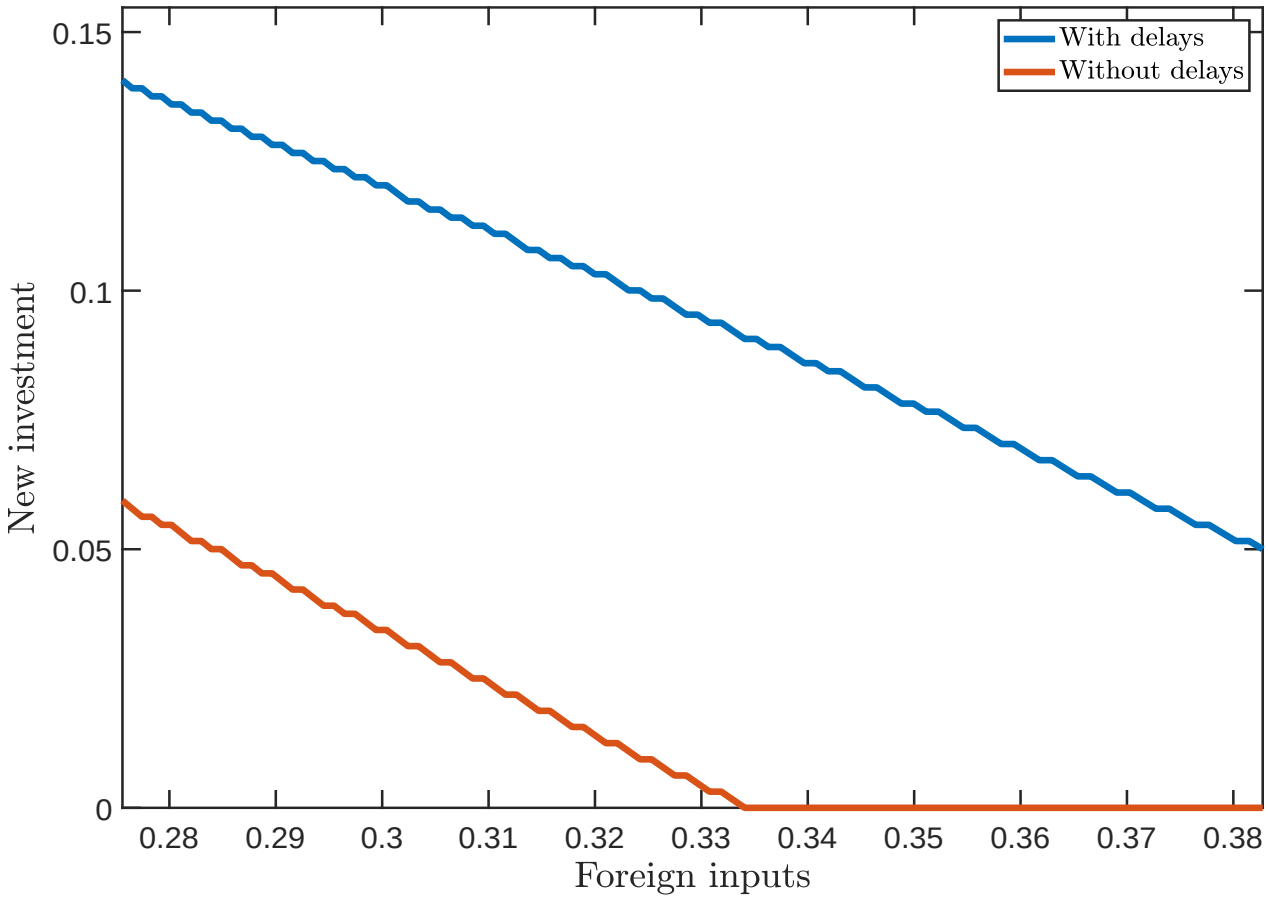

Figure 5: Effects of the border delays on ivestment.

