MULTI-PRODUCT FIRMS AND MISALLOCATION

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Abstract

Shocks and distortions could affect the aggregate economy via the multi-product channel (Bernard, Redding, and Schott, 2010, BRS henceforth; Miniti and Turino, 2013; Jaef, 2018). This paper finds that (i) compared to the U.S., multi-products firms are fewer and smaller in China; (ii) firms with higher Hsieh and Klenow(2009, HK henceforth) taxes are less likely to be multi-product producers, controlling for the size effect. While the empirics confirm the existance of the product channel, our quantitative analysis using a discrete multi-product choice model with endogenous firm entry and exit suggests that this channel generates a small misallocation. This is because marginal firms that drop products due to distortions are of medium productivities. The output loss from the product extensive margin is small once the granularity of the firm size distribution is matched in the model. Most welfare loss comes from the firm extensive margin and the product intensive margin.

Empirical Analysis

We use the National Bureau of Statistics firm-level data, 1998-2007 and the Economic Census 2004 data in China. Products are defined as 5-digit SIC levels, similar to BRS (2010). In the data, the number of products is topcoded at 3. We hence focus on the dimesion of single-product versus multi-product firms.

	CN: AIES 98-07 Pooled			CN: Census	U.S.
	All	Non-SOE	Non-Exporter	2004	BRS(2010)
Number share	0.27	0.26	0.26	0.17	0.39
Output share	0.44	0.41	0.36	0.42	0.87
Relative Size	2.08	2.03	1.58	3.50	10.47

Fig. 1: Number, Output Share and Relative Size of Multi-Product Firms, China vs U.S.

Figure 1 shows that multi-product firms are fewer and smaller in China. The *fewer* result is robust to industry composition differences and possible measurement error in product definitions in the Chinese data.

We run the following regression to test if firms with a higher tax distortion is less likely to be a multi-product firm, where distortions are the TFPR measure in HK:

$$P(Multi_{ist}) = \Phi(\beta_0 + \beta_1 Distortion_{ist} + \beta_2 SOE_{ist} + \beta_3 NonExporter_{ist} + \beta_4 LogAsset_{ist} + \delta_s + \delta_t + \epsilon_{ist})$$

Figure 2 shows the negative effect are statistically significant in the baseline regression (collumn 3). The resutls are robust after controlling for markups (De Loecker and Warzynski, 2012) or contemporaneous distortions are replaced by lagged distortions.

	(1)	(2)	(3)	(4) 04-07 sub-sample	(5)	(6)	(7)
taul	-0.168***						
	(0.004)						
tauk		-0.002***					
		(0.001)					
tau			-0.088***	-0.074***			
			(0.003)	(0.005)			
markup				-0.048***			
				(0.006)			
L.tau					-0.044***		
					(0.006)		
L.multi					2.894***		
					(0.005)		
L2.tau						-0.040***	
						(0.006)	
L2.multi						2.037***	
						(0.005)	
L3.tau							-0.041***
							(0.006)
L3.multi							1.444***
							(0.005)
age	0.013***	0.013***	0.013***	0.008***	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
soe	0.047***	0.047***	0.046***	0.078***	-0.013**	-0.006	-0.009
	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)
nexporter	-0.076***	-0.089***	-0.086***	-0.076***	-0.039***	-0.054***	-0.058***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)
logasset	0.134***	0.128***	0.125***	0.106***	0.062***	0.077***	0.089***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
constant	-1.896***	-1.967***	-1.905***	-1.606***	-2.363***	-2.143***	-1.990***
	(0.011)	(0.011)	(0.011)	(0.017)	(0.022)	(0.021)	(0.023)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,432,808	1,432,808	1,432,808	640,428	831,655	570,379	376,464

Fig. 2: Higher Distortions, Less Likely Multi-Product Firms

Model

We build a general equilibrium model with firm entry and exit. Firms can choose 1 (single-product) or 2 (multi-product) products. The modelling of discrete product number choice connects tightly to the data and helps the following quantitative work, compared to models with a continuum of products (BRS, 2010; Jaef, 2018).

The household's utility function is

$$Q = \left[\int_{\omega\in\Omega} (\lambda(\omega)q(\omega))^{\rho}\, d\omega\right]^{\frac{1}{\rho}},\ 0<\rho<1 \tag{1}$$

where $q(\omega)$ and $\lambda(\omega)$ are the quantity and product appeal of the product variety ω. Households supply unskilled labor L and human capital H inelastically.

