Online Appendices

Appendix A: Proofs

Proof of Lemma 1. The proof follows from noting that, since $T > 0$ and $d(r)^{-\theta} < 1$, (7) and (8) imply that $c_{j,A} < c_{j,B}$ when $0 \le \alpha_j < \frac{1}{2}$, $c_{j,A} > c_{j,B}$ when $\frac{1}{2} < \alpha_j \le 1$, and $c_{j,A} = c_{j,B}$ when $\alpha_j = \frac{1}{2}$. ■

Proof of Lemma 2. The first part of the lemma follows immediately from (9), bearing in mind that Assumption 2 means $d(r_1)^{-\theta} < d(r_2)^{-\theta}$.

To prove the second part, apply logs on the ratio $c_j(r_1)/c_j(r_2)$, which using the expressions in (9) leads to:

$$\ln\left(\frac{c_j(r_1)}{c_j(r_2)}\right) = \begin{cases} \frac{1}{\theta}\left[(1-\alpha_j)\ln\left(\frac{(1+T)+d(r_2)^{-\theta}}{(1+T)+d(r_1)^{-\theta}}\right) + \alpha_j \ln\left(\frac{1+(1+T)d(r_2)^{-\theta}}{1+(1+T)d(r_1)^{-\theta}}\right)\right] & \text{if } \alpha_j \in \left[0, \frac{1}{2}\right], \\ \frac{1}{\theta}\left[(1-\alpha_j)\ln\left(\frac{1+(1+T)d(r_2)^{-\theta}}{1+(1+T)d(r_1)^{-\theta}}\right) + \alpha_j \ln\left(\frac{(1+T)+d(r_2)^{-\theta}}{(1+T)+d(r_1)^{-\theta}}\right)\right] & \text{if } \alpha_j \in \left[\frac{1}{2}, 1\right]. \end{cases} \tag{21}$$

Consider first the case when $\alpha_j \le 0.5$. Differentiating the relevant expression in (21) with respect to α_j, it follows that

$$\frac{\partial\left(\ln(c_j(r_1)/c_j(r_2)\right)}{\partial \alpha_j} > 0 \quad \Leftrightarrow \quad \frac{1+(1+T)\,d(r_2)^{-\theta}}{(1+T)+d(r_2)^{-\theta}} > \frac{1+(1+T)\,d(r_1)^{-\theta}}{(1+T)+d(r_1)^{-\theta}},$$

which holds holds true since $T > 0$ and $d(r_2)^{-\theta} > d(r_1)^{-\theta}$. Similarly, considering the case when $\alpha_j \ge 0.5$, and differentiating the relevant part of (21) with respect to α_j, it follows now that

$$\frac{\partial\left(\ln(c_j(r_1)/c_j(r_2)\right)}{\partial \alpha_j} < 0 \quad \Leftrightarrow \quad \frac{1+(1+T)\,d(r_2)^{-\theta}}{(1+T)+d(r_2)^{-\theta}} > \frac{1+(1+T)\,d(r_1)^{-\theta}}{(1+T)+d(r_1)^{-\theta}}.$$

Therefore, the ratio $c_j(r_1)/c_j(r_2)$ is strictly increasing in α_j whenever $\alpha_j < 0.5$, while it is strictly decreasing in α_j whenever $\alpha_j > 0.5$. In addition, by continuity, the ratio $c_j(r_1)/c_j(r_2)$ must reach a global maximum at $\alpha_j = 0.5$. ■

Proof of Proposition 1. As a preliminary step, notice that using $w_F = 1$, $\omega = w_H/w_F$, and $d_F = \lambda d_H$, we then can observe that

$$\frac{\chi_{j,H}}{\chi_{j,F}} = \begin{cases} \omega\left[\frac{(1+T)+(\lambda d_H)^{-\theta}}{(1+T)+d_H^{-\theta}}\right]^{(1-\alpha_j)/\theta}\left[\frac{(1+T)\,(\lambda d_H)^{-\theta}+1}{(1+T)d_H^{-\theta}+1}\right]^{\alpha_j/\theta} & \text{if } \alpha_j \le 0.5, \\ \omega\left[\frac{(1+T)\,(\lambda d_H)^{-\theta}+1}{(1+T)d_H^{-\theta}+1}\right]^{(1-\alpha_j)/\theta}\left[\frac{(1+T)+(\lambda d_H)^{-\theta}}{(1+T)+d_H^{-\theta}}\right]^{\alpha_j/\theta} & \text{if } \alpha_j \ge 0.5, \end{cases} \tag{22}$$

where recall that the $\chi_{j,C}$ are implicitly defined by (14) and (12).

Suppose now that $\omega = 1$. Then, given that Assumption 3 means that $\lambda > 1$, it follows from (22) that when $\omega = 1$, the ratio $\chi_{j,H}/\chi_{j,F} < 1$. Furthermore, notice that in equilibrium the following trade balance condition must hold:

$$\int_0^1 \pi_H(j)\, dj = \omega^* \int_0^1 \pi_F(j)\, dj. \tag{23}$$

To ease notation, let now $\Xi(\omega) \equiv \chi_{j,H}/\chi_{j,F}$, given the value of ω, and notice from (22) that $\Xi'(\omega) > 0$ and $\lim_{\omega\to\infty} \Xi(\omega) = \infty$. Plugging thus the respective expression of (15) into (23), combined with $\omega^* = 1$, implies that for $\omega = 1$ to hold in equilibrium,

$$\int_0^1 \left[1 + \tau^{\vartheta}\, \Xi(1)^{\vartheta}\right]^{-1} dj = \int_0^1 \left[1 + \tau^{\vartheta}\, \Xi(1)^{-\vartheta}\right]^{-1} dj,$$

must hold true. However, $\Xi(1) < 1$ means that $\int_0^1 \left[1 + \tau^{\vartheta}\, \Xi(1)^{\vartheta}\right]^{-1} dj > \int_0^1 \left[1 + \tau^{\vartheta}\, \Xi(1)^{-\vartheta}\right]^{-1} dj$, hence there cannot exist an equilibrium where $\omega = 1$. Furthermore, the fact that $\Xi'(\omega) > 0$ and $\lim_{\omega\to\infty} \Xi(\omega) = \infty$ implies that there must exist some value $\omega^* > 1$ such that it verifies (23), and that this ω^* must be unique. Finally, the results $\partial\omega^*/\partial\lambda > 0$ and $\lim_{\lambda\to 1} \omega^*(\lambda) = 1$ follow straightforwardly from observing from (22) that the ratio $\chi_{j,H}/\chi_{j,F} < 1$ is strictly decreasing in λ and that $\lim_{\lambda\to 1}(\chi_{j,H}/\chi_{j,F}) = 1$. ■

Proof of Proposition 2. To prove the first two results, note that using (15), we can write:

$$\pi_H(j) = \frac{\tau^{-\vartheta}}{\tau^{-\vartheta} + \left(\chi_F(j)/\chi_H(j)\right)^{-\vartheta}} \qquad \text{and} \qquad \pi_F(j) = \frac{\tau^{-\vartheta}}{\tau^{-\vartheta} + \left(\chi_H(j)/\chi_F(j)\right)^{-\vartheta}}. \tag{24}$$

Furthermore, differentiating (22) with respect to α_j, the following result obtains:

$$\begin{aligned} \frac{\partial\left(\chi_{j,H}/\chi_{j,F}\right)}{\partial\alpha_j} &< 0, \qquad \text{for all } 0 \le \alpha_j < \frac{1}{2}; \\ \frac{\partial\left(\chi_{j,H}/\chi_{j,F}\right)}{\partial\alpha_j} &> 0, \qquad \text{for all } \frac{1}{2} < \alpha_j \le 1. \end{aligned} \tag{25}$$

Therefore, using (24) together with (25), the results concerning $\partial\pi_H/\partial\alpha_j$ and $\partial\pi_F/\partial\alpha_j$ below and above $\alpha_j = \frac{1}{2}$ immediately obtain.

Next, to prove the last result, recall that the trade balance equilibrium requires that (23) holds true. Then, given that in equilibrium $\omega^* > 1$, from (23) it follows that there must necessarily exist a positive mass of j for which $\pi_H(j) > \pi_F(j)$. As a result, given that the ratio $\pi_H(j)/\pi_F(j)$ is highest at $\alpha_j = \frac{1}{2}$, it must be that $\pi_H(\alpha_j = \frac{1}{2}) > \pi_F(\alpha_j = \frac{1}{2})$. ■

Proof of Proposition 3. In the sake of brevity, we carry out the proof only for the case in which $\alpha_j \leq 0.5$. (The extension of the proof to the case in which $\alpha_j \geq 0.5$ is straightforward, and it is available from the author upon request.)