Quantitative results II

- Uncertainty effect

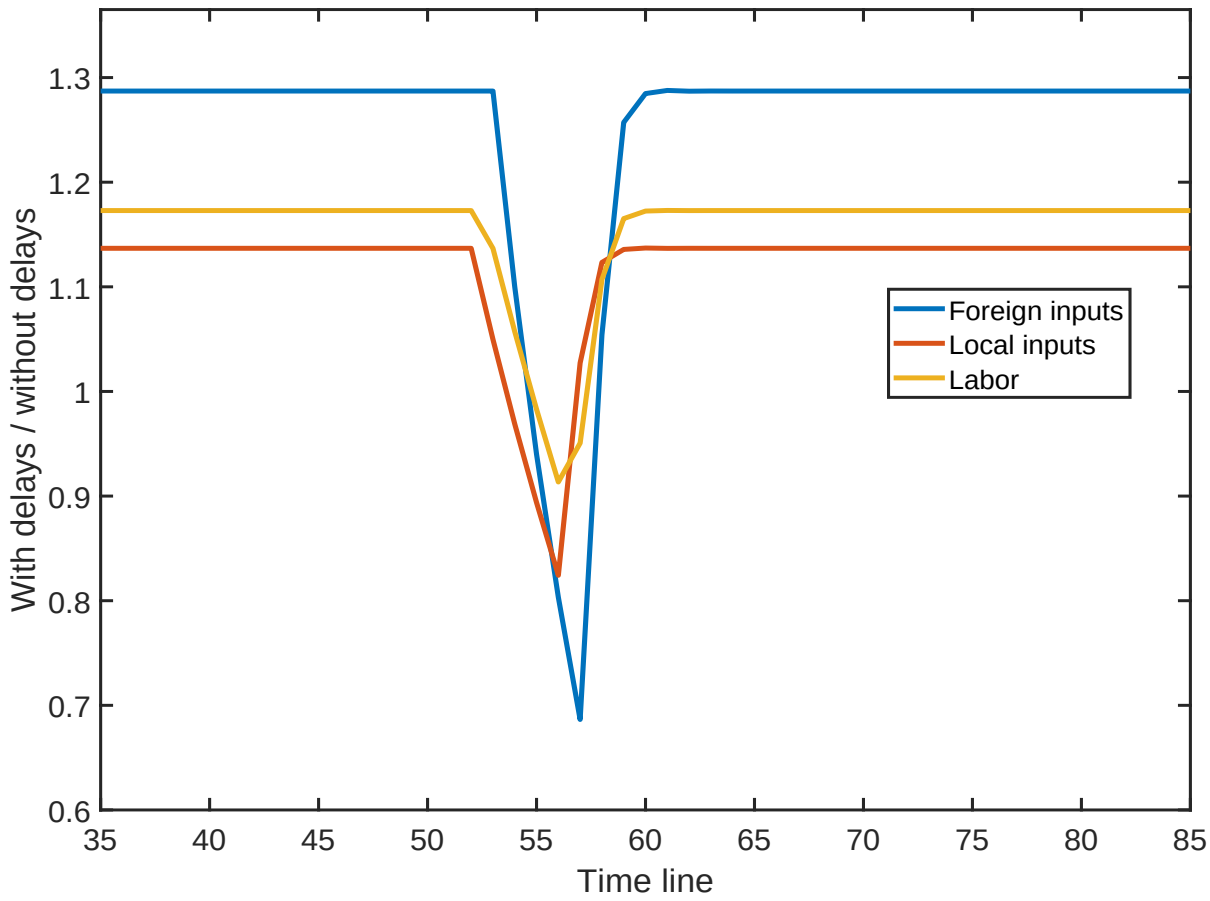

Figure 6: Foreign inputs under delay risk and ex-post systematic delivery

Quantitative results III

- Inputs disruptions effect

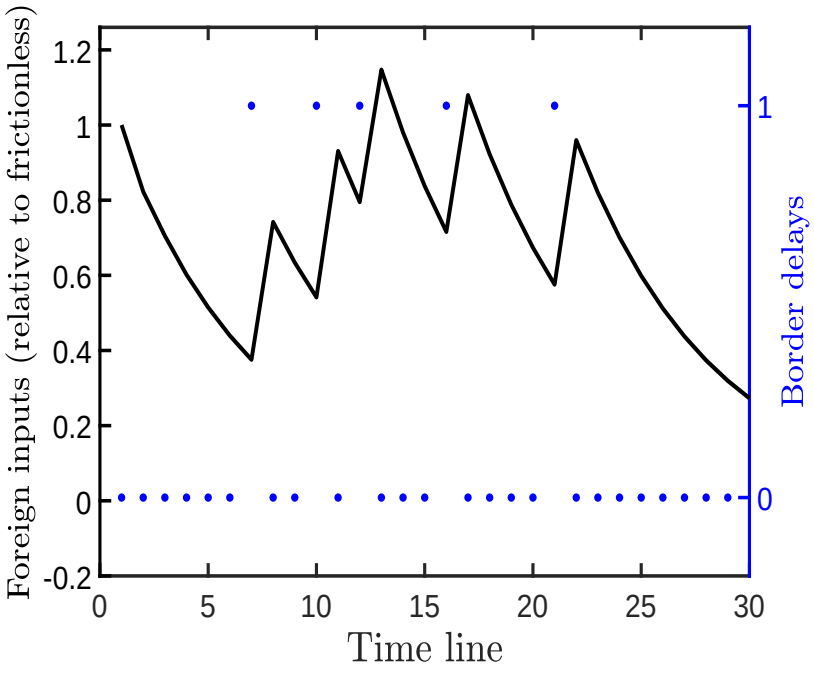

