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Self-Employment in the Global Economy

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Abstract:
This paper studies the effects of foreign competition on self-employment levels. We begin by pointing out a previously unknown fact: the greater the exposure to foreign competition, the smaller the fraction of self-employed people. This fact holds across very different countries, across relatively similar countries like European Union members, and across industries within the United States. We develop a model where heterogeneous agents select themselves into being either employees or self-employed in the spirit of Lucas (1978). This, in turn, translates into intra-industry firm heterogeneity as in Melitz (2003). Self-employed agents (firms) can also decide to enter into the export markets, subject to fixed and variable trade costs. The model delivers three basic predictions: (1) domestic self-employment increases with the trade costs of exporting from a foreign country to the home country, (2) domestic self-employment increases with the trade costs of exporting to the foreign country, and (3) higher levels of self-employment are associated with a lower fraction of exporting firms. Our empirical work on inter-industry data for the United States confirms these predictions of the model.

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Keywords: self-employment, tariffs, international trade

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1 Overview

Nearly one out of nine workers is self-employed in the United States (Hipple 2010). The rate of self-employment is around 10 percent for most of the developed countries and the figures are even higher for developing countries. Moreover, self-employment is often used as a measure of entrepreneurship (see Parker 2009). Given the importance of entrepreneurs in the economy and the fact that the world is becoming increasingly interconnected, it is relevant to understand the effects of trade on the rate of self-employment. Therefore, self-employment is an important economic phenomenon, both conceptually and quantitatively, and one that has been mostly overlooked by the international economics literature. In this paper we aim to fill this gap in the literature.[1,2]

We start by unveiling a previously unknown fact—namely, that the rate of self-employment in an economy (or sector) is negatively affected by the economy's (sector's) degree of *openness*, measured either as trade costs or as the ratio of exports and imports to GDP. That is, economies (sectors) that are more exposed to foreign competition show lower levels of self-employment.

To illustrate this point, consider Figure I, where we plot self-employment in the manufacturing sector and tariff levels for 32 countries and the European Union for 2006. The self-employment data are from the International Labour Organization (ILO).[3] The tariff data come from the United Nations' TRAINS database. We define self-employment as the share of employers or own-account workers in the total labor force of the country. We focus on manufactures to abstract our analysis from the agricultural sector—we want to avoid the agricultural sector because it usually has very high rates of self-employment and less developed countries tend to have a large fraction of their labor force in agricultural activities. Figure I shows that there is a clear, positive (and statistically significant) relationship between self-employment and tariffs. Inasmuch as lower tariffs imply that an economy is more open, Figure I provides some graphical evidence that more-open economies have lower rates of self-employment.

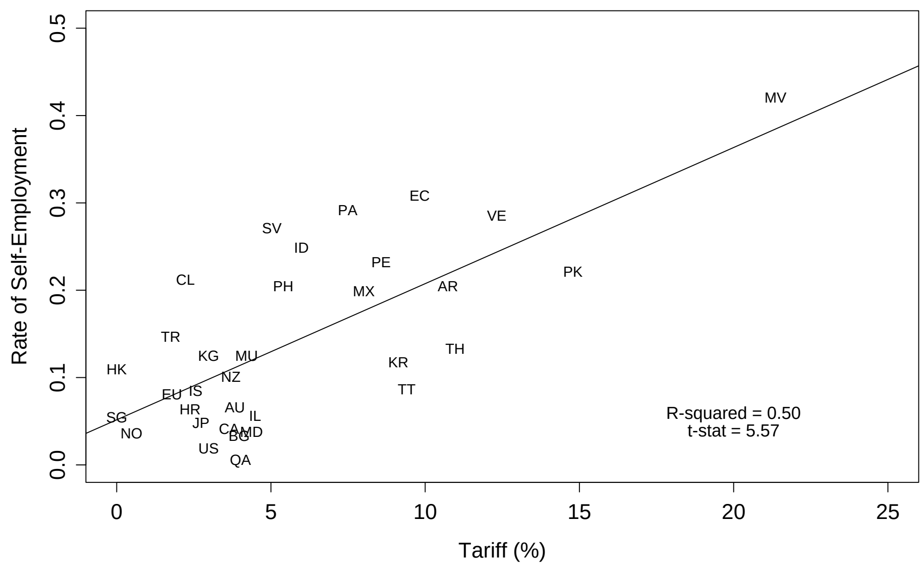
The evidence of Figure I is quite suggestive, but it could be argued that the set of countries in it is very heterogeneous and that, therefore, the differences in their levels of development could be driving the results. To address these concerns, in Figure II we look at the members of the European Union, which consists of a relatively homogeneous group of countries. Figure II plots, for 2006, the rates of manufacturing self-employment (measured as the rate of employers

[1] We follow the Bureau of Labor Statistics (BLS) and define a self-employed person as someone who does not work for someone else; that is, our definition includes employers as well as own-account workers (those who engage independently in a profession or trade, and hire no employees). See the appendix for details. Note that this definition is different from that of Garicano and Rossi-Hansberg (2006a, 2006b), where a self-employed person is someone who does not form part of any organization; that is, an own-account worker without partners.

[2] There are several recent papers studying the effects of international trade on labor markets. However, the focus of these papers is not on self-employment but rather on wage inequality (see Burstein and Vogel 2009; Costinot and Vogel 2010; and Ohnsorge and Trefler 2007); or unemployment (see Helpman, Itskhoki, and Redding 2010; and Helpman and Itskhoki 2010).

[3] The ILO collects labor data for over 200 countries—unfortunately, however, the data set has many problems if the goal is to do international comparisons, as countries use different classification systems and most countries are in and out of the database across years. Figure I uses data for 2006 precisely because for this year there is a large group of countries for which data are available.

Figure I: Rate of Self-Employment and Tariffs



Notes: "Rate of Self-Employment" is the ratio of employers or own-account workers to the total labor force, within manufacturing. "Tariff" is the average tariff imposed by the country. Data are for 2006. See Appendix C.1 for country codes and further details.

or own account workers in the manufacturing labor force) against the openness of the economy (measured as imports plus exports divided by GDP). Self-employment data are again from the ILO, while the openness measure is from the Penn World Tables.[4] Figure II provides some new evidence that there is a negative (and statistically significant) relationship between self-employment and openness. That is, more-open economies show lower rates of self-employment.