Each firm pays entry cost f_e in units of unskilled labor. Upon entry, they draw a permanent productivity $\phi \sim g(\psi)$, and two taste shocks a_1, a_2 independently from a Binomial distribution, with $P(a_i = a_h) = p, P(a_i = a_l) = 1 - p, a_l < a_h, i = 1, 2$. Potential distortions are size-dependent (Gunner, Ventura, and Xu, 2008): if $\psi > \psi_{tax}$, firms are taxed by $\tau_t > 0$; otherwise, they are subsidized by $\tau_s < 0$.

Conditional on producing, firm chooses to set price p and hire labor and human capital $\{l, h\}$, given the states of $\{\psi, a_1, a_2, \tau; P, Q\}$, a headquarter cost f_0, and a per product line fixed cost f_i:

$$\max_{p,l,h} = \{(1-\tau)p_1q_1 - w_Ll_1 - w_Hh_1 - w_Lf_0 - w_Lf_1 \\ + \mathbb{I}\left((1-\tau)p_2q_2 - w_Ll_2 - w_Hh_2 - w_Lf_2\right)\}$$

subject to

$$\text{Inverse demand:}\quad q_i = \frac{Q}{\lambda_i}\left[\frac{p_i}{\lambda_i P}\right]^{-\sigma}, i = 1, 2$$

$$\text{Linear production:}\quad q_i = l_i\varphi, \quad i = 1, 2$$

$$\text{Appeal production:}\quad \lambda_1 = a_1h_1^{\alpha}$$

$$\text{Appeal production:}\quad \lambda_2 = \xi a_2h_2^{\alpha}$$

$\xi \in [0, 1]$ span of control parameter: limited management capacity for the second product line.

The decisions on entry and the number of products are cutoff rules as in Metliz (2003). Figure 3 colors the region of firms producing 2 products in yellow, and the region of firms producing 1 product in blue. Taxes increases the cutoffs of multi-product and single-product firms, while subsidies invite low productivity firms to produce and even produce 2 products.