Figure 7: Example of a firm subject to border delays

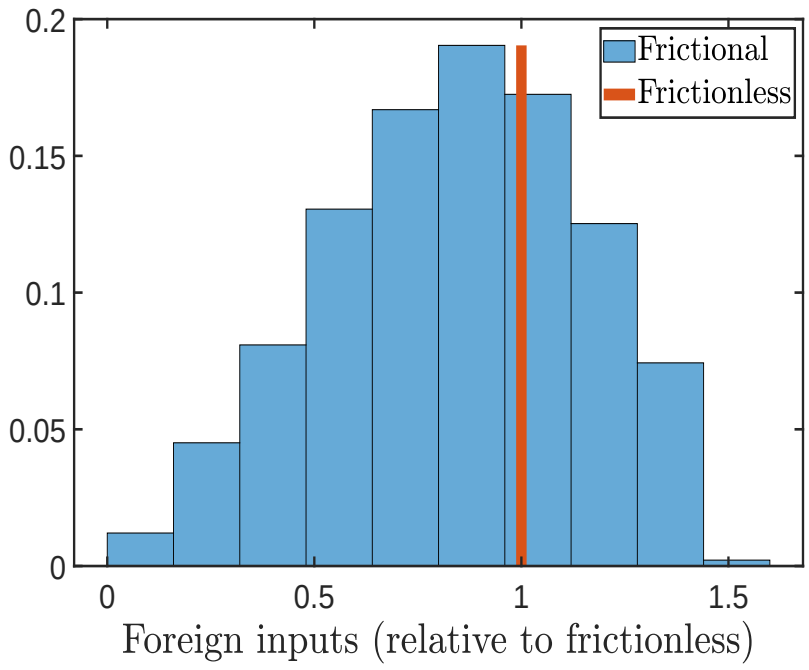

Figure 8: Steady state distribution of foreign inputs

Quantitative results IV

- Aggregate effects in the long run (Cameroon)