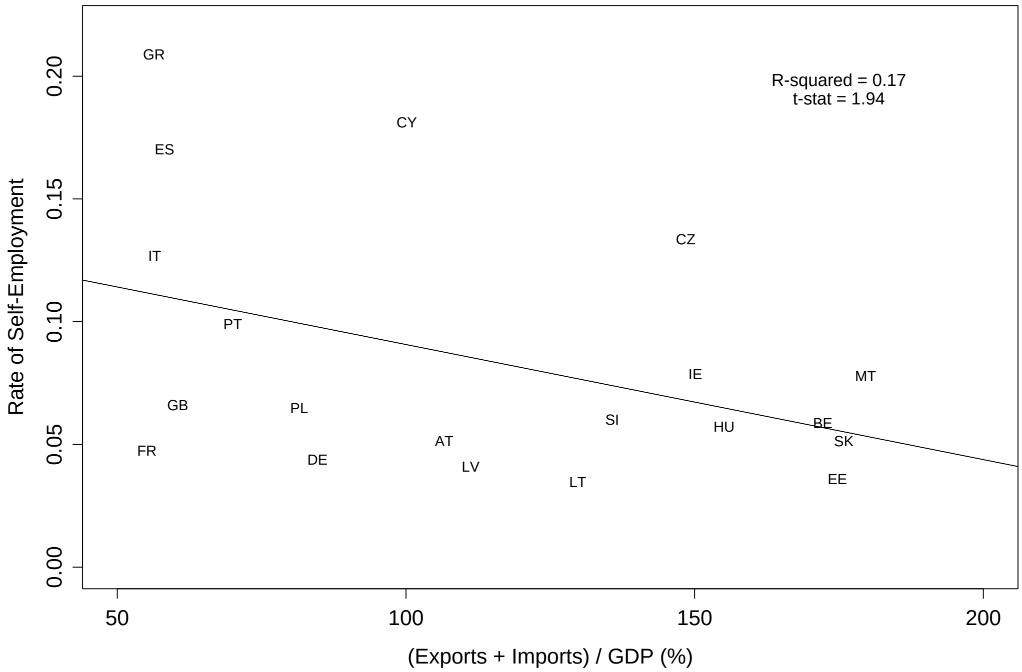
Furthermore, this same pattern holds across industries within the United States. Indeed, Figure III plots self-employment levels against openness for 3-digit NAICS manufacturing industries. Self-employment data are from the Bureau of Labor Statistics, while the openness measure is constructed with data from the Annual Survey of Manufacturers.[5] From Figure III we observe, once again, a negative relationship between self-employment and openness: those industries that are more open to international trade show lower rates of self-employment.

We develop a theoretical model of international trade with heterogeneous agents to rationalize the relationship between self-employment and trade. In the model, agents differ from one another in their ability to operate a firm. In the spirit of Lucas (1978), they decide to

[4]The graph contains 20 observations, since the ILO database does not contain data for Denmark, Finland, Luxembourg, Netherlands, and Sweden for 2006.

[5]We construct the openness measure as the ratio of exports plus imports to value added for each sector. Three industries were dropped as outliers: 314 (textile product mills), 315 (apparel manufacturing) and 316 (leather and allied product manufacturing).

Figure II: Rate of Self-Employment and Openness for the E.U.



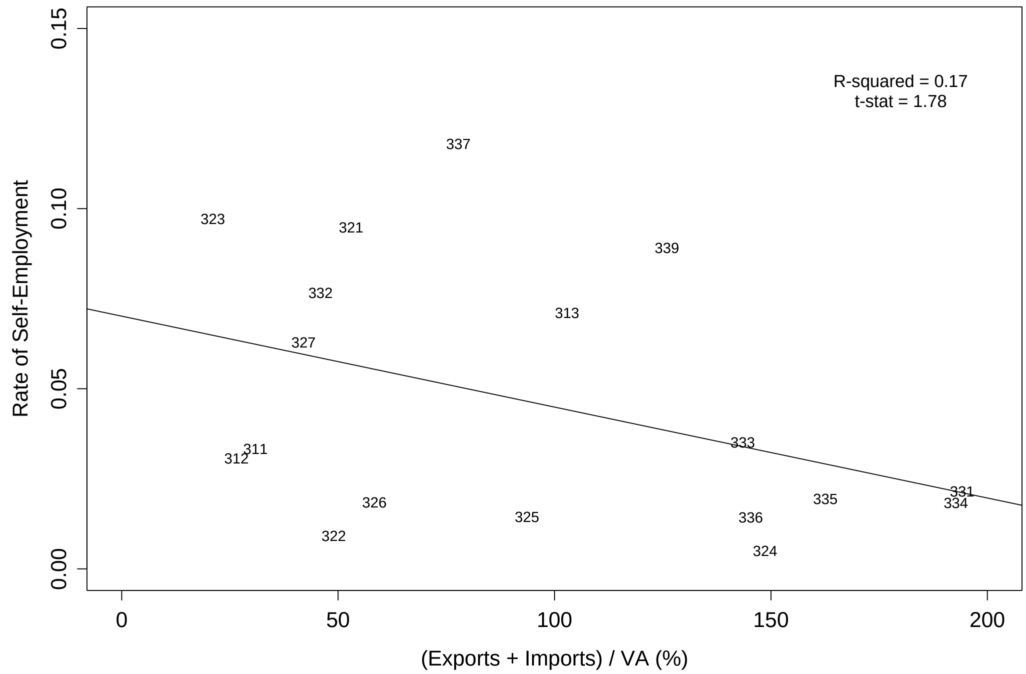
Notes: "Rate of Self-Employment" is the ratio of employers or own-account workers to the total labor force, within manufacturing. "(Exports+Imports)/GDP" is the openness measure discussed in the main text. Data are for 2006. See Appendix C.2 for country codes and further details.

be either employees or self-employed, conditional on their own ability. This selection process generates intra-industry firm heterogeneity as in Melitz (2003).[6] When the economy is open to international trade, self-employed agents (firms) can chose to export to the foreign market, subject to fixed and variable costs; or they can choose to become employees—because of the fixed costs only the most productive firms will be exporters. In the case of trade liberalization, resources are reallocated through two channels. First, as a result of foreign competition and increased labor demand by exporting firms, domestic real wages go up, increasing the opportunity cost of those who are marginally self-employed, who now find it profitable to become employees (the Lucas channel). Second, at the same time, higher real wages reduce the profits of non-exporting firms and re-allocate resources towards the more productive firms (the Melitz channel). These mechanisms provide the rationale for the stylized fact commented on above.[7]

[6] As an alternative to the Lucas (1978) setting we could have used the Garicano and Rossi-Hansberg (2006a, 2006b) framework of managerial hierarchies, merging their self-employed agents with their top-level managers (entrepreneurs). However, we find that embedding the Lucas (1978) choice model into the Melitz (2003) trade framework is a more straightforward exercise. We should note as well that Monte (2011) also combines elements from Lucas (1978) and Melitz (2003), although his paper focuses on the effects of trade on wage dispersion.

[7] We should emphasize that while we use, rather loosely, "self-employed" and "firms" as interchangeable terms in the model's description, they are clearly different objects in the data. First, the terms are conceptually different (people vs. legal entities) and are measured by different agencies (BLS vs. Census). Moreover, in the data there are situations where one self-employed person owns more than one firm, two or more self-employed people own a given firm, or one firm is just a subsidiary of another firm (so the president of the first one is

Figure III: Rate of Self-Employment and Openness for U.S. Industries



Notes: "Rate of Self-Employment" is the ratio of self-employed workers to total employment in the industry. "(Exports+Imports)/Value Added" is the openness measure discussed in the main text. Data is for 2009. See Appendix C.3 for industry codes and Appendix D for further details.

The model delivers three new predictions, *refining* the mechanism just described. First, in the case of domestic trade liberalization, the rate of domestic self-employment will decrease and the share of domestic exporting firms will increase. Intuitively, the foreign competition increases real wages (through lower aggregate prices) and this reduces self-employment, as just described. At the same time, higher foreign income increases foreign demand for domestic varieties, inducing more domestic firms to become exporters. Second, in the case of foreign trade liberalization, the effects are qualitatively the same: domestic self-employment decreases and the rate of domestic exporters increases. The intuition is clear: the improved access to foreign markets makes it profitable for more firms to export—the increased domestic labor demand increases the real wage and reduces the rate of self-employment. Third, and as a corollary of the previous two results, the model predicts that there is a negative relationship between the rate of self-employment and the share of exporting firms.