To carry out the proof for H's exports, it proves convenient to first define

$$\varphi_H(\cdot) \equiv \left(\frac{\tau \chi_{j,H}}{\chi_{j,F}}\right)^{\vartheta}, \tag{26}$$

and notice from (22) that, when holding constant r_F, we have that $\partial\varphi_H/\partial r_H = (\partial\varphi_H/\partial d_H) \times (\partial d_H/\partial r_H) < 0$ and $\partial\varphi_H/\partial\alpha_j < 0$. Now, replacing (26) into (15), we can observe that, when holding constant r_F, we have that

$$\frac{\partial \pi_H}{\partial r_H} = -\left(1+\varphi_H(\cdot)\right)^{-2}\left(\frac{\partial\varphi_H}{\partial d_H} \times \frac{\partial d_H}{\partial r_H}\right) > 0. \tag{27}$$

Differentiating (27) with respect to α_j, in turn, yields:

$$\frac{\partial\left(\partial\pi_H/\partial r_H\right)}{\partial\alpha_j} = -\left(1+\varphi_H(\cdot)\right)^{-2}\frac{\partial^2\varphi_H}{\partial d_H \partial\alpha_j}\frac{\partial d_H}{\partial r_H} + 2\left(1+\varphi_H(\cdot)\right)^{-3}\left(\frac{\partial\varphi_H}{\partial d_H}\cdot\frac{\partial d_H}{\partial r_H}\right)\frac{\partial\varphi_H}{\partial\alpha_j} > 0, \tag{28}$$

where the positive sign in (28) follows from the fact that $\partial\varphi_H/\partial d_H > 0$, $\partial d_H/\partial r_H < 0$, $\partial\varphi_H/\partial\alpha_j < 0$, and $\partial^2\varphi_H/\left(\partial d_H\partial\alpha_j\right) > 0$.[43]

To carry out the proof for F's exports, note from (22) that using (26) we can write the probability that F exports final good j as follows:

$$\pi_F(j) = \frac{\varphi_H(\cdot)}{\tau^{2\vartheta} + \varphi_H(\cdot)}. \tag{29}$$

Differentiating (29) with respect to r_H, while holding r_F fixed, we obtain

$$\frac{\partial\pi_F}{\partial r_H} = \tau^{2\vartheta}(\tau^{2\vartheta} + \varphi_H(\cdot))^{-2}\left(\frac{\partial\varphi_H}{\partial d_H} \times \frac{\partial d_H}{\partial r_H}\right) < 0. \tag{30}$$

Differentiating (30) with respect to α_j, in turn, yields:

$$\frac{\partial\left(\partial\pi_F/\partial r_H\right)}{\partial\alpha_j} = \tau^{2\vartheta}(\tau^{2\vartheta} + \varphi_H(\cdot))^{-2}\frac{\partial^2\varphi_H}{\partial d_H\partial\alpha_j}\frac{\partial d_H}{\partial r_H} - 2\tau^{2\vartheta}\left(\tau^{2\vartheta} + \varphi_H(\cdot)\right)^{-3}\left(\frac{\partial\varphi_H}{\partial d_H}\frac{\partial d_H}{\partial r_H}\right)\frac{\partial\varphi_H}{\partial\alpha_j} < 0, \tag{31}$$

[43] To see that $\partial^2\varphi_H/\left(\partial d_H\partial\alpha_j\right) > 0$, notice from (22) that, when $\alpha_j \leq 0.5$, after replacing $d_L = \lambda d_H$, and holding d_L constant, differentiating with respect to α_j :

$$\begin{aligned}\frac{\partial\left(\chi_{j,H}/\chi_{j,F}\right)}{\partial\alpha_j} &= \frac{1}{\theta}\left[\frac{(1+T)d_L+1}{d_L}\right]^{1/\theta}\left[\frac{d_H}{(1+T)d_H+1}\right]^{1/\theta} \\ &\quad \left[\frac{(1+T)+d_L}{(1+T)d_L+1}\frac{(1+T)d_H+1}{(1+T)+d_H}\right]^{\alpha_j/\theta}\ln\left[\frac{(1+T)+d_L}{(1+T)d_L+1}\frac{(1+T)d_H+1}{(1+T)+d_H}\right],\end{aligned}$$

from where it follows that $\partial^2\left(\chi_{j,H}/\chi_{j,F}\right)/\left(\partial\alpha_j\partial d_H\right) > 0$, and bearing in mind (26) yields $\partial^2\varphi_H/\left(\partial d_H\partial\alpha_j\right) > 0$.

where the negative sign in (31) follows from $\partial\varphi_H/\partial d_H > 0$, $\partial d_H/\partial r_H < 0$, $\partial\varphi_H/\partial\alpha_j < 0$, and $\partial^2\varphi_H/\left(\partial d_H \partial\alpha_j\right) > 0$. ■

Proof of Proposition 4. To prove the result, note first that the probability that country C exports good j_k to country $-C$ is given by

$$\pi_C(j_k) = \frac{1}{1+\tau^{\vartheta}\left(\frac{\chi_{j_k,C}}{\chi_{j_k,-C}}\right)^{\vartheta}}. \tag{32}$$

Hence, $\pi_C(j_k)$ is decreasing in the ratio $\chi_{j_k,C}/\chi_{j_k,-C}$. Next, note that from (18), it follows that

$$\frac{\partial \ln\left(\frac{\chi_{j_k,H}}{\chi_{j_k,F}}\right)}{\partial\gamma_{j_k}} = \frac{1}{2\theta}\left\{\ln\left[\frac{(1+T)+(\lambda d_H)^{-\theta}}{(1+T)+d_H^{-\theta}}\right] - \frac{N}{(N-1)}\ln\left[\frac{1+(1+T)\,(\lambda d_H)^{-\theta}}{1+(1+T)\,d_H^{-\theta}}\right]\right\}. \tag{33}$$

As a consequence, a sufficient condition for $\partial\left(\chi_{j_k,H}/\chi_{j_k,F}\right)/\partial\gamma_{j_k} < 0$ is that

$$\ln\left[\frac{(1+T)+(\lambda d_H)^{-\theta}}{(1+T)+d_H^{-\theta}}\right] < \ln\left[\frac{1+(1+T)\,(\lambda d_H)^{-\theta}}{1+(1+T)\,d_H^{-\theta}}\right],$$

which it is actually the case given that $T > 0$. Therefore, combining $\partial\left(\chi_{j_k,H}/\chi_{j_k,F}\right)/\partial\gamma_{j_k} < 0$ with (32), the derivatives $\partial\pi_H/\partial\gamma_{j_k} < 0$ and $\partial\pi_F/\partial\gamma_{j_k} > 0$ obtain. Lastly, the proof that $\pi_H(\gamma_{j_k} = 0) > \pi_F(\gamma_{j_k} = 0)$ follows from the fact that $\partial\pi_H/\partial\gamma_{j_k} < 0$ and $\omega^* > 1$, since if $\pi_H(\gamma_{j_k} = 0) \leq \pi_F(\gamma_{j_k} = 0)$ with $\omega^* > 1$, then H would be running a trade deficit with F. ■

Proof of Gini$_{j_k}$= γ_{j_k}. Applying the formula to compute the Gini coefficient to the input expenditure shares, we have that

$$Gini_{j_k} = \frac{2\times\sum_{n=1}^{N} n\times S_{j_k,n}}{N\times\sum_{n=1}^{N} S_{j_k,n}} - \frac{N+1}{N}, \tag{34}$$

where $S_{j_k,n}$ denotes the share intermediate sector $n \in \{1, 2, ..., N\}$ over the total value of intermediates purchased by final sector j_k, and where argument $\sum_{n=1}^{N} n\times S_{j_k,n}$ in the numerator of the first member of (34) is ordering $S_{j_k,n}$ non-decreasing order (i.e., $S_{j_k,n} \leq S_{j_k,n+1}$). Note now that (16) implies that $S_{j_k,n} = \frac{1}{N} - \frac{\gamma_{j_k}}{N-1}$ for all $n \neq k$, and that $S_{j_k,k} = \frac{1}{N} + \gamma_{j_k}$. Plugging these expressions into (34), we can then obtain

$$Gini_{j_k} = 2\times\frac{\left(\frac{1}{N} - \frac{\gamma_{j_k}}{N-1}\right)\left(\sum_{n=1}^{N-1} n\right) + N\left(\frac{1}{N} + \gamma_{j_k}\right)}{N\times\left[(N-1)\left(\frac{1}{N} - \frac{\gamma_{j_k}}{N-1}\right) + \left(\frac{1}{N} + \gamma_{j_k}\right)\right]} - \frac{N+1}{N}. \tag{35}$$

Using finally the fact that $\sum_{n=1}^{N-1} n = \frac{(N-1)N}{2}$ into (35), the result $Gini_{j_k} = \gamma_{j_k}$ eventually obtains after some algebra. ■

Appendix B: Additional Empirical Results

B.1 Complementary Results for Section 5.3

Table A.1 shows the results of a set of regressions that include only the interaction term between road density and a number of measures of input narrowness. Column (1) of Table A.1 reproduces the same regression as in column (1) of Table I in the main text where input narrowness is measured by the Gini coefficient. Next, columns (2) - (4) of Table A.1 display the results of this simple correlation when input narrowness is measured by three alternative measures: the Herfindahl index, the coefficient of variation, and the log-variance of industry k's intermediates expenditure shares. As it can be observed, the estimate of β is negative and highly significant under all these alternative measures as well.[44]