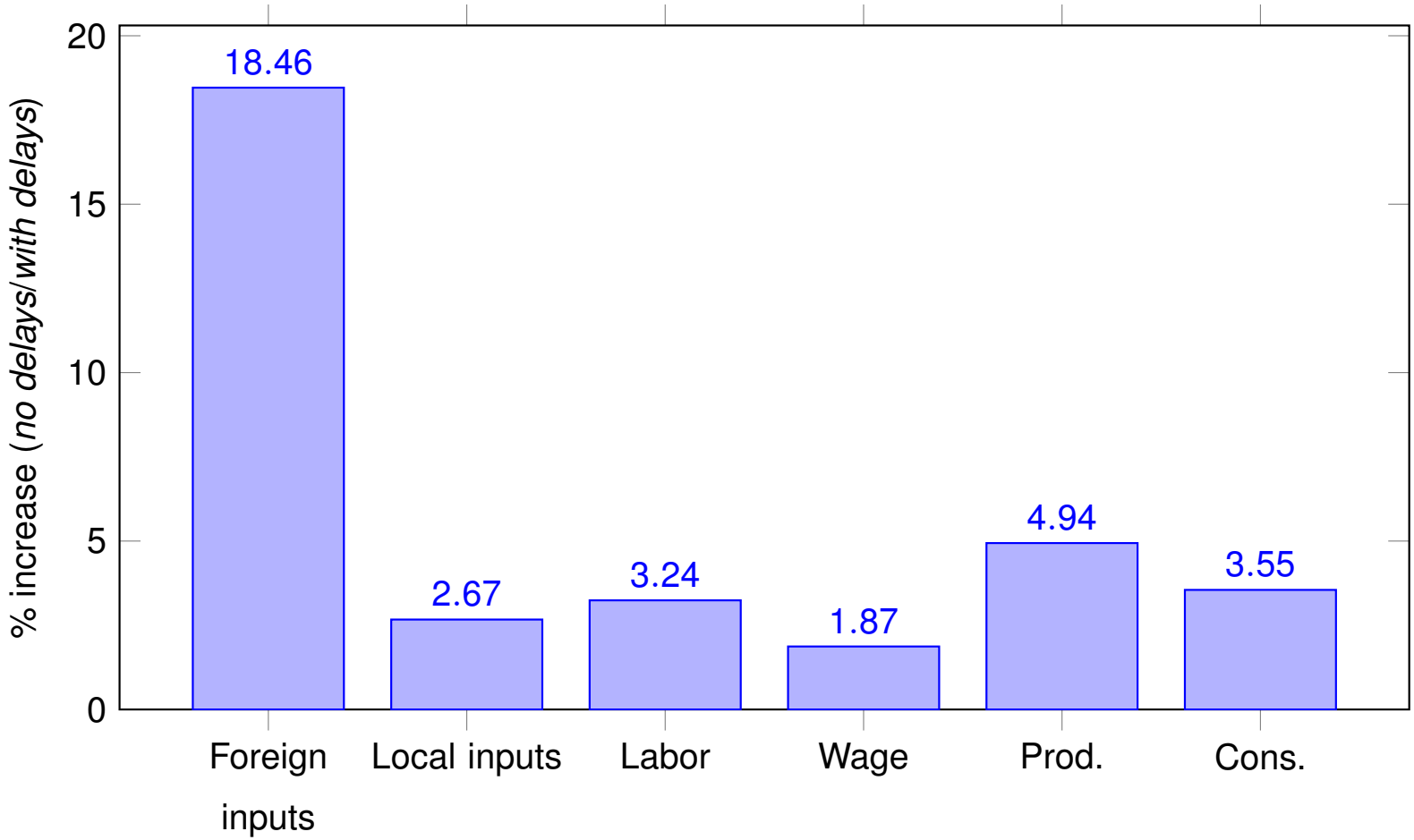

Figure 9: Macoreconomic effects of removing border delays. ▸ Rob. to σ

Quantitative results V

- Other countries: Different structure . . . different effects

Country	Avg. delay	k_f prop (%)	K (%)	M (%)	k_f (%)	k_l (%)	Lab (%)	W (%)	Y (%)	C (%)
Cameroon	23.4	32.8	0.38	0.62	18.46	2.67	3.24	1.87	4.94	3.55
Ethiopia	19.4	17.8	0.47	0.53	10.73	1.94	-1.45	1.25	1.27	0.39
Uganda	19.4	13.6	0.33	0.67	11.81	2.89	1.41	0.63	2.76	2.13
Benin	14.0	52.8	0.23	0.77	6.09	2.64	2.03	1.25	2.21	1.15
Senegal	18.0	18.6	0.31	0.69	16.15	0.72	0.21	1.88	1.38	0.32
Guinea	18.0	62.8	0.38	0.62	5.58	1.00	-0.62	1.87	1.16	-0.07
Liberia	8.0	34.4	0.38	0.62	0.13	0.12	-2.54	0.00	0.12	0.13
Zimbabwe	9.0	38.2	0.39	0.61	0.05	0.29	0.53	0.00	0.22	0.24
Nigeria	9.0	16.4	0.55	0.45	0.12	0.11	-2.75	0.00	0.10	0.10
Burundi	32.4	49.8	0.29	0.71	29.84	6.79	2.65	6.25	8.31	4.15

Conclusion

- Border delays are pervasive in SSA, and many times longer than in other countries in the world.
- Inputs delays exarcebate the cost of investment and lower production inputs accumulation.
- The negative effect is quantitatively relevent on production and growth, and spills over to local inputs and labor markets.

Complementary project

- Border delays also imply heterogeneous MC of investment in foreign inputs $\Longrightarrow$ factors misallocation.
- "*Inputs delays, Firm Dynamics, and Misallocation in Sub-Saharan Africa*", with Immo Schott.
  - Firms differ also with respect to their productivity.
  - Endogenous technology adoption by firms.
  - Rich firms dynamics and distribution.
  - Highlight different channels of the effect of the border delays: extansive margin, selection margin, intensive margin.