Next, we take these predictions to the data. Our empirical work, using data for U.S. manufacturing industries, suggests that the model's predictions are supported by the data.

The rest of the paper is organized as follows. Section 2 describes the basic setup of the

just an employee of the second one). We could extend our model to accommodate several of these different self-employment scenarios, but that would take us farther from the intuition we want to emphasize through the Lucas and Melitz channels.

model in the context of a closed economy. In Section 3, the bulk of the theory, we present the open economy version of the model and study the effects of trade costs on self-employment and exporting status. In Section 4, we take the model's predictions to the data. Finally, Section 5 concludes.[8]

2 The Model: Closed Economy

2.1 Basic Setup

Consider an economy populated by a mass L of consumers with the same Dixit-Stiglitz preferences over a set J of differentiated goods $y(j)$:

$$U = \left[\int_{j\in J} y(j)^{\frac{\sigma-1}{\sigma}}\, dj\right]^{\frac{\sigma}{\sigma-1}} \equiv Y, \tag{1}$$

where $\sigma > 1$ is the elasticity of substitution between any two goods and Y represents aggregate consumption. As is well known, these preferences generate the following individual demand function $y(j)$ for each variety j:

$$y(j) = \left(\frac{p(j)}{P}\right)^{-\sigma} Y, \tag{2}$$

where $p(j)$ is variety j's price, and

$$P = \left[\int_{j\in J} p(j)^{1-\sigma}\, dj\right]^{\frac{1}{1-\sigma}} \tag{3}$$

stands for the aggregate price, and $R = PY$ represents total expenditure. Note that consumers' expenditure on a particular variety can be expressed as $R(j) = \left(\frac{p(j)}{P}\right)^{1-\sigma} R$.

Production is undertaken by monopolistically competitive firms using labor as the only factor of production. Firms differ from one another in the particular variety j they produce and in their productivity level, φ—as in Melitz (2003), productivity reduces the marginal cost. Thus, the firm's problem can be written as

$$\max_{p(j)} \pi(j) = R(j) - \frac{wy(j)}{\varphi(j)}, \tag{4}$$

which leads to the following pricing equation:

$$\frac{p(j)}{P} = \frac{\sigma}{\sigma-1}\frac{1}{\varphi(j)}\frac{w}{P}, \tag{5}$$

[8] Additionally, in Appendix B we provide a two-sector version of the model and show that all of our results are (qualitatively) preserved once we have more than one industry in the economy.

where w is the wage of production workers. Using this last expression, the profit maximizing function (per unit mass of consumers) can be written as

$$\pi(j) = \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{\varphi(j)}{w/P}\right)^{\sigma-1} R. \tag{6}$$

2.2 Selection into Self-Employment

The labor force is composed of a mass L of workers (who are also the consumers). Workers choose whether to run a firm (and thus be self-employed) and earn total profits of $L\pi$, or to become production workers employed by someone else's firm and earn a wage, w. Workers are heterogeneous in their ability to run a firm, given by φ.[9]

There is an ability/productivity cutoff φ_c, such that all agents with a productivity draw below φ_c will work as production workers/employees, whereas all agents with a draw greater than φ_c will be self-employed. Formally, this cutoff is given by the following expression:

$$\varphi_c \equiv \inf\left[\varphi : L\pi\left(\varphi, R, \frac{w}{P}\right) - w \geq 0\right]. \tag{7}$$

Let $G(\varphi)$ be the measure (mass) of agents with ability less than φ. Then, $G(\varphi_c)$ is the measure of workers and $[L - G(\varphi_c)]$ is the mass of self-employed (that is, employers). Also, note that $G(\infty) = L$.

2.3 Equilibrium

From equation (7) and the profit function we can express φ_c as

$$\varphi_c = \sigma^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma-1}\left(\frac{w}{P}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{RL}{P}\right)^{-\frac{1}{\sigma-1}}. \tag{8}$$

Labor market clearing requires the number (mass) of workers to be equal to the amount of labor demanded by good producers to satisfy their demand. That is,

$$\int_{\varphi_c}^{\infty} L\frac{y(\varphi)}{\varphi} dG(\varphi) = G(\varphi_c), \tag{9}$$

which, using expressions (2) and (5), can be re-written as

$$\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\frac{RL}{P}\left(\frac{w}{P}\right)^{-\sigma}\int_{\varphi_c}^{\infty}\varphi^{\sigma-1} dG(\varphi) = G(\varphi_c). \tag{10}$$

Finally, from the definition of P and equation (5) we get the following expression

$$\int_{\varphi_c}^{\infty}\left(\frac{\sigma-1}{\sigma}\right)\left(\frac{\varphi}{w/P}\right)^{\sigma-1} dG(\varphi) = 1. \tag{11}$$

[9] Note that in this way, in the spirit of Lucas (1978), we associate a firm's productivity with its owner's ability to run a business.

Therefore, the model is closed by the system of equations (8)–(11) that determine the values of the variables φ_c, $\frac{R}{P}$ and $\frac{w}{P}$.

Suppose the productivity parameter φ is Pareto distributed—then, $G(\varphi) = L\left[1 - \left(\frac{\varphi_0}{\varphi}\right)^{\alpha}\right]$, where φ_0 is the lower bound of the distribution and α is the shape parameter of the function, assumed to be large enough ($\alpha > 1$) so that the distribution has a finite mean.[10]

Under this assumption, it is straightforward to check that equations (8) and (10) imply the following:[11]

$$\left[1 + (\sigma - 1)\frac{\alpha}{\alpha + 1 - \sigma}\right]\left(\frac{\varphi_0}{\varphi_c}\right)^{\alpha} = 1, \tag{12}$$

where $\left(\frac{\varphi_0}{\varphi_c}\right)^{\alpha}$ is the rate of self-employment. Intuitively, this expression implies that if σ increases, so that there is greater substitutability between goods, then markups and profits decrease and, therefore, self-employment becomes less attractive.

3 The Model: Open Economy

3.1 Basic Setup

Consider now a world with two countries, Home and Foreign. Home is the country described above, while Foreign has the same preferences and production function as Home, and its variables are labeled by an asterisk ($*$).

Suppose that these countries are allowed to trade with each other. Then, it is easy to show that the Home demands for domestic and foreign goods are

$$\begin{aligned} y_d(j) &= \left(\frac{p_d(j)}{P}\right)^{-\sigma}\frac{R}{P}, \\ y_x^*(j) &= \left(\frac{p_x^*(j)}{P}\right)^{-\sigma}\frac{R}{P}, \end{aligned} \tag{13}$$

respectively. In the expressions above, p_d (p_x^*) refers to the price paid by Home consumers for domestic (foreign) goods. Note that the aggregate price now includes the foreign varieties consumed at Home:[12]

$$P^{1-\sigma} = \int_{j \in Home} p_d(j)^{1-\sigma}\, dj + \int_{j \in Foreign} p_x^*(j)^{1-\sigma}\, dj. \tag{14}$$

The producer's problem in its Home market looks exactly as in the closed economy case,

[10] The assumption that firm productivity is Pareto distributed is widely used in the literature on firm heterogeneity and trade (see Antràs and Helpman 2004; and Helpman, Melitz, and Yeaple 2004). Additionally, the Pareto distribution approximates reasonably well the observed distribution of firm sizes (see Axtell 2001). Since the distribution of firm productivity is just the truncated distribution of abilities, it is reasonable to conjecture that the ability parameter is also Pareto distributed (a truncated Pareto is also a Pareto).