TABLE A.1

Export Specialization across Industries with Different Levels of Input Narrowness

	(1)	(2)	(3)	(4)
Road Density x Input Narrowness	-4.084***	-0.710***	-0.034***	-0.122***
	(0.305)	(0.141)	(0.004)	(0.012)
Observations	42,578	42,578	42,578	42,578
R-squared	0.765	0.764	0.764	0.764
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Number of Countries	166	166	166	166
Number of Industries	294	294	294	294
Narrowness Measure	Gini	Herf	Coef Var	Log Var

Robust standard errors reported in parentheses. The dependent variable is the log of total exports in industry k by country c in year 2014.
*** p<0.01, ** p<0.05, * p<0.1

Table A.2 and A.3 show the results of a set of regressions, analogous to some of those previously presented in Section 5.3, but where the measure of the density of the transport network is either changed or expanded. In Table A.2, road density is replaced by railway density, as our main measure of depth of local transport network. All the results follow a similar pattern as those in Section 5.3. In Table A.3, we expand the measure of transport

[44] Note that the magnitudes of the different estimates of β in Table A.1 are not directly comparable to one another, as their effects should be computed at the relevant values of each of the alternative measures of input narrowness. To get an idea of the actual magnitudes, computing the effect of an increase in one standard deviation of road density on exports of industries in the 90th percentile vs. those in the 10th percentile of the input narrowness, the increase in exports when using the Gini is 33.8% higher for the former than for the latter. When using the Herfindahl index the increase differential is 16.9% higher for the 90th relative to the 10th percentile; when using the coefficient of variation this gap is 24.0%; and when using the log-var is 28.4%.

network density to include, in addition to roadways, also railways and waterways. In this case, the density of the transport network of country c is measured as the sum of total kilometers of roadways, railways and waterways, divided by the area of the country. Again, all the results follow a similar pattern as those in Section 5.3.[45]

Table A.4 provides additional robustness checks, by restricting the samples of the regressions reported in column (5) of Table I on a number of dimensions, and also by adding a few additional covariates to that regression. Column (1) restricts the sample to countries with area greater than 10,000 sq km, while column (2) restricts the sample to countries with population larger than half million inhabitants. Results remain qualitatively unaltered when we exclude small countries (either in size or population) from the sample. Column (3) excludes very large countries in terms of their size. In particular, we drop from the sample countries whose area is larger than 3,000,000 sq km.[46] The rationale for this additional robustness check is to account for the possibility that results may be affected by the fact that some very large countries may also have large swaths of uninhabitable land. Next, column (4) uses again the entire sample of countries, but adds interactions terms between countries log area and $Gini_k$, and between log population and $Gini_k$. This would control for the possibility that larger countries may offer more opportunity for input diversity than smaller countries. Column (5) includes an interaction term log GDP and $Gini_k$, in case the aggregate size of the economy may have some impact on specialization in sectors with different degrees of input narrowness. Finally, one additional issue that may raise some concern is the fact that the road data come from a broad range of years, from 2000 to 2015, while the export data is only from year 2014. In order to assess whether such heterogeneity in the data creates serious problems to our estimates, we restrict the sample of countries in columns (6) and (7), so as to have a more temporally homogenous one. In particular, column (6) excludes from the sample countries whose road network was measured before year 2010, which corresponds to the median year in the sample (see details in Table A.10 in Appendix C). Even more stringently, column (7) restricts the sample of countries to those whose roads were measured either in year 2010 or 2011. Again, all our estimates remain qualitatively unaltered in both subsamples.

[45] Note that for many countries we do not have information on railways or waterways, while we do have information on roadways. For additional comparison, in columns (4), (5) and (6), we also include countries with missing information on either railways or waterways (or in both), replacing the missing values by zeros.

[46] This excludes the following seven countries from the sample: Russia, Canada, United States, China, Brazil, Australia and India. The results are robust to setting the area-threshold for exclusion on alternative levels, such as at 7,000,000 km^2 (which would leave India within the sample), or at 2,000,000 km^2 (which would additionally remove Argentina, Algeria, Congo, and Saudi Arabia from the sample).

TABLE A.2

Transport Density measured by Railway Density

	(1)	(2)	(3)	(4)
Railway Density x Gini	-2.281***	-1.189***	-0.903***	-0.885***
	(0.133)	(0.159)	(0.162)	(0.163)
Rule of Law x Gini		-1.567**	-2.408***	-2.359***
		(0.766)	(0.824)	(0.828)
Financial Development x Gini		-4.328***	-2.048**	-2.031**
		(0.936)	(1.006)	(1.007)
log GDP per capita x Gini		-0.442	0.574	0.979
		(0.746)	(0.782)	(0.775)
Capital Intensity x log (*K/L*)			0.009*	
			(0.005)	
Skill Intensity x Human Capital			0.007***	
			(0.001)	
Observations	33,099	32,153	26,444	26,444
R-squared	0.754	0.756	0.794	0.793
Number of Countries	122	118	109	109
Number of Industries	294	294	259	259

Robust standard errors in parentheses. All regressions include country and industry fixed effects. Railway density equals total length of the railway network in km, divided by the area measured in sq km. Data of railway network length is taken from the CIA factbook. *** p<0.01, ** p<0.05, * p<0.1

TABLE A.3

Transport density measured by sum of roadways, railways and waterways per square km

	(1)	(2)	(3)	(4)	(5)	(6)
Transp. (road + rail + waterway) Density x Gini	-7.268***	-2.680***	-1.519***	-4.108***	-2.376***	-1.881***
	(0.519)	(0.598)	(0.587)	(0.302)	(0.361)	(0.375)
Rule of Law x Gini		-2.381***	-2.892***		-2.394***	-3.091***
		(0.900)	(0.936)		(0.703)	(0.764)
Financial Development x Gini		-4.304***	-2.487**		-3.537***	-1.698*
		(1.072)	(1.114)		(0.822)	(0.913)
log GDP per capita x Gini		-0.872	-0.054		-0.410	0.911
		(0.874)	(0.933)		(0.602)	(0.656)
Capital Intensity x log (*K/L*)			0.009			0.010**
			(0.006)			(0.004)
Skill Intensity x Human Capital			0.007***			0.008***
			(0.002)			(0.001)
Observations	25,180	24,234	21,014	42,578	40,692	31,892
R-squared	0.768	0.769	0.805	0.765	0.764	0.794
Number of Countries	92	88	86	166	157	134
Number of Industries	294	294	259	294	294	259

Robust standard errors in parentheses. All regressions include country and industry fixed effects. Columns (1) to (3) only include observations where information on all transport measures (i.e., roadway, railway and waterway) is available. Columns (4) to (6) also include observations where information on either railway or waterway (or both) are missing, replacing the missing values by zero. *** p<0.01, ** p<0.05, * p<0.1

TABLE A.4

Additional Robustness Checks: area, population and year of roads in sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Road Density x Gini	-2.589***	-1.767***	-2.034***	-1.584***	-1.733***	-1.748***	-1.831***
	(0.579)	(0.399)	(0.514)	(0.485)	(0.512)	(0.511)	(0.667)
Rule of Law x Gini	-2.869***	-3.929***	-3.172***	-3.363***	-3.350***	-2.888***	-2.615**
	(0.804)	(0.833)	(0.788)	(0.769)	(0.770)	(0.842)	(1.186)
Financial Development x Gini	-1.687*	-0.793	-1.611*	-1.422*	-1.600*	-2.123**	-3.288**
	(0.950)	(0.961)	(0.928)	(0.922)	(0.940)	(1.099)	(1.484)
log GDP per capita x Gini	0.889	0.797	0.983	0.736	5.417	0.207	1.076
	(0.676)	(0.677)	(0.663)	(0.665)	(5.263)	(0.821)	(1.234)
Capital Intensity x log (*K/L*)	0.009***	0.011**	0.009**	0.010**	0.010**	0.017***	0.023***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.007)
Skill Intensity x Human Capital	0.007***	0.006***	0.007***	0.008***	0.008***	0.012***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
log area x Gini				0.606	0.572		
				(0.397)	(0.398)		
log population x Gini				-1.107**	3.599		
				(0.453)	(5.310)		
log GDP x Gini					-4.666		
					(5.229)		
Observations	29,760	30,085	30,817	31,892	31,892	24,467	13,119
R-squared	0.796	0.780	0.794	0.794	0.794	0.792	0.788
Number of Countries	125	127	129	134	134	101	55
Number of Industries	259	259	259	259	259	294	294
Sample (countries)	> 10 000 km^2	> 500,000 pop	< 3 million km^2	all	all	year roads 2010+	year roads 2010-11