THANK YOU

Annexes: Proportion of imported inputs I

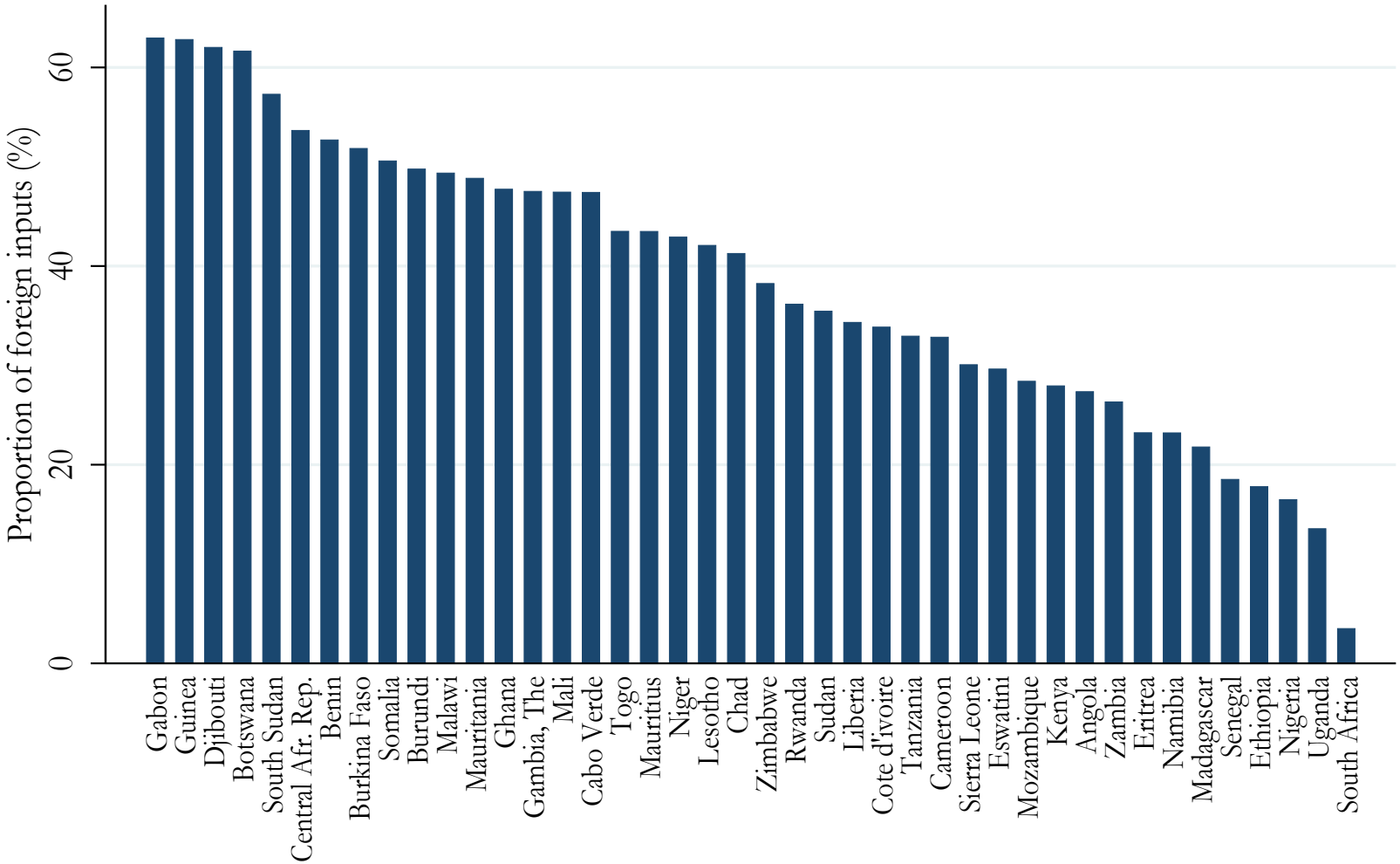

Figure 10: Proportion of foreign inputs by country. Source: WBES data and the author's calculations.