[11] We assume that $\alpha > \sigma - 1$ for the convergence of the integral of the labor market clearing condition.

[12] The expressions for demands and aggregate prices in the Foreign country are analogous to those of the Home country.

yielding the same pricing and profit functions:

$$\frac{p_d(j)}{P} = \frac{\sigma}{\sigma-1}\frac{w/P}{\varphi(j)}; \qquad \pi_d(j) = \sigma^{-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{\varphi(j)}{w/P}\right)^{\sigma-1} R. \tag{15}$$

Entry into foreign markets requires producers to first pay an entry cost f (f^* for foreign producers). Additionally, there is also a variable cost, such that $\tau^* > 1$ ($\tau > 1$) units of good $y(j)$ must be shipped in order for one unit of $y(j)$ to be delivered to consumers in the Foreign (Home) market. Therefore, the producer's operating export profits (before paying the entry cost f) can be written as

$$\max_{p_x(j)} \pi_x(j) = p_x(j)\, y_x(j) - w\tau^* \frac{y_x(j)}{\varphi(j)}, \tag{16}$$

yielding the following pricing and profit functions (per unit mass of consumers):

$$\frac{p_x(j)}{P^*} = \frac{\sigma}{\sigma-1}\tau^*\frac{w/P^*}{\varphi(j)}; \qquad \pi_x(j) = \sigma^{-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}(\tau^*)^{1-\sigma}\left(\frac{\varphi(j)}{w/P^*}\right)^{\sigma-1} R^*. \tag{17}$$

Note that this implies that prices charged in the Home market and in the Foreign market are closely related: $p_x(j) = \tau^* p_d(j)$.

3.2 Selection

As in the closed economy case, each agent selects himself into being either self-employed or an employee. However, in the open economy, those who are self-employed (those agents who own a firm) must also decide whether they are going to export. Therefore, now there are two cutoffs. The first cutoff, φ_d, determines which agents will be self-employed ($\varphi > \varphi_d$) and which ones will be employees ($\varphi < \varphi_d$); thus, φ_d is essentially the open economy version of φ_c. The second cutoff, φ_x, determines which agents/firms are exporters ($\varphi > \varphi_x$) and which ones sell only in the domestic market ($\varphi < \varphi_x$). Formally,[13]

$$\begin{aligned}
\varphi_d &= \sigma^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma-1}\left(\frac{w}{P}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{RL}{P}\right)^{-\frac{1}{\sigma-1}} \\
\varphi_x &= \max\left\{\varphi_d,\ \sigma^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma-1}\tau^* f^{\frac{1}{\sigma-1}}\left(\frac{w}{P^*}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{R^*L^*}{P^*}\right)^{-\frac{1}{\sigma-1}}\right\}.
\end{aligned} \tag{18}$$

Note that it is not possible for a self-employed agent to export without selling in the Home market: by exporting the agent already gives up wage income, and there is no entry cost into the domestic market. Agents in the Foreign country face an analogous situation. Thus, there

[13] We assume that the parameters are such that $\varphi_x > \varphi_d$, so not every firm is an exporter, in accordance with the data. If the countries are symmetric, then a sufficient condition is $\tau^* f^{\frac{1}{\sigma-1}} > 1$.

are two other cutoffs to consider:

$$\begin{aligned} \varphi_d^* &= \sigma^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} \left(\frac{w^*}{P^*}\right)^{\frac{\sigma}{\sigma-1}} \left(\frac{R^* L^*}{P^*}\right)^{-\frac{1}{\sigma-1}} \\ \varphi_x^* &= \max\left\{\varphi_d^*,\ \sigma^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} \tau \left(f^*\right)^{\frac{1}{\sigma-1}} \left(\frac{w^*}{P}\right)^{\frac{\sigma}{\sigma-1}} \left(\frac{RL}{P}\right)^{-\frac{1}{\sigma-1}}\right\}. \end{aligned} \tag{19}$$

After some simple algebra we can rewrite the cutoffs as follows:

$$\begin{aligned} \varphi_x &= \tau^* f^{\frac{1}{\sigma-1}} \left(\frac{w}{w^*}\right)^{\frac{\sigma}{\sigma-1}} \varphi_d^* \\ \varphi_x^* &= \tau \left(f^*\right)^{\frac{1}{\sigma-1}} \left(\frac{w^*}{w}\right)^{\frac{\sigma}{\sigma-1}} \varphi_d. \end{aligned} \tag{20}$$

This relationship between the cutoffs is going to prove useful when solving for the equilibrium of the model—we do that next.

3.3 Equilibrium

In order to solve the model we use the expressions for the cutoffs from the previous section, along with some conditions to ensure that trade is balanced and that labor markets clear.

First, the trade balance condition simply states that Home exports should be equal to Home imports:

$$L^* \int_{j \in Home} p_x(j)\, y_x(j)\, dj = L \int_{j \in Foreign} p_x^*(j)\, y_x^*(j)\, dj. \tag{21}$$

Using expressions (13)–(19), and assuming that both φ and φ^* are Pareto distributed, we can re-write the trade balance condition in the following way:

$$f \frac{w}{L^*} \frac{\alpha}{\alpha+1-\sigma} \left(\frac{\varphi_0}{\varphi_x}\right)^{\alpha} = f^* \frac{w^*}{L} \frac{\alpha^*}{\alpha^*+1-\sigma} \left(\frac{\varphi_0^*}{\varphi_x^*}\right)^{\alpha^*}. \tag{22}$$

We then combine equation (22) with each of the expressions in (20) relating the different cutoffs; after some algebra we obtain the following two equations:

$$f \frac{L}{L^*} \frac{\alpha}{\alpha+1-\sigma} \Psi_x \Psi_d^{-\frac{\sigma-1}{\sigma\alpha}} = \left(\frac{f^*}{\tau}\right)^{\frac{\sigma-1}{\sigma}} \frac{\alpha^*}{\alpha^*+1-\sigma} \left(\frac{\varphi_0^*}{\varphi_0^*}\right)^{\frac{\sigma-1}{\sigma}} \left(\Psi_x^*\right)^{1-\frac{\sigma-1}{\sigma\alpha^*}} \tag{23}$$

$$f^* \frac{L^*}{L} \frac{\alpha^*}{\alpha^*+1-\sigma} \Psi_x^* \left(\Psi_d^*\right)^{-\frac{\sigma-1}{\sigma\alpha}} = \left(\frac{f}{\tau^*}\right)^{\frac{\sigma-1}{\sigma}} \frac{\alpha}{\alpha+1-\sigma} \left(\frac{\varphi_0}{\varphi_0^*}\right)^{\frac{\sigma-1}{\sigma}} \Psi_x^{1-\frac{\sigma-1}{\sigma\alpha}}, \tag{24}$$

where $\Psi_d \equiv \left(\frac{\varphi_0}{\varphi_d}\right)^{\alpha}$, $\Psi_x \equiv \left(\frac{\varphi_0}{\varphi_x}\right)^{\alpha}$, $\Psi_d^* \equiv \left(\frac{\varphi_0^*}{\varphi_d^*}\right)^{\alpha^*}$ and $\Psi_x^* \equiv \left(\frac{\varphi_0^*}{\varphi_x^*}\right)^{\alpha^*}$. Note that Ψ_d (Ψ_d^*) is the measure of self-employed workers (and of firms) in the Home (Foreign) country. Likewise, Ψ_x (Ψ_x^*) is the measure of exporting firms.