Robust standard errors in parentheses. All regressions include country and industry fixed effects. Column (1) excludes countries whose area is smaller than 10,000 km^2. Column (2) excludes countries whose population is below 500,000 inhabitants. Column (3) excludes countries with area larger than 3,000,000 km^2. Column (6) excludes countries for which the measure of road density in the dataset was recorded before 2010, and column (7) includes only countries whose road length is measured in either year 2010 or 2011. *** p<0.01, ** p<0.05, * p<0.1

TABLE A.5

Additional Robustness Checks: Paved Roads Density

	(1)	(2)	(3)	(4)
(Paved) Road Density x Gini	-2.433***		-1.880***	
	(0.431)		(0.441)	
Road Density x Gini		-2.243***		-1.767***
		(0.376)		(0.393)
Rule of Law x Gini	-1.877**	-1.934**	-2.631***	-2.608***
	(0.788)	(0.785)	(0.838)	(0.838)
Financial Development x Gini	-4.284***	-4.219***	-2.269**	-2.299**
	(0.939)	(0.939)	(1.024)	(1.024)
log GDP per capita x Gini	-0.252	-0.213	1.031	1.071
	(0.644)	(0.644)	(0.704)	(0.704)
Capital Intensity x log (*K/L*)			0.009*	0.009*
			(0.005)	(0.005)
Skill Intensity x Human Capital			0.007***	0.007***
			(0.001)	(0.001)
Observations	33,868	33,868	26,703	26,703
R-squared	0.754	0.754	0.782	0.782
Number of Countries	131	131	112	112
Number of Industries	294	294	294	259

Robust standard errors reported in parentheses. All regressions include country fixed effects and industry fixed effects. The interaction term (Paved) Road Density x Input Narrowness is computed using the share of roads that are defined as paved by the International Road Federation and the World Road Statistics. Countries whose share of paved roads data is dated before 2000 were dropped from the sample. *** p<0.01, ** p<0.05, * p<0.1

TABLE A.6

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
log (Road Density) x Gini	-5.080***	-3.465***	-3.264***	-3.255***	-2.300***	-2.276***	-2.288***
	(0.295)	(0.363)	(0.378)	(0.381)	(0.408)	(0.408)	(0.418)
Rule of Law x Gini		-3.875***	-2.102***	-2.059***	-2.827***	-2.748***	-2.822***
		(0.483)	(0.647)	(0.699)	(0.765)	(0.767)	(0.766)
Financial Development x Gini			-2.674***	-2.633***	-1.152	-1.135	-1.149
			(0.774)	(0.830)	(0.917)	(0.920)	(0.925)
log GDP per capita x Gini				-0.093	1.084*	1.484**	1.080
				(0.605)	(0.658)	(0.656)	(0.665)
Capital Intensity x log (*K/L*)					0.010**		0.010**
					(0.004)		(0.004)
Skill Intensity x Human Capital					0.008***		0.008***
					(0.001)		(0.001)
(Pop) Density x Gini							-0.009
							(0.098)
log (Road Density) x (Pop) Density x Gini							0.002
							(0.075)
Observations	42,578	41,947	40,692	40,692	31,892	31,892	31,892
R-squared	0.765	0.764	0.764	0.764	0.794	0.793	0.794
Number of Countries	163	163	157	157	134	134	157
Number of Industries	294	294	294	294	259	259	259

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As one additional robustness check, Table A.5 shows the results corresponding to the previous regressions in columns (4) and (5) of Table I, but computing the variable 'road density' using only the total length of *paved* roads.[47] Note that in Table A.5 some of the original countries in the regressions reported in Table I were lost (this is due to lack of sufficiently updated data on share of paved roads for some of the original countries). For that reason, in the sake of comparability, Table A.5 reports in columns (2) and (4) the regressions of the relevant restricted sample of countries, in which 'road density' is computed with both paved and unpaved roads, as previously done in the main text. Besides the fact that results still hold through, an interesting observation is that the estimate for the interaction term using *only* paved roads is (in absolute terms) quantitatively greater than that one obtained when it includes *both* paved and unpaved roads. This is indeed the kind of behavior one should expect to see if paved roads provide better quality transportation infrastructure than unpaved roads. Lastly, Table A.6 repeats the regressions previously displayed in Table I in the main text, but using the logarithm of roadways per area –i.e., $log(roadways_c/area_c)$– for the variable r_c instead of 'roadways density' as roadways length (measured in km.) divided by countries' area (measured in square km.).

[47] The information on the share of paved roads by country is drawn from the *World Road Statistics* by the *International Road Federation.*

B.2 Complementary Results for Section 6.1.1

TABLE A.7

Additional Robustness Checks: Waterways Density

	(1)	(2)	(3)	(4)
Waterways Density x Gini	-1.634***	-1.921***	-2.037***	-2.155***
	(0.584)	(0.606)	(0.592)	(0.614)
Waterways Density x Gini x log Income	0.486***	0.554***	0.738***	0.702***
	(0.174)	(0.180)	(0.183)	(0.189)
Rule of Law x Gini	-4.968***	-4.731***	-3.420***	-3.811***
	(0.822)	(0.853)	(0.875)	(0.904)
Financial Development x Gini	-2.745**	-1.037	-2.793***	-1.076
	(1.071)	(1.112)	(1.071)	(1.113)
log GDP per capita x Gini	-1.174	-0.235	-1.052	-0.145
	(0.854)	(0.905)	(0.854)	(0.906)
Capital Intensity x log (*K/L*)		0.007		0.007
		(0.006)		(0.006)
Skill Intensity x Human Capital		0.007***		0.007***
		(0.001)		(0.001)
Road Density x Input Narrowness			-3.903***	-2.328***
			(0.757)	(0.744)
Observations	25,975	22,357	25,975	22,357
R-squared	0.775	0.811	0.775	0.811
Number of Countries	96	93	96	93
Number of Industries	294	259	294	259

Robust standard errors in parentheses. All regressions include country and industry fixed effects. The dependent variable is log($Expo_{c,k}$) in year 2014. Waterways data id taken from the CIA World Factbook, and comprises total length of navigable rivers, canals and other inland water bodies. Waterway density equals internal waterways per square km. ***p<0.01, **p<0.05, *p<0.1

Table A.7 shows the results of regressions analogous to those in Table III in the main text, but instead of splitting the sample of countries according to their income per head, it introduces a triple interaction term between waterway density, the degree of input narrowness and the (log) income per head of countries.

The results in Table A.7 are consistent with those of Table III. In particular, we can see that the triple interaction term carries always a positive and significant coefficient. This suggests that the positive effect of waterways density on specialization in industries with broad input bases tends to be lower for richer economies than it is for lower-income countries.

B.3 Complementary Results for Section 6.1.2

Table A.8 shows in columns (1) - (3) the simple correlation between the different used measures of terrain roughness in country c and road density in c. In all three cases the simple correlation between the variables is negative and highly significant. Next, in columns (4) - (6), we add

TABLE A.8

Terrain Roughness and Road Density

	Dependent Variable: Roads per Km^2					
	(1)	(2)	(3)	(4)	(5)	(6)
Elevation Difference	-0.020***			-0.012**		
	(0.006)			(0.005)		
Std. Dev. Elevation		-0.591***			-0.363**	
		(0.184)			(0.153)	
% Mountainous			-0.835***			-0.534**
			(0.296)			(0.232)
Ruggedness						
Rule of Law				0.371***	0.329***	0.404***
				(0.117)	(0.112)	(0.118)
Financial Development				0.045	-0.038	-0.046
				(0.133)	(0.114)	(0.098)
log Income				-0.091	-0.275	-0.167
				(0.219)	(0.204)	(0.164)
Human Capital Index				-0.028	-0.076	-0.099
				(0.202)	(0.232)	(0.237)
log $(K/L)_c$				0.257	0.468***	0.364***
				(0.188)	(0.146)	(0.134)
Observations	166	140	142	134	122	126
R-squared	0.100	0.051	0.037	0.306	0.366	0.383

Robust standard reported errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

some additional country-level controls that may be affecting road density (and which are used in the regressions in the main text interacted with industry-level variables). As it can be readily seen, the partial correlation between the three measures of terrain roughness and road density always remains negative and highly significant.

Table A.9 displays the results of a set of regressions that simultaneously include together as independent variables $r_c \times Gini_k$ and terrain roughness interacted with $Gini_k$. The rationale for these regressions is to try to get some sense of whether, after controlling for the effect of the internal roadway network, terrain roughness may still display a systematic impact on specialization across industries with different degrees of input narrowness. As it can be observed, once the regressions control for the effect of road density, the measures of terrain roughness tend not to exhibit a significant effect on industry specialization.[48] Table A.8 does not represent any sort of test about the validity of the exclusion restriction in the regressions in Table IV. (In fact, there is no way to test the validity of the exclusion restriction in the context of our paper.) Yet, those results are comforting, in the sense that they somehow tame the concerns that the

[48] The only exception is column (1), where the coefficient is positive and significant at 10%. This estimate would imply that terrain roughness is associated with lower specialization in industries with wide input bases, even after controlling for the impact of road density. Notice, however, that the significance disappears in column (2), after we control for the effect of factor endowments.