◂ Introduction: data

Annexes: Imported inputs I

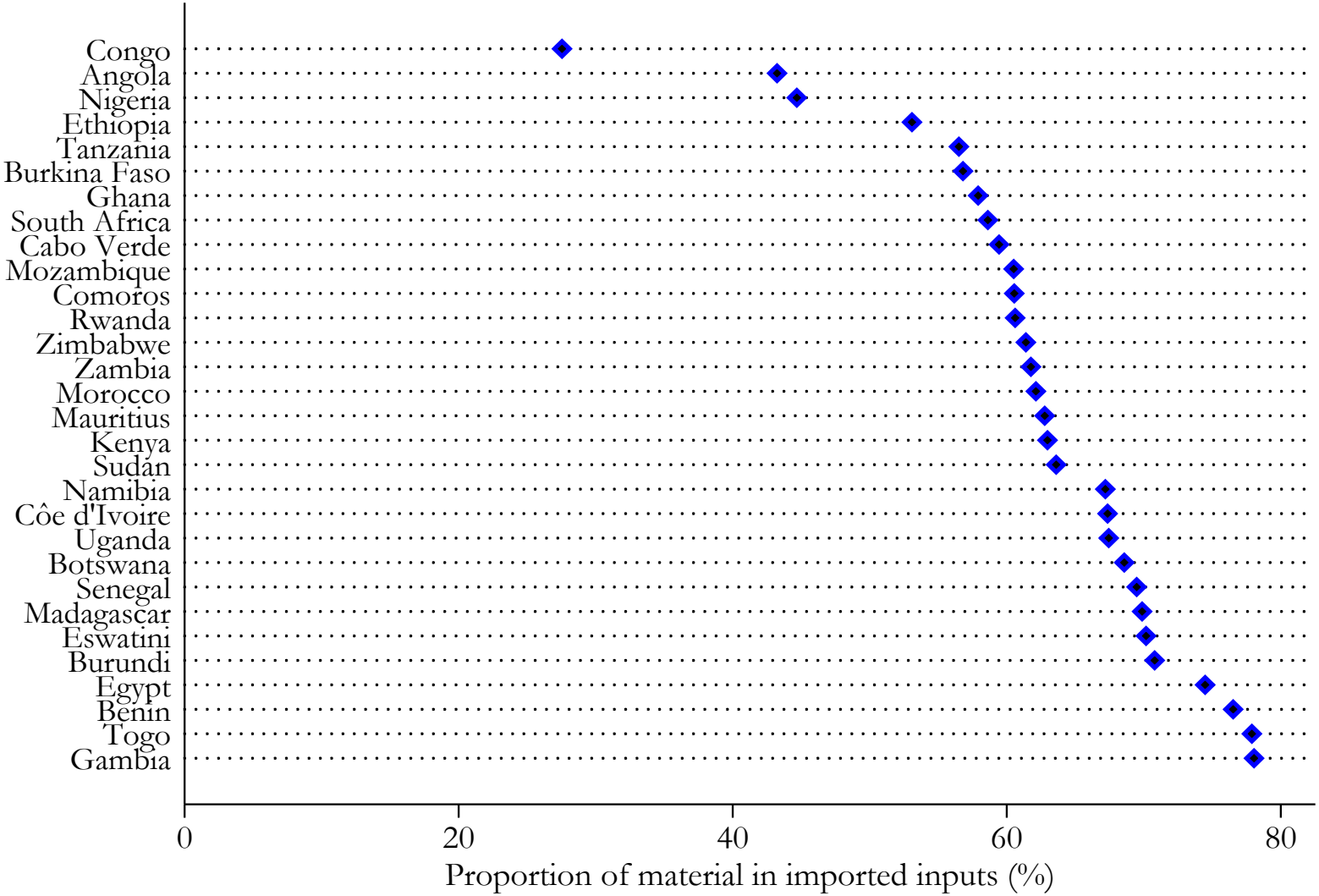

Figure 11: Proportion of materials and intermediate goods in imported inputs.

Source: UNCOMTRADE and the author's calculations.

◂ Introduction: data

Annexes: Causes of border delays I

- My paper does not focus on the “why”, but takes border delays as given.
- Many reasons from the literature. Most important: red tape
  - AfDB (2012): In Africa, the Avg. customs transaction involves 20–30 different parties, 40 documents, 200 data elements (30 of which repeat at least 30 times), and the rekeying of 60-70% of all data at least once.
  - Djankov et al. (2010): Red tape accounts for 75% export delay in Africa.
  - Montagnat-Rentier and Parent (2012) identify some causes of poor customs efficiency in Africa: red tape, redundant inspections, deficient infrastructure.

Annexes: Causes of border delays II

- The WEF assesses the efficiency of the customs administration. In a sample of 132 countries in 2012, 28 SSAC ranked on average 100 with an average score of 3.2 on a 1-to-7 scale.
- I also found negative correlation between the efficiency of the border administration and the average border delays.

◂ Data

Annexes: Robustness check (w.r.t σ) I

- Robustness (w.r.t σ)

σ	Foreign inputs	Local inputs	Labor	Wage	Production	Consumption
0.5	17.93	5.83	1.09	3.75	4.09	1.74
0.8	18.46	2.67	3.24	1.87	4.94	3.55
1.5	22.91	2.87	3.79	1.25	6.19	4.53
2	15.77	-3.60	-1.49	1.22	1.25	0.38

Table 3: Aggregate results: robustness w.r.t σ

◂ Ag. results