Second, the condition for labor market clearing can be written as follows

$$L\int_{j\in Dom}\frac{y_d\left(j\right)}{\varphi\left(j\right)}dj+\int_{j\in Export}\left(L^*\frac{\tau^* y_x\left(j\right)}{\varphi\left(j\right)}+f\right)dj=G(\varphi_d). \tag{25}$$

Next, using the definitions of the cutoffs on this last expression we obtain

$$1=A\left[\Psi_d+f\Psi_x\right]. \tag{26}$$

A similar expression can be found for the Foreign country:

$$1=B\left[\Psi_d^*+f^*\Psi_x^*\right], \tag{27}$$

where $\Psi_d, \Psi_x, \Psi_d^*, \Psi_x^*$ are defined as above and $A\equiv\left(1+(\sigma-1)\frac{\alpha}{\alpha+1-\sigma}\right)$, and $B\equiv\left(1+(\sigma-1)\frac{\alpha^*}{\alpha^*+1-\sigma}\right)$.

Remark 1. *Equations (26) and (27) imply that, in each country, the mass of self-employed agents* (Ψ_d, Ψ_d^*) *and the mass of exporting firms* (Ψ_x, Ψ_x^*) *must move in opposite directions.*

Finally, we have a system of four equations (23)–(27) in four unknowns: Ψ_d, Ψ_x, Ψ_d^*, and Ψ_x^*. We are interested in the effects that changes in trade costs (τ^* and τ) have on the resulting levels of self-employment and exporting status. Formally, after taking logarithms, we totally differentiate the system with respect to the trade costs of exporting to the Home market (τ) and obtain the following objects:[14]

$$\begin{array}{ll}\varepsilon_d\equiv\frac{d\log\Psi_d}{d\log\tau}>0 & \varepsilon_d^*\equiv\frac{d\log\Psi_d^*}{d\log\tau}>0\\ \varepsilon_x\equiv\frac{d\log\Psi_x}{d\log\tau}<0 & \varepsilon_x^*\equiv\frac{d\log\Psi_x^*}{d\log\tau}<0.\end{array} \tag{28}$$

Likewise, we differentiate with respect to the trade costs of exporting to the Foreign market and find the following:

$$\begin{array}{ll}\eta_d\equiv\frac{d\log\Psi_d}{d\log\tau^*}>0 & \eta_d^*\equiv\frac{d\log\Psi_d^*}{d\log\tau^*}>0\\ \eta_x\equiv\frac{d\log\Psi_x}{d\log\tau^*}<0 & \eta_x^*\equiv\frac{d\log\Psi_x^*}{d\log\tau^*}<0.\end{array} \tag{29}$$

The interpretation of these results is fairly simple. Higher (lower) trade costs will increase (decrease) the mass of self-employed agents and reduce (increase) that of exporting firms. It is interesting to note that this holds true regardless of whether we consider τ^* or τ.

Consider first a decrease in τ^*, so that it is cheaper to export goods from Home to Foreign. This increases the mass of domestic firms that find it profitable to export (and makes it even more profitable for those that were already exporting). In turn, this results in an increase in the demand for labor from the more productive firms, raising the domestic real wage and decreasing the mass of agents who choose to be self-employed.[15]

[14] See Appendix A.1 for the exact expressions for the different εs and ηs.

[15] In Appendix A.2 we show that φ_d can be expressed as the product of a constant times the real wage w/P.

Next, consider a decrease in τ, so that it is cheaper to export goods from Foreign to Home. The presence of (efficiently produced) Foreign goods in the Home market increases the domestic real wage, making some marginal self-employed agents become employees. In the Foreign country, increased exports and the reallocation of resources towards more productive firms, increases the real wage. This, in turn, increases the Foreign demand for Home goods, where the mass of exporters increases, employing the formerly self-employed workers. An analogous argument applies for the self-employment and exporting status in the Foreign country. We summarize these results in the following two propositions.

Proposition 1. *An increase in Home country's trading cost, τ, will have the following effects:*

1. *The mass of self-employed agents at Home will increase.*
2. *The mass of exporting firms at Home will decrease.*
3. *These effects are the qualitatively the same for the Foreign country variables.*

Proposition 2. *An increase in Foreign country's trading cost, τ^*, will have the following effects:*

1. *The mass of self-employed agents at Home will increase.*
2. *The mass of exporting firms at Home will decrease.*
3. *These effects are qualitatively the same for the Foreign country variables.*

4 Empirical Evidence

4.1 Data Sources

In this section we use U.S. data to test the predictions of the model. Specifically, we look at self-employment data across the 3-digit NAICS manufacturing sectors for the period 2000–2010. The source for these data is the Bureau of Labor Statistics.[16]

We also need measures of trade costs. From the model, these measures should be inclusive of all costs of accessing a country's market—that is, they should include tariffs and transportation costs (freight and insurance costs). We were able to construct a measure of transportation costs for the United States only (that is, the cost of shipping to the U.S.), but we plan to construct an equivalent measure of foreign transportation costs (that is, the cost of shipping from the U.S.).[17] Tariff data are at the 6-digit level of the Harmonized System (HS) from the

[16] See Appendix D for an explanation of how this variable is measured.

[17] This implies that our current measure of τ includes tariffs and transportation costs, while the measure of τ^* includes only tariffs. In some univariate regressions (not reported) we assumed that the transportation rate is symmetric—that is, the freight and insurance costs are the same whether shipping goods to or from the U.S.—and we added this rate to the foreign tariffs. These regressions showed that the data supported our predictions. In the multivariate analysis presented below we do not follow this path because of the multi-collinearity problem this creates.