TABLE A.9

Direct Effect of Terrain Roughness

	(1)	(2)	(3)	(4)	(5)	(6)
Road Density x Gini	-2.180***	-1.771***	-3.252***	-2.086***	-3.277***	-1.884***
	(0.380)	(0.394)	(0.521)	(0.554)	(0.516)	(0.526)
Rule of Law x Gini	-2.233***	-2.995***	-2.160***	-2.693***	-2.047***	-3.095***
	(0.707)	(0.777)	(0.729)	(0.802)	(0.739)	(0.792)
Financial Development x Gini	-3.648***	-1.761**	-4.174***	-2.728***	-4.051***	-1.600*
	(0.822)	(0.910)	(0.877)	(0.953)	(0.872)	(0.937)
log GDP per capita x Gini	-0.494	0.844	0.133	1.106	0.078	0.948
	(0.605)	(0.665)	(0.669)	(0.720)	(0.641)	(0.675)
Capital Intensity x log (K/L)		0.010**		0.009**		0.008*
		(0.004)		(0.005)		(0.004)
Skill Intensity x Human Capital		0.008***		0.007***		0.008***
		(0.001)		(0.001)		(0.001)
Terrain Roughness x Gini	***0.376****	***0.186***	***1.331***	***1.601***	***0.015***	***0.027***
	(0.210)	***(0.228)***	***(1.293)***	***(1.427)***	***(0.022)***	***(0.025)***
Measure of Terrain Roughness	Elevation Difference (CIA Wolrd Factbook)		Std. Dev. Elevation (Ramcharan, 2009)		% Mountainous Terrain (Fearon and Laitin, 2003)	
Observations	40,692	31,892	35,988	29,229	36,544	30,067
R-squared	0.764	0.794	0.764	0.794	0.757	0.795
Number of Countries	157	134	137	122	138	126
Number of Industries	294	259	294	259	294	259

Robust standard errors in parentheses. All regressions include country and industry fixed effects. 'Terrain Roughness' is measured in column (1) and (2) by the difference between the max and min elevation within country *c* (source: CIA Factbook), in columns (3) and (4) by the std dev of elevation in country c at the 30" resolution (source: Ramcharan, 2009), and in columns (8) and (10) by the percentage of mountainous in terrain in country *c* (source: Fearon and Laitin, 2003).
*** p<0.01, ** p<0.05, * p<0.1

instrument may be capturing some direct effect of topography on specialization in industries with broad input bases, besides the effect mediated through its impact on road density.

Appendix C: Further Data Details

TABLE A.10

country	roads (km)	year (roads)	roads/sq km	gdp pc (2014)	country	roads (km)	year (roads)	roads/sq km	gdp pc (2014)
Angola	51,429	2001	0.04125	7,968	Germany	645,000	2010	1.80661	45,961
Albania	18,000	2002	0.62613	10,664	Djibouti	3,065	2000	0.13211	3,200
UAE	4,080	2008	0.04880	64,398	Dominica	1,512	2010	2.01332	10,188
Argentina	231,374	2004	0.08322	20,222	Denmark	74,497	2016	1.72871	44,924
Armenia	7,792	2013	0.26198	8,586	Dominican Rep.	19,705	2002	0.40487	12,511
Antigua & Barbuda	1,170	2011	2.64108	21,002	Algeria	113,655	2010	0.04772	12,812
Australia	823,217	2011	0.10634	43,071	Ecuador	43,670	2007	0.15401	10,968
Austria	133,597	2016	1.59289	47,744	Egypt	137,430	2010	0.13723	9,909
Azerbaijan	52,942	2006	0.61134	15,887	Spain	683,175	2011	1.35183	33,864
Burundi	12,322	2004	0.44276	772	Estonia	58,412	2011	1.29150	28,538
Belgium	154,012	2010	5.04494	43,668	Ethiopia	110,414	2015	0.09999	1,323
Benin	16,000	2006	0.14207	1,922	Finland	454,000	2012	1.34262	40,401
Burkina Faso	15,272	2010	0.05570	1,565	Fiji	3,440	2011	0.18825	7,909
Bangladesh	21,269	2010	0.14326	2,885	France	1,028,446	2010	1.59746	39,374
Bulgaria	19,512	2011	0.17598	17,462	Gabon	9,170	2007	0.03426	14,161
Bahrain	4,122	2010	5.42368	41,626	United Kingdom	394,428	2009	1.61910	40,242
Bahamas, The	2,700	2011	0.19452	23,452	Georgia	19,109	2010	0.27416	9,362
Bosnia and Herz.	22,926	2010	0.44780	10,028	Ghana	109,515	2009	0.45912	3,570
Belarus	86,392	2010	0.41615	20,290	Guinea	44,348	2003	0.18038	1,429
Belize	2,870	2011	0.12497	8,393	Gambia, The	3,740	2011	0.33097	1,544
Bermuda	447	2010	8.27778	57,531	Guinea-Bissau	3,455	2002	0.09564	1,251
Bolivia	80,488	2010	0.07327	6,013	Equatorial Guinea	2,880	2000	0.10267	40,133
Brazil	1,580,964	2010	0.18565	14,871	Greece	116,960	2010	0.88635	25,990
Barbados	1,600	2011	3.72093	14,220	Grenada	1,127	2001	3.27616	11,155
Bhutan	10,578	2013	0.27551	6,880	Guatemala	17,332	2015	0.15917	6,851
Central African Rep.	20,278	2010	0.03255	594	Hong Kong	2,100	2015	1.89531	51,808
Canada	1,042,300	2011	0.10439	42,352	Honduras	14,742	2012	0.13152	4,424
Switzerland	71,464	2011	1.73133	58,469	Croatia	26,958	2015	0.47634	21,675
Chile	77,764	2010	0.10285	21,581	Haiti	4,266	2009	0.15373	1,562
China	4,106,387	2011	0.42788	12,473	Hungary	203,601	2014	2.18860	25,758
Cote d'Ivoire	81,996	2007	0.25428	3,352	Indonesia	496,607	2011	0.26075	9,707
Cameroon	51,350	2011	0.10801	2,682	India	4,699,024	2015	1.42946	5,224
Congo, Dem. Rep.	153,497	2004	0.06546	1,217	Ireland	96,036	2014	1.36661	48,767
Congo, Rep.	17,000	2006	0.04971	4,426	Iran	198,866	2010	0.12066	15,547
Colombia	204,855	2015	0.17987	12,599	Iraq	59,623	2012	0.13603	12,096
Comoros	880	2002	0.39374	1,460	Iceland	12,890	2012	0.12515	42,876
Cabo Verde	1,350	2013	0.33474	6,290	Israel	18,566	2011	0.89389	33,270
Costa Rica	39,018	2010	0.76356	14,186	Italy	487,700	2007	1.61844	35,807
Curacao	550	*N.A.*	1.23874	25,965	Jamaica	22,121	2011	2.01265	7,449
Cayman Islands	785	2007	2.97348	51,465	Jordan	7,203	2011	0.08062	10,456
Cyprus	20,006	2011	2.16258	28,602	Japan	1,218,772	2015	3.22499	35,358
Czech Republic	130,661	2011	1.65673	31,856	Kazakhstan	97,418	2012	0.03575	23,450

TABLE A.10 (cont.)