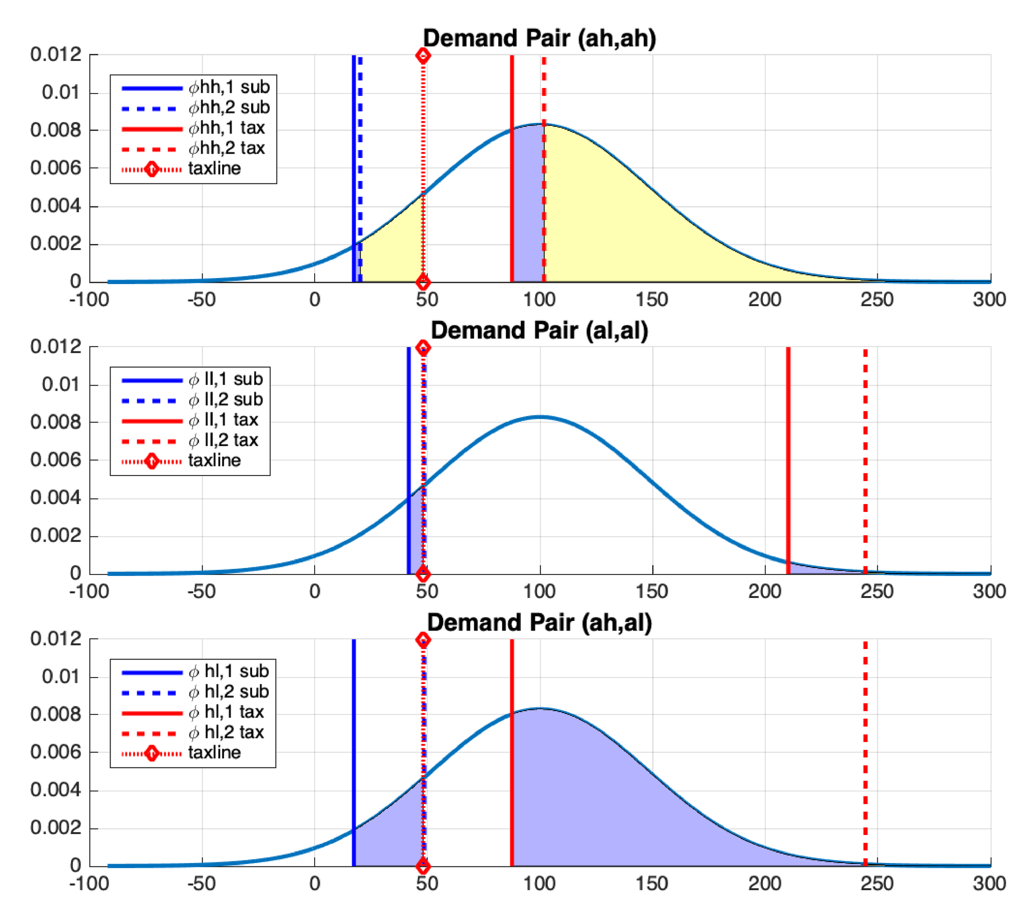

Fig. 3: How Distortions Change the Cutoffs

We solve the model in the stationary equilibrium. As in Melitz(2003), the general equilibrium are determined by the free entry condition of entrants and the markets clear conditions.

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Quantitative Analysis

We set some parameters exogenously. For example, the human capital share $\alpha = 0.2$, elasticity of substitution $\sigma = 4.5$ and the productivity distribution to be normal $\varphi \sim N(\mu_\varphi, \sigma_\varphi^2)$. We set some parameters to match the U.S. data as a distortion free economy. Importantly, we set the scale of control parameter ξ and distortion related parameter to match the multi-product firm output share and the top 5% output share in Chinese data (Figure 4). The data displays features of fat tail in output share.

Parameter	Value	Moment	Data	Model
ξ	0.865	Number Share (Multi)	0.27	0.2972
τ_t	0.615	Output Share (Multi)	0.44	0.4249
$P(\varphi > \varphi_{tax})$	0.855	Top 5% Output Share	0.61	0.6819
τ_s	−0.225	Subsidized Share	0.16	0.1590

Fig. 4: Calibration with the Chinese NBS Firm-Level Data

We look into the role of distortion by removing them in the benchmark model. Tax distortions depress welfare hugely, dropping to 29.82%. Subsidy improves welfare to 32.57% by increasing the variety of products and the measure of firms.

Moments	Data	Benchmark		$\xi = 0.865$		$\xi = 1(U.S.)$
		$\tau_{tax} \neq 0$, $\tau_{sub} \neq 0$	$\tau_{tax} = 0$, $\tau_{sub} = 0$	$\tau_{tax} \neq 0$, $\tau_{sub} = 0$	$\tau_{tax} = 0$, $\tau_{sub} \neq 0$	$\tau_{tax} = 0$, $\tau_{sub} = 0$
Number Share (Multi)	0.27	0.2972	0.3095	0.3118	0.3095	0.3829
Output Share (Multi)	0.44	0.4249	0.6208	0.6046	0.6208	0.8591
Top 5% Output Share	0.61	0.6819	0.8055	0.7942	0.8055	0.8120
Subsidized Firm Share	0.16	0.1590	0	0	0	0
Top 10% Output Share	0.71	0.8491	0.9033	0.8844	0.9033	0.9065
Drop Rate of Entries	0.31	0.4148	0.4546	0.3755	0.4546	0.4575
Subsidized MP Firm Share	0.05	0.0566	0	0	0	0.088
Measure of Firms	-	0.197	0.270	0.112	0.270	0.269
Aggregate Price	-	0.00054	0.00018	0.00052	0.00018	0.00018
Welfare	-	32.57%	100%	29.82%	100%	102.8%

Fig. 5: Counterfactual Economies for China

We decompose the welfare loss into three margins in Figure 6.

	Benchmark	PF-FF	PF	No Dist.
Measure of Firms	0.197	0.197	0.234	0.270
Aggregate Price	0.000537	0.000190	0.000187	0.000178
Welfare	32.57%	61.68%	97.77%	100%

Fig. 6: Decomposition of Misallocations into Three Margins

PF-FF: All distortions are removed while both the product cutoffs and the firm measure are fixed as in the Benchmark. PF: Distortions are removed, the firm measure adjusts while the product cutoffs are still fixed as in the Benchmark. Labor and human capital are reallocated in both cases.

The overall welfare loss is 67.43% compared to the distortion-free economy. The product extensive margin is least important, 2.23%, and the product intensive margin and firm extensive margin account for 29.11% and 36.09% respectively.

Conclusions

We find that multi-product firms are fewer and smaller in China, and the product extensive margin of distortion is statistically significant in Probit regressions.

To quantify the effects of distortions, we build a discrete multi-product choice model with endogenous firm entry and exit and calibrate it to match the China data. The model theoretically confirms the product extensive margin of distortions, but quantitatively the welfare loss is much smaller through this margin, compared to the product intensive margin and firm extensive margin.