United Nations' TRAINS database. For each HS6 industry, we observe the U.S. tariff and the foreign tariff (defined as the average tariff of the rest of the world). For the transportation costs we use data from the United States International Trade Commission. For each HS10 industry, the transport cost is computed as the ratio of import charges (insurance, freight, and all other charges excluding import duties) to import values. We add these transport cost values to the tariffs and obtain the trade cost measure, which we then map into 3-digit NAICS.[18]

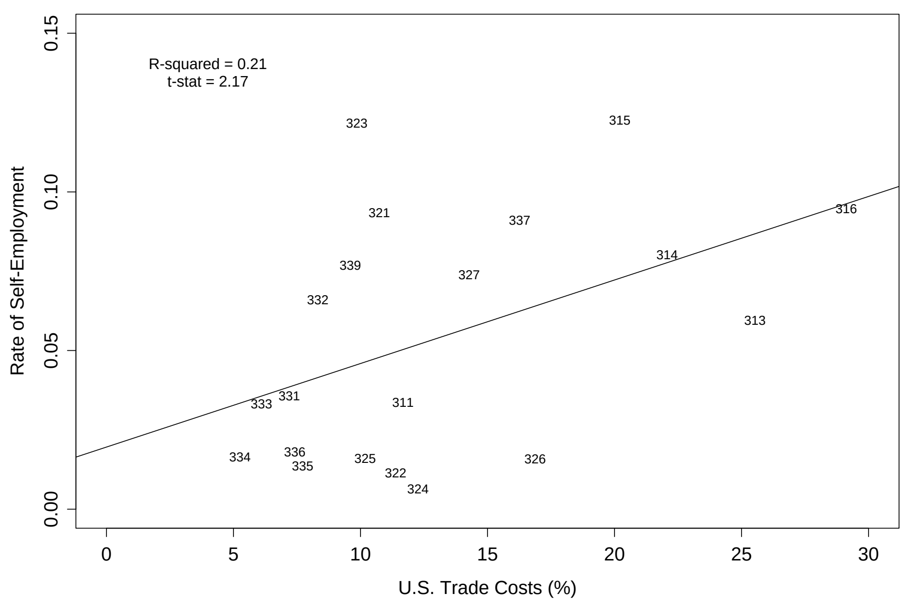
Finally, from Bernard et al. (2007) we obtain data on the percentage of firms that are exporters for each 3-digit NAICS industry for 2002.

4.2 Some Graphical Evidence

In this subsection we present some graphical evidence of our theory's predictions. Specifically, we show three graphs that suggest that the data indeed support the model's implications.

The first prediction we test is: *"Industries with higher U.S. trade costs will have higher rates of self-employment."* Figure IV shows that this is indeed the case. That is, consistent with the theory, the data show that there is a strong, positive and statistically significant relationship between U.S. trade costs and self-employment rates.[19]

Figure IV: Rate of Self-Employment and U.S. Trade Costs



Notes: "Rate of Self-Employment" is the ratio of self-employed workers to total employment in the industry. "U.S. Trade Costs" is the openness measure discussed in the main text. Data are for 2010. See Appendix C.3 and for industry codes and Appendix D for further details.

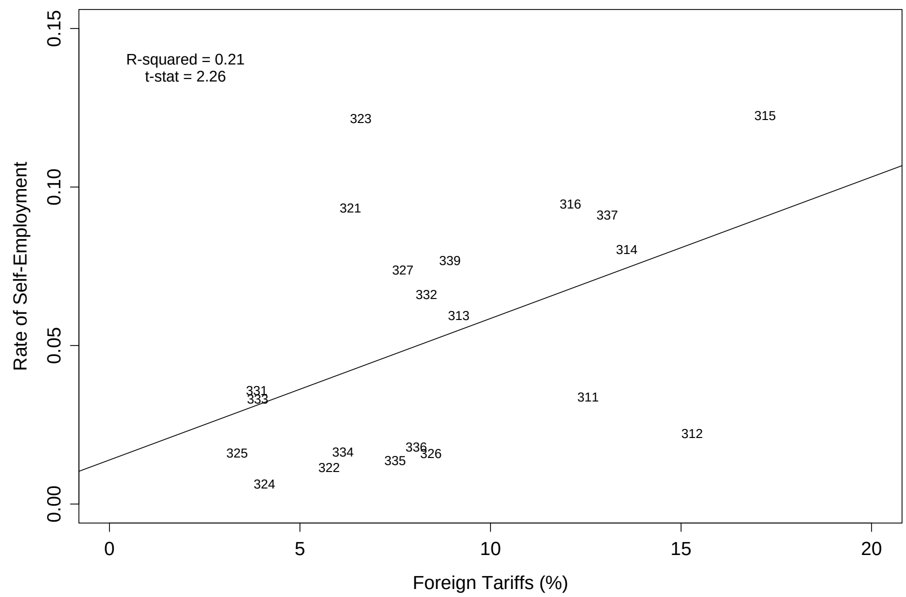
The second prediction is the following: *"Industries with higher Foreign trade costs will*

[18] When we add transport costs and tariffs, we implicitly assume that within each HS6 tariff line, all HS10 industries share the same tariff value.

[19] Industry 312 (beverages and tobacco) was dropped as an outlier.

have higher rates of self-employment." As is clear from Figure V, the data seem to support this prediction as well. That is, the data show that there is a strong, positive, and statistically significant relationship between Foreign trade costs and self-employment rates.

Figure V: Rate of Self-Employment and Foreign Tariffs



Notes: "Rate of Self-Employment" is the ratio of self-employed workers to total employment in the industry. "Foreign Tariffs" is the openness measure discussed in the main text. Data are for 2010. See the Appendix C.3 for industry codes and Appendix D for further details.

The final prediction we test is: *"Industries with a higher fraction of exporting firms will have lower rates of self-employment."* Figure VI suggests that this prediction is also supported by the data. That is, consistent with the theory, the data show that there is a negative and statistically significant relationship between self-employment rates and the share of exporters.

4.3 Econometric Evidence

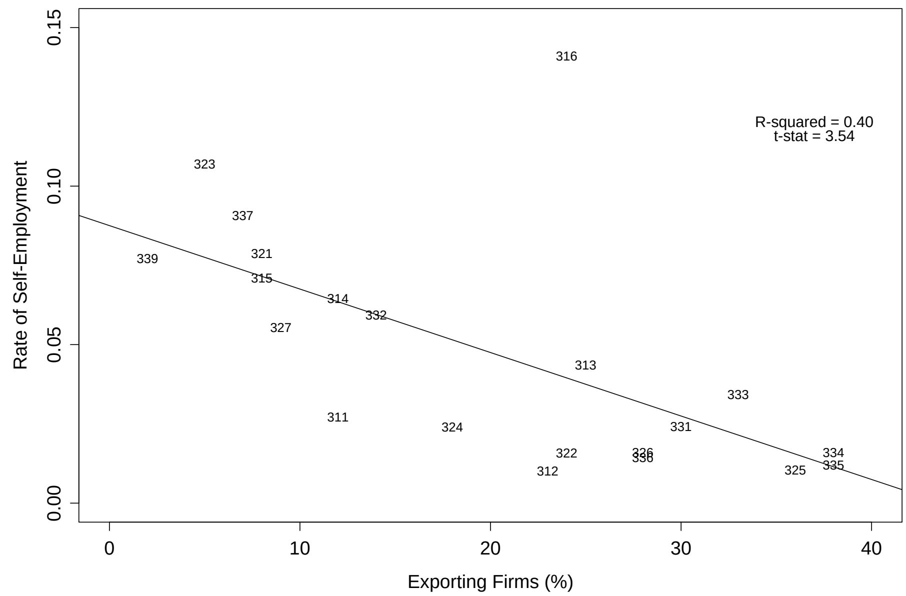
In this subsection we present our main empirical results. From our theory, we expect self-employment to be positively affected by the trading costs (both, domestic and foreign) of that particular industry. That is, we pose the following econometric model

$$se_{it} = \beta_0 + \beta_1 \tau_{it}^{US} + \beta_3 \tau_{it}^{F} + Controls + \nu_{it}, \tag{30}$$

and we expect $\beta_1 > 0$ and $\beta_2 > 0$. We try several specifications using different controls.[20] The idea underlying a first group of controls is that one possible impediment to self-employment is the lack of capital, as there is some evidence that entrepreneurs face liquidity constraints

[20]The data source for these controls is the Annual Survey of Manufacturers. This is not available for some years, so the number of observations decreases when we use these controls.