country	roads (km)	year (roads)	roads/sq km	gdp pc (2014)	country	roads (km)	year (roads)	roads/sq km	gdp pc (2014)
Kenya	160,878	2013	0.27720	2,769	Paraguay	32,059	2010	0.07882	8,284
Kyrgyzstan	34,000	2007	0.17004	3,359	Qatar	9,830	2010	0.84844	144,340
Cambodia	44,709	2010	0.24696	2,995	Romania	84,185	2012	0.35314	20,817
Korea, South	104,983	2009	1.05278	35,104	Russia	1,283,387	2012	0.07506	24,039
Kuwait	6,608	2010	0.37086	63,886	Rwanda	4,700	2012	0.17845	1,565
Laos	39,586	2009	0.16717	5,544	Saudi Arabia	221,372	2006	0.10298	48,025
Lebanon	6,970	2005	0.67019	13,999	Sudan	11,900	2000	0.00639	3,781
Liberia	10,600	2000	0.09518	838	Senegal	15,000	2015	0.07625	2,247
Sri Lanka	114,093	2010	1.73896	10,342	Singapore	3,425	2012	4.91392	72,583
Lithuania	84,166	2012	1.28891	28,208	Sierra Leone	11,300	2002	0.15751	1,419
Latvia	72,440	2013	1.12155	23,679	El Salvador	6,918	2010	0.32879	7,843
Morocco	58,395	2010	0.13077	7,163	Serbia	44,248	2010	0.57113	13,441
Moldova	9,352	2012	0.27627	4,811	Sao Tome & Princ.	320	2000	0.33195	3,239
Madagascar	37,476	2010	0.06384	1,237	Suriname	4,304	2003	0.02627	15,655
Maldives	88	2013	0.29530	14,391	Slovakia	54,869	2012	1.11898	28,609
Mexico	377,660	2012	0.19225	15,853	Slovenia	38,985	2012	1.92300	30,488
Macedonia	14,182	2014	0.55155	13,151	Sweden	579,564	2010	1.28708	44,598
Mali	22,474	2009	0.01812	1,434	Seychelles	526	2015	1.15604	25,822
Malta	3,096	2008	9.79747	31,644	Syria	69,873	2010	0.37732	4,200
Burma	34,377	2010	0.05081	5,344	Turks and Caicos	121	2003	0.12764	20,853
Montenegro	7,762	2010	0.56198	14,567	Chad	40,000	2011	0.03115	2,013
Mongolia	49,249	2013	0.03149	11,526	Togo	11,652	2007	0.20520	1,384
Mozambique	30,331	2009	0.03794	1,137	Thailand	180,053	2006	0.35090	13,967
Mauritania	10,628	2010	0.01031	3,409	Tajikistan	27,767	2000	0.19269	2,747
Mauritius	2,149	2012	1.05343	17,942	Turkmenistan	58,592	2002	0.12004	20,953
Malawi	15,450	2011	0.13040	949	Trinidad & Tobago	9,592	2015	1.87051	31,196
Malaysia	144,403	2010	0.43779	23,158	Tunisia	19,418	2010	0.11868	10,365
Niger	18,949	2010	0.01496	852	Turkey	385,754	2012	0.49231	19,236
Nigeria	193,200	2004	0.20914	5,501	Tanzania	86,472	2010	0.09128	2,213
Nicaragua	23,897	2014	0.18330	4,453	Uganda	20,000	2011	0.08297	1,839
Netherlands	138,641	2014	3.33729	47,240	Ukraine	169,694	2012	0.28116	10,335
Norway	93,870	2013	0.28990	64,274	Uruguay	77,732	2010	0.44112	20,396
Nepal	10,844	2010	0.07368	2,173	United States	6,586,610	2012	0.66981	52,292
New Zealand	94,902	2012	0.35301	34,735	Uzbekistan	86,496	2000	0.19333	8,195
Oman	60,230	2012	0.19460	38,527	Venezuela	96,189	2014	0.10546	14,134
Pakistan	263,942	2014	0.33155	4,646	British Virgin Isl.	200	2007	1.32450	26,976
Panama	15,137	2010	0.20070	19,702	Vietnam	195,468	2013	0.59016	5,353
Peru	140,672	2012	0.10945	10,993	Yemen	71,300	2005	0.13505	3,355
Philippines	216,387	2014	0.72129	6,659	South Africa	747,014	2014	0.61276	12,128
Poland	412,035	2012	1.31773	25,156	Zambia	40,454	2005	0.05375	3,726
Portugal	82,900	2008	0.90021	28,476	Zimbabwe	97,267	2002	0.24892	1,869

TABLE A.11: Summary Statistics

Input Narrowness Measure	Mean	Std Dev	Median	Min	Max
Gini	0.939	0.023	0.943	0.889	0.993
Herfindhal	0.101	0.080	0.076	0.029	0.776
Coeff Variation	5.806	2.035	5.313	3.196	17.248
Log-Variance	-8.492	0.621	-8.566	-9.583	-6.211

TABLE A.12: Simple Cross Correlations

Narrowness Measure	Gini	Herfindhal	Coeff Var	Log-Var
Gini	1	0.728	0.820	0.875
Herfindhal		1	0.973	0.909
Coeff Variation			1	0.979
Log-Variance				1

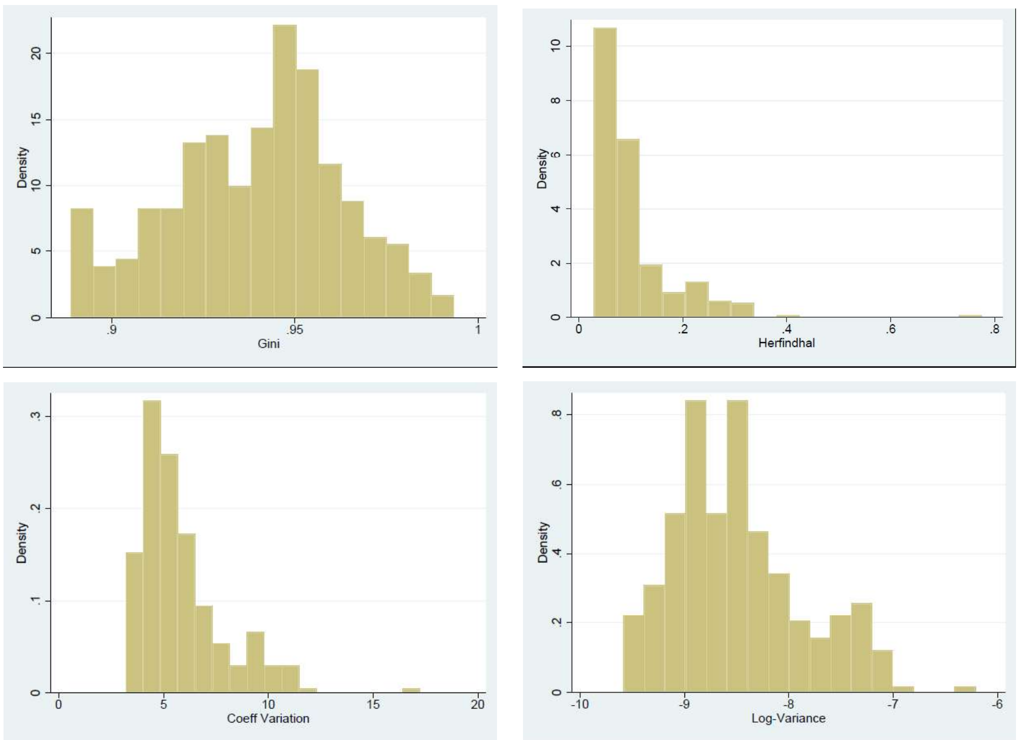

FIGURE A.1: Histograms of Input Narrowness Measures

Appendix D: Internal Transport Cost of Final Goods

This section briefly shows the implications of extending the model in Section 3 to add an iceberg cost for internal transportation final goods within a closed economy. We assume now that shipping final goods between regions A and B entails an iceberg cost $\delta(r)$, where $\delta(r) > 1$ and $\delta'(r) < 0$, for all $r \in \mathbb{R}_+$.

One particularly simplifying feature of the closed-economy model with costless internal transportation of final goods is that it straightforwardly implies that, in equilibrium, the wage must be necessarily be identical in A and B (otherwise all individuals will prefer to live in the region with the higher wage). As the next lemma formally shows, this result remains unaltered when we extend the model in Section 3 to encompass an iceberg cost term $\delta(r) > 1$ for final goods. The reason for regional equality to remain valid lies in the (implicit) technological symmetry of regions coupled with the logarithmic utility function (2). Those two features entail that, in order to equalize the utility of individuals living in A and B, their earnings should be equal.

Lemma 3 *Let Assumptions 1 and 2 hold true, preferences be given by (2), and final goods technologies be the same in regions A and B. Then, in equilibrium, the wage per unit of labor in regions A and B must be identical, no matter the value of the iceberg trade cost of final goods between regions A and B (that is, for any $\delta(r) \geq 1$).*

Proof. Let w_R denote the wage in region R, and take $w_A = 1$ and $w_B = w$ (i.e., take w_A as the numeraire). The marginal costs of producing final good j in region A and B are thus given, respectively, by

$$c_{j,A} = \gamma \left[(1+T) + \frac{1}{(wd(r))^{\theta}} \right]^{-\frac{1-\alpha_j}{\theta}} \left[1 + \frac{1+T}{(wd(r))^{\theta}} \right]^{-\frac{\alpha_j}{\theta}} \tag{36}$$

and

$$c_{j,B} = \gamma \left[\frac{1}{w^{\theta}} + \frac{1+T}{d(r)^{\theta}} \right]^{-\frac{1-\alpha_j}{\theta}} \left[\frac{1+T}{w^{\theta}} + \frac{1}{d(r)^{\theta}} \right]^{-\frac{\alpha_j}{\theta}} . \tag{37}$$

Prices of final goods faced by individuals living in each of the two regions are given by

$$P_j^A = \begin{cases} c_{j,A} & \text{if } \alpha_j \leq \widetilde{\alpha}_B(w) \\ \delta(r) c_{j,B} & \text{if } \alpha_j > \widetilde{\alpha}_B(w) \end{cases} \quad \text{and} \quad P_j^B = \begin{cases} \delta(r) c_{j,B} & \text{if } \alpha_j < \widetilde{\alpha}_A(w) \\ c_{j,B} & \text{if } \alpha_j \geq \widetilde{\alpha}_A(w) \end{cases} , \tag{38}$$

where $c_{j,A}$ is given by (36), $c_{j,B}$ is given by (37), and

$$\widetilde{\alpha}_A(w) \equiv \frac{\ln\left[\frac{1+(1+T)(wd(r))^\theta}{d(r)^\theta+(1+T)w^\theta}\right] - \ln\left(\delta(r)^\theta\right)}{\ln\left[\frac{(1+T)d(r)^\theta+w^\theta}{(1+T)+(wd(r))^\theta}\frac{1+(1+T)(wd(r))^\theta}{d(r)^\theta+(1+T)w^\theta}\right]} \quad \text{and} \quad \widetilde{\alpha}_B(w) \equiv \frac{\ln\left(\delta(r)^\theta\right) + \ln\left[\frac{1+(1+T)(wd(r))^\theta}{d(r)^\theta+(1+T)w^\theta}\right]}{\ln\left[\frac{(1+T)d(r)^\theta+w^\theta}{(1+T)+(wd(r))^\theta}\frac{1+(1+T)(wd(r))^\theta}{d(r)^\theta+(1+T)w^\theta}\right]}. \tag{39}$$