Figure VI: Rate of Self-Employment and Share of Exporters



Notes: "Rate of Self-Employment" is the ratio of self-employed workers to total employment in the industry in 2002. "Exporting Firms (%)" is the share of firms within an industry that were exporters in 2002. See the Appendix C.3 for industry codes and Appendix D for further details.

(see Evans and Leighton 1989; and Evans and Jovanovic 1989). In this spirit, we use two different measures for the importance of capital in a given sector. First, we use the ratio of total capital expenditures to the value of shipments ($k/ship$); second, we use the ratio of capital expenditures and material purchases to the value of shipments ($exp/ship$).[21] We also control for a number of demographic characteristics at the industry level. Specifically, since the self-employed are more likely to be male, white, and older, we control for the fraction of workers in an industry who are *male*, the fraction who are *white*, and the median *age* of the workers in the industry (see Hipple 2010; and OECD 2000).[22]

The results are shown in Table I. In column (1), we run a simple regression of self-employment on trade costs, with no controls (other than year fixed effects). From column (2) onwards we use the different controls described above. Note the positive and significant effect that both measures of trade costs have across all specifications. For example, under the specification of column (6), a 1 percentage point increase in U.S. trade costs increases the self-employment rate by almost 0.2 percentage points; likewise, a 1 percentage point increase in the foreign tariff increases the rate of self-employment by 0.169 percentage points. Overall, the data seem to strongly support the model's predictions.

[21]We also tried alternatives, including the ratio of capital expenditures to payroll, and the ratio of capital expenditures to the number of employees. The resulting estimates were very similar to those in Table I.

[22]There are other variables that might affect self-employment, but these are mostly for cross-country comparisons to control for developmental issues: GDP per capita, ratio of government gross liabilities to GDP, proportion of value added accounted for by capital, proportion of services in value added (OECD 2000).

Table I: Self-Employment Regressions

	-1-	-2-	-3-	-4-	-5-	-6-
τ^{US}	0.157***	0.166***	0.234***	0.100**	0.114***	0.199***
	(0.039)	(0.042)	(0.040)	(0.046)	(0.049)	(0.048)
τ^{F}	0.416***	0.414***	0.242***	0.197***	0.215***	0.169***
	(0.062)	(0.071)	(0.063)	(0.070)	(0.077)	(0.069)
$k/ship$		0.042			0.257	
		(0.196)			(0.183)	
$exp/ship$			−0.147***			−0.098***
			(0.019)			(0.018)
$male$				−0.001***	−0.002***	−0.001***
				(0.000)	(0.000)	(0.000)
$white$				0.004***	0.004***	0.003***
				(0.000)	(0.001)	(0.001)
age				−0.003*	−0.002	−0.002
				(0.001)	(0.002)	(0.002)
R^2	0.323	0.320	0.457	0.526	0.532	0.573
Observations	220	200	200	220	200	200

Notes: '***', '**' and '*' refers to statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are adjusted for heteroscedasticity. Regressions include year fixed effects.

5 Conclusion

In this paper we unveil a previously unknown fact: the greater a country's exposure to foreign competition, the lower the rate of self-employment. This holds across different countries and across industries within the United States.

We develop a simple model that is able to rationalize this behavior. In the model heterogeneous agents choose whether to be employees or self-employed. Self-employed agents (firms) can also select themselves into the exporting market. The model delivers three main predictions that we test against the data:

1. Higher Home trade costs (overall costs of exporting to the Home country), result in lower self-employment.

2. Higher Foreign trade costs, also result in lower self-employment.

3. The rates of self-employment and of exporting firms are negatively related.

We use 3-digit NAICS data for U.S. manufacturing industries and find support for all three predictions across different econometric specifications.

A venue that would be most interesting to explore is reverse causality. That is, to consider the possibility that self-employment may affect tariff rates. Our first impression is that this should not be driving our results. Presumably, organizing to lobby for protection should be easier in the case of concentrated industries, that is, in the case of low rates of self-employment. Thus, this argument would predict that low rates of self-employment should be *negatively* associated with high tariff rates—precisely the opposite of what our model predicts and of what we observe in the data.

As a final note, it is interesting to compare the message of this paper with Lucas's (1978) final remarks. On the one hand, Lucas's ultimate message is that, under Gibrat's law and an elasticity of technical substitution less than unity, the managerial ability cutoff (in our notation, φ_c) increases with the capital-labor ratio of the economy. Since the capital per capita indeed increases through time, one would expect the share of self-employed to decrease with time. On the other hand, if we think that the world is becoming increasingly interconnected through international trade, then our model predicts that the rate of self-employment will decrease through time. Thus, our model delivers exactly the same prediction as Lucas (1978) does but for a very different reason.

Appendix

A Theoretical Derivations

In this appendix we detail the solution to the model presented in the main text of the paper.

A.1 Elasticities

If we take logs and differentiate the system of four equations (23)–(27) with respect to τ, we obtain the following:

$$\begin{bmatrix} \phi & f & 0 & 0 \\ 0 & 0 & \phi^* & f^* \\ -\frac{\sigma-1}{\alpha\sigma} & 1 & 0 & -\left(1-\frac{\sigma-1}{\alpha^*\sigma}\right) \\ 0 & -\left(1-\frac{\sigma-1}{\alpha\sigma}\right) & -\frac{\sigma-1}{\alpha^*\sigma} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_d \\ \varepsilon_x \\ \varepsilon_d^* \\ \varepsilon_x^* \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -\frac{\sigma-1}{\sigma} \\ 0 \end{bmatrix},$$

where $\phi \equiv \Psi_d/\Psi_x$. The solution to this system is as follows:

$$\begin{aligned} \varepsilon_d &= \alpha f \frac{f^*(\sigma-1)+\phi^*\alpha^*\sigma}{f\left(f^*(\sigma-1)+\phi^*\alpha^*\sigma\right)+\phi\left(f^*\alpha\sigma+\phi^*\left(1+(\alpha+\alpha^*-1)\sigma\right)\right)} > 0, \\ \varepsilon_x &= -\varepsilon_d \frac{\phi^*}{f} < 0, \\ \varepsilon_d^* &= f^*\alpha^*\phi \frac{1+(\alpha-1)\sigma}{f\left(f^*(\sigma-1)+\phi^*\alpha^*\sigma\right)+\phi\left(f^*\alpha\sigma+\phi^*\left(1+(\alpha+\alpha^*-1)\sigma\right)\right)} > 0, \\ \varepsilon_x^* &= -\varepsilon_d^* \frac{\phi^*}{f^*} < 0. \end{aligned}$$

If, instead, we differentiate with respect to the cost of trading with the Foreign country τ^*, we obtain the ηs mentioned in the main text. The expressions are entirely analogous to the ones above, with f, ϕ, and α, respectively, replaced with f^*, ϕ^*, and α^*, and vice versa.