For the sake of the proof, let henceforth both $\widetilde{\alpha}_A(w) \in (0,1)$ and $\widetilde{\alpha}_B(w) \in (0,1)$.[49] The utility obtained by an individual in region A is given by:

$$\begin{aligned} U^A(w) &= \frac{1}{\gamma}\left[\int_0^{\widetilde{\alpha}_B(w)} \left(1+T+\frac{1}{(wd(r))^\theta}\right)^{\frac{1-\alpha_j}{\theta}} \left(1+\frac{1+T}{(wd(r))^{-\theta}}\right)^{\frac{\alpha_j}{\theta}} d\alpha_j \; + \right. \qquad (40) \\ &\left. \frac{1}{\delta(r)}\int_{\widetilde{\alpha}_B(w)}^1 \left(\frac{1}{w^\theta}+\frac{1+T}{d(r)^\theta}\right)^{\frac{1-\alpha_j}{\theta}} \left(\frac{1+T}{w^\theta}+\frac{1}{d(r)^\theta}\right)^{\frac{\alpha_j}{\theta}} d\alpha_j\right]. \end{aligned}$$

The utility obtained by an individual in region B is:

$$\begin{aligned} U^B(w) &= \frac{w}{\gamma}\left[\frac{1}{\delta(r)}\int_0^{\widetilde{\alpha}_A(w)} \left(1+T+\frac{1}{(wd(r))^\theta}\right)^{\frac{1-\alpha_j}{\theta}} \left(1+\frac{1+T}{(wd(r))^\theta}\right)^{\frac{\alpha_j}{\theta}} d\alpha_j \; + \right. \qquad (41) \\ &\left. \int_{\widetilde{\alpha}_B(w)}^1 \left(\frac{1}{w^\theta}+\frac{1+T}{d(r)^\theta}\right)^{\frac{1-\alpha_j}{\theta}} \left(\frac{1+T}{w^\theta}+\frac{1}{d(r)^\theta}\right)^{\frac{\alpha_j}{\theta}} d\alpha_j\right]. \end{aligned}$$

Free mobility of individuals between regions implies that, in equilibrium, $U^A = U^B$. We first show that $w = 1$ is an equilibrium. Next, we show that it the equilibrium is unique.

Letting $w = 1$, the expressions in (39) boil down to (in order to lighten up notation we skip henceforth the dependence of d and δ with respect to r):

$$\widetilde{\alpha}_A(1) = \frac{1}{2} - \frac{\ln\left(\delta^\theta\right)}{2}\left[\ln\left(\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right)\right]^{-1} \quad \text{and} \quad \widetilde{\alpha}_B(1) = \frac{1}{2} + \frac{\ln\left(\delta^\theta\right)}{2}\left[\ln\left(\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right)\right]^{-1},$$

from where it can be observed that $\widetilde{\alpha}_B(1) = 1 - \widetilde{\alpha}_A(1)$. Thus, plugging $w = 1$ into (40) yields:

$$\begin{aligned} U^A(1) &= \frac{1}{\gamma}\left[\int_0^{\widetilde{\alpha}_B(1)} \left[(1+T)+d^{-\theta}\right]^{(1-\alpha_j)/\theta} \left[1+(1+T)\,d^{-\theta}\right]^{\alpha_j/\theta} d\alpha_j + \right. \qquad (42) \\ &\left. \frac{1}{\delta}\int_{\widetilde{\alpha}_B(1)}^1 \left[1+(1+T)\,d^{-\theta}\right]^{(1-\alpha_j)/\theta} \left[(1+T)+d^{-\theta}\right]^{\alpha_j/\theta} d\alpha_j\right]. \end{aligned}$$

[49] Extending the proof to cases in which either $\widetilde{\alpha}_A(w)$ or $\widetilde{\alpha}_B(w)$, or both, could fall outside the unit interval is quite straightforward, hence we skip it in the sake of brevity.

On the other hand, plugging $w = 1$ into (41), and defining $\beta_j = 1 - \alpha_j$, we can write $U^B(1)$ as:

$$U^B(1) = \frac{1}{\gamma}\left[\int_0^{1-\widetilde{\alpha}_A(1)} \left[(1+T) + d^{-\theta}\right]^{\beta_j/\theta} \left[1 + (1+T)\,d^{-\theta}\right]^{\left(1-\beta_j\right)/\theta} d\beta_j + \frac{1}{\delta}\int_{1-\widetilde{\alpha}_A(1)}^{1} \left[1 + (1+T)\,d^{-\theta}\right]^{\beta_j/\theta} \left[(1+T) + d^{-\theta}\right]^{\left(1-\beta_j\right)/\theta} d\alpha_j\right]. \tag{43}$$

Finally, recalling that $\widetilde{\alpha}_B(1) = 1 - \widetilde{\alpha}_A(1)$, from (42) and (43) it follows that $U^A = U^B$ when $w = 1$, and thus $w = 1$ is an equilibrium.

To prove that this equilibrium is unique, note that from (40) it follows that $dU^A(w)/dw < 0$, while (41) could be re-written as

$$U^B(w) = \frac{1}{\gamma}\left[\frac{1}{\delta}\int_0^{\widetilde{\alpha}_A(w)} \left[(1+T)\,w^\theta + d^{-\theta}\right]^{(1-\alpha_j)/\theta} \left[w^\theta + (1+T)\,d^{-\theta}\right]^{\alpha_j/\theta} d\alpha_j + \int_{\widetilde{\alpha}_B(w)}^{1} \left[w^\theta + (1+T)\,d^{-\theta}\right]^{(1-\alpha_j)/\theta} \left[(1+T) + w^\theta d^{-\theta}\right]^{\alpha_j/\theta} d\alpha_j\right],$$

from where we can observe that $dU^B(w)/dw > 0$.[50] As a result of this, for any $w > 1$ we would have $U^B(w) > U^A(w)$, whereas for any $w < 1$ we would have $U^A(w) > U^B(w)$, implying that $w = 1$ is the unique equilibrium value of the relative wage between regions A and B. ■

The result in Lemma 3 implies all the expressions regarding to the cost of production of final goods, namely (4) - (8), will still hold true in the presence of costly internal transportation of final goods. The difference with respect to Section 3 is that the price at which final good j produced in region R will be sold in region $-R$ will now incorporate the iceberg trade cost, and thus be equal to $\delta(r)\,c_{j,R}$. On the other hand, the price of locally produced goods will still remain equal to $c_{j,R}$. The price gap between locally produced goods and goods sourced from region $-R$ will mean that some goods will end up being produced in *both* regions, and sold *only* locally. The following lemma states this result, extending the previous result in Lemma 1 in the main text.

[50] Note that the effect of $d\widetilde{\alpha}_A(w)/dw$ on $dU^A(w)/dw$ is actually zero, as its effect will perfectly cancel out when considering the two separate definite integrals in (40) and the definition of $\widetilde{\alpha}_A(w)$ in (39). The same argument applies to the effect of $d\widetilde{\alpha}_B(w)/dw$ on $dU^B(w)/dw$, which thus also cancels itself out and turns out to be zero.

Lemma 4 *i) When* $\delta < \left[\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right]^{\frac{1}{\theta}}$, *there exists a cut-off level* $\widetilde{\alpha}_A$ *given by*

$$\widetilde{\alpha}_A \equiv \frac{1}{2}\left(1 - \frac{\ln\left(\delta^\theta\right)}{\ln\left[\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right]}\right) \quad (44)$$

such that, $0 < \widetilde{\alpha}_A < \frac{1}{2}$, *and i) all producers of final goods for which* $\alpha_j < \widetilde{\alpha}_A$ *will locate in region* A, *and sell their output to consumers in both* A *and* B*; ii) all producers of final goods for which* $\alpha_j > 1 - \widetilde{\alpha}_A$ *will locate in region* B, *and sell their output to consumers in both* A *and* B*; iii) the producers of the final goods for which* $\alpha_j \in [\widetilde{\alpha}_A, 1-\widetilde{\alpha}_A]$ *will locate in both regions, and will only sell their output to local consumers.*
ii) When $\delta \geq \left[\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right]^{\frac{1}{\theta}}$, *all final goods consumed in* A *are produced by firms located in* A, *whereas all final goods consumed in* B *are produced by firms located in* B.

Proof. Consider first the case in which $\delta < \left[\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right]^{\frac{1}{\theta}}$. A firm will locate in A and cater to consumers in both A and B when $\delta(r)c_{j,A} < c_{j,B}$. Using the expressions in (7) and (8), this leads to

$$\delta(r)c_{j,A} < c_{j,B} \quad \Leftrightarrow \quad \delta^{\frac{\theta}{1-2\alpha_j}} > \tfrac{(1+T)d^\theta+1}{(1+T)+d^\theta}.$$

Noting that $\delta^{\theta/(1-2\alpha_j)}$ is increasing in α_j when $\alpha_j < 0.5$, it then follows that for all $\alpha_j < \widetilde{\alpha}_A$, where $\widetilde{\alpha}_A$ is given in (44), we have $\delta(r)c_{j,A} < c_{j,B}$. Next, a firm will locate in B and cater to consumers in both A and B when $c_{j,A} > \delta(r)c_{j,B}$. Using again (7) and (8), this leads to

$$c_{j,A} > \delta(r)c_{j,B} \quad \Leftrightarrow \quad \delta^{\frac{\theta}{2\alpha_j-1}} > \frac{(1+T)d^\theta+1}{(1+T)+d^\theta}.$$

Now, noting that $\delta^{\theta/(2\alpha_j-1)}$ is decreasing in α_j when $\alpha_j > 0.5$, it then follows that for all $\alpha_j > 1-\widetilde{\alpha}_A$, we have $c_{j,A} > \delta(r)c_{j,B}$. Notice now that the above results in turn imply that, for all $\widetilde{\alpha}_A < \alpha_j < 1-\widetilde{\alpha}_A$, both $\delta(r)c_{j,A} > c_{j,B}$ and $c_{j,A} < \delta(r)c_{j,B}$ simultaneously hold. Thus, all those final goods such that $\alpha_j \in [\widetilde{\alpha}_A, 1-\widetilde{\alpha}_A]$ will be locally sourced in both regions. Finally, in the case in which $\delta > \left[\frac{(1+T)d^\theta+1}{(1+T)+d^\theta}\right]^{\frac{1}{\theta}}$, it is straightforward to observe that $\delta(r)c_{j,A} > c_{j,B}$ and $c_{j,A} < \delta(r)c_{j,B}$ hold simultaneously true for all $\alpha_j \in [0,1]$. ■

In the main text, Lemma 2 states that the marginal cost of production of final goods characterized by α_j closer to $\frac{1}{2}$ fall proportionally more when r increases. This result naturally remains still true in the case of a closed economy with costly internal trade of final goods, since the cost of production of final goods does not depend on $\delta(r)$, which only (possibly) affects the prices of final goods faced by consumers.

Appendix E: International Trade of Intermediate Inputs

Here we allow intermediate goods to be traded internationally. We assume that trading intermediate goods between H and F entails an iceberg cost $\iota > 1$. We also assume that the international transportation cost of intermediate goods is greater than its internal transportation, even for the country with more costly internal transportation: $\iota > d_F = \lambda d_H$.[51] We maintain the assumption that international trade of final goods is subject to an iceberg cost $\tau > 1$, and also that the technologies for final goods are given by (10) together with (11).

The possibility to import intermediate goods will imply that the marginal cost of producing final good j will encompass now, not only prices from national inputs, but also prices from imported inputs. Applying again the results in Eaton and Kortum (2002) to this framework, we can obtain that the marginal cost of producing final good j in H, given the relative wage ω, is given by $c_j^H = \chi_{j,H}/\zeta_{j,H}$ where now

$$\chi_{j,H} = \begin{cases} \gamma \left[\frac{(1+T) + d_H^{-\theta}}{\omega^\theta} + \frac{2+T}{\iota^\theta} \right]^{-\frac{1-\alpha_j}{\theta}} \left[\frac{(1+T)\, d_H^{-\theta} + 1}{\omega^\theta} + \frac{2+T}{\iota^\theta} \right]^{-\frac{\alpha_j}{\theta}} & \text{if } \alpha_j \leq \frac{1}{2}, \\ \gamma \left[\frac{(1+T)\, d_H^{-\theta} + 1}{\omega^\theta} + \frac{2+T}{\iota^\theta} \right]^{-\frac{1-\alpha_j}{\theta}} \left[\frac{(1+T) + d_H^{-\theta}}{\omega^\theta} + \frac{2+T}{\iota^\theta} \right]^{-\frac{\alpha_j}{\theta}} & \text{if } \alpha_j \geq \frac{1}{2}. \end{cases} \quad (45)$$

Similarly, the marginal cost of producing j in F is given by $c_j^F = \chi_{j,F}/\zeta_{j,F}$ where now

$$\chi_{j,F} = \begin{cases} \gamma \left[(1+T) + \frac{1}{(\lambda d_H)^\theta} + \frac{2+T}{(\iota\omega)^\theta} \right]^{-\frac{1-\alpha_j}{\theta}} \left[\frac{1+T}{(\lambda d_H)^\theta} + 1 + \frac{2+T}{(\iota\omega)^\theta} \right]^{-\frac{\alpha_j}{\theta}} & \text{if } \alpha_j \leq \frac{1}{2}, \\ \gamma \left[\frac{1+T}{(\lambda d_H)^\theta} + 1 + \frac{2+T}{(\iota\omega)^\theta} \right]^{-\frac{1-\alpha_j}{\theta}} \left[(1+T) + \frac{1}{(\lambda d_H)^\theta} + \frac{2+T}{(\iota\omega)^\theta} \right]^{-\frac{\alpha_j}{\theta}} & \text{if } \alpha_j \geq \frac{1}{2}. \end{cases} \quad (46)$$

Comparing (45) vis-a-vis (46), it can be observed that:

Lemma 5 *The ratio $\chi_{j,H}/\chi_{j,F}$ is strictly decreasing in α_j for all $\alpha_j \in \left[0, \frac{1}{2}\right)$, and strictly increasing in α_j for all $\alpha_j \in \left(\frac{1}{2}, 1\right]$.*

[51] The reason for this assumption is that, given that final goods are produced only by combining intermediate inputs, a higher international transportation cost of inputs relative to the internal transportation cost ensures that an increase in the relative wage of H over F will impact more strongly on the marginal cost of final goods produced in H than in those produced in F.

Proof. Consider first the case in which $\alpha_j \leq \frac{1}{2}$. Using (45) and (46), we can write $\ln\left(\chi_{j,H}/\chi_{j,F}\right) = \theta^{-1}\left[\ln(\Theta) - \alpha_j \ln(\Theta \times \Psi)\right]$, where

$$\Theta \equiv \frac{\left[(1+T) + (\lambda d_H)^{-\theta}\right]\omega^{\theta} + (2+T)\,\iota^{-\theta}}{\left[(1+T) + d_H^{-\theta}\right] + (2+T)\,\iota^{-\theta}\omega^{\theta}} \tag{47}$$

and

$$\Psi \equiv \frac{\left[(1+T)\,d_H^{-\theta} + 1\right] + (2+T)\,\iota^{-\theta}\omega^{\theta}}{\left[(1+T)\,(\lambda d_H)^{-\theta} + 1\right]\omega^{\theta} + (2+T)\,\iota^{-\theta}}. \tag{48}$$

Let us now define $\Lambda \equiv \Theta \times \Psi$. Thus, we can say that $\partial(\chi_{j,H}/\chi_{j,F})/\partial\alpha_j < 0 \iff \Lambda > 1$. Notice now that $\lim_{\lambda\to 1}(\Lambda) > 1$, since in equilibrium $\omega > 1$. Furthermore, differentiating Λ with respect to λ, we can observe that $\partial\Lambda/\partial\lambda > 0$. Therefore, it follows that $\Lambda > 1$ for all $\lambda > 1$, proving that $\partial(\chi_{j,H}/\chi_{j,F})/\partial\alpha_j < 0$ for all $\alpha_j \leq \frac{1}{2}$.

Consider now the case in which $\alpha_j \geq \frac{1}{2}$. Using (45) and (46), we can write $\ln\left(\chi_{j,H}/\chi_{j,F}\right) = \theta^{-1}\left[\ln(\Psi^{-1}) + \alpha_j \ln(\Theta \times \Psi)\right]$, where Θ is given by (47) and Ψ by (48). In this case, the proof follows then from the fact that $\partial(\chi_{j,H}/\chi_{j,F})/\partial\alpha_j > 0 \iff \Lambda > 1$. ■

Notice now that the probability that country C exports final good j to the other country (i.e., $\pi_C(j)$), is still given by

$$\pi_C(j) = \frac{1}{1 + \left(\dfrac{\chi_{j,-C}}{\tau\,\chi_{j,C}}\right)^{-\vartheta}},$$

with $\chi_{j,C}$ and $\chi_{j,-C}$ given in this case by (45)-(46) as they correspond to each case. As a consequence, an analogous result at that one in Proposition 2 in the main text also holds true when intermediate inputs can be traded internationally alongside final goods.