A.2 Some Further Details

It is interesting to note that the cutoffs can be expressed as the product of a constant term and the real wages. Specifically, note that the constant markup of the monopolistically competitive producers implies that the total income (revenue) of Home producers should be equal to the mark-up times the total wages earned by production workers; that is,

$$\begin{aligned} L\int R_d(j)\,dj + L^*\int R_x(j)\,dj &= \frac{\sigma}{\sigma-1} wL\left(\int \frac{y_d(j)}{\varphi(j)}dj + \int \frac{y_x(j)}{\varphi(j)}dj\right) \\ &= \frac{\sigma}{\sigma-1} wL\left(\int l_d(j)\,dj + \int l_x(j)\,dj\right), \end{aligned}$$

where l_d and l_x are the labor used for producting the output sold in the domestic and export markets (per unit mass of consumer), respectively. Next, given that the total revenue is equal to the total spending of Home consumers, we can rewrite the above expression as follows:

$$R = \frac{\sigma}{\sigma-1} w\left[1-\left(\frac{\varphi_0}{\varphi_d}\right)^{\alpha} - f\left(\frac{\varphi_0}{\varphi_x}\right)^{\alpha}\right].$$

Combining this last expression with equation (26), we can re-write R as

$$R = \frac{\sigma}{\sigma-1} w \left[1 - \frac{1}{1+(\sigma-1)\frac{\alpha}{\alpha+1-\sigma}}\right] \equiv Mw.$$

Finally, plugging in this expression for R in the definition of the cutoff φ_d from equation (18) we obtain the following:

$$\varphi_d = \sigma^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} (ML)^{\frac{-1}{\sigma-1}} \frac{w}{P}.$$

Thus, when real wages increase, so does φ_d—which implies that self-employment decreases.

B Two-Sector Model

In this appendix, we present a two-sector version of the model developed in the main text. The key assumption is that both labor and managerial skills are sector-specific. This assumption is not so strong, given that in our empirical work we look at industries at rather a high level of aggregation. We show that all of our results are (qualitatively) preserved once we have more than one industry in the economy.

B.1 Closed Economy

Consider a similar model to the one presented in the main text, but where the Home country has two industries, labeled A and B.

In this setting, the consumer's problem can be written as,

$$\begin{aligned} \max Y &\equiv \left(Y_A^{\mu} + Y_B^{\mu}\right)^{1/\mu} \\ s.t. & \\ R &= R_A + R_B, \end{aligned} \tag{B-1}$$

where $Y_k = \left[\int_{j \in J_k} y_k(j)^{\frac{\sigma-1}{\sigma}} dj\right]^{\frac{\sigma}{\sigma-1}}$ is the aggregate consumption of goods from industry k, $R_k = \int_{j \in J_k} p_k(j) y_k(j) dj$ is the expenditure on industry k, and $p_k(j)$ and $y_k(j)$ are the price and quantity of firm j within industry k, where $k \in \{A, B\}$. We assume that $\sigma > 1$ and $\frac{\sigma-1}{\sigma} > \mu > 0$, implying that the degree of substitution between varieties within an industry is greater than the degree of substitution across industries (see Antràs and Helpman (2004)).

From the first-order conditions, we obtain the following expressions for the optimal pricing and profit functions (per unit mass of consumer):

$$\begin{aligned} \frac{p_k(j)}{P_k} &= \frac{\sigma}{\sigma-1} \frac{1}{\varphi_k(j)} \frac{w_k}{P_k}, \\ \pi_k(j) &= \frac{1}{\sigma} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \left(\frac{\varphi_k(j)}{w_k/P_k}\right)^{\sigma-1} R_k, \end{aligned}$$

where P_k is the price index for sector $k \in \{A, B\}$. It is interesting to note that the first-order conditions also imply this relationship between consumption and expenditure across both industries:

$$\frac{R_A}{Y_A^{\mu}} = \frac{R_B}{Y_B^{\mu}}. \tag{B-2}$$

The agents within sector k select themselves into being either self-employed or production workers, just as in the one-sector model. Specifically, we assume that agents within sector k are heterogeneous in regard to their ability, φ, to run a firm. Thus, there is a sector-specific cutoff, $\varphi_{c,k}$, such that all agents with ability $\varphi < \varphi_{c,k}$ chose to be production workers, and all agents above this threshold chose to be self-employed. Formally, the cutoff for sector $k \in \{A, B\}$ is defined as follows:

$$\begin{aligned}
\varphi_{c,k} &\equiv \inf\left[\varphi : L\pi_k - w_k \geq 0\right], \\
\varphi_{c,k} &= \sigma^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1}\left(\frac{w_k}{P_k}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{R_k L}{P_k}\right)^{-\frac{1}{\sigma-1}}.
\end{aligned}$$

In order to close the model, we look at the labor market clearing condition (one for each sector $k \in \{A, B\}$). Just as in the one-sector model, we can write the condition as follows:

$$\int_{\varphi_{c,k}}^{\infty} L\frac{y_k(j)}{\varphi} dG_k(\varphi) = G_k(\varphi_{c,k}).$$

Under the assumption of φ being Pareto distributed in each sector, so that $G_k(\varphi) = L_k\left[1 - \left(\frac{\varphi_{0,k}}{\varphi}\right)^{\alpha_k}\right]$, the last expression yields the following equilibrium condition:

$$\left(1 + (\sigma-1)\frac{\alpha_k}{\alpha_k + 1 - \sigma}\right)\left(\frac{\varphi_{0,k}}{\varphi_{c,k}}\right)^{\alpha} = 1. \tag{B-3}$$

where L_k is the labor force in sector k and $\left(\frac{\varphi_{0,k}}{\varphi_{c,k}}\right)^{\alpha}$ is k's rate of self-employment. Note that equation (B-3) is very similar to (12), the analogous condition for the one-sector model. Intuitively, this expression implies that if σ increases, so that there is greater substitutability between goods within industry k, then markups and profits decrease and, therefore, self-employment becomes less attractive in sector k.

B.2 Open Economy

The open economy is analogous to the one-sector model. That is, there are two countries, Home and Foreign, with populations L and L^*. Consumers in both countries share the same preferences over the goods produced by the two industries A and B, as represented by B-1.

Firms in each country and sector can access the foreign market through exports—but in order to do so, they must pay a sector- and country-specific fixed cost (f_k and f_k^*) as well as variable trade costs (τ_k^* and τ_k).

In a similar way as the one described in the main text, it is straightforward to check that the demand function of the Home consumer for goods of industry $k \in \{A, B\}$ is the following:

$$\begin{aligned}
y_{d,k}(j) &= \left(\frac{p_{d,k}(j)}{P_k}\right)^{-\sigma}\frac{R_k}{P_k}, \\
y_{x,k}^*(j) &= \left(\frac{p_{x,k}^*(j)}{P_k}\right)^{-\sigma}\frac{R_k}{P_k},
\end{aligned}$$

where the first expression corresponds to the demand for domestically produced goods, while the second expression is the demand for goods produced abroad (that is, exports from Foreign, sector k producers).

Proceeding in an analogous way as before, we obtain the following expressions for the optimal pricing, output, and profits of the firm that sells domestically (per unit mass of Home consumer):

$$\begin{aligned}\frac{p_{d,k}(j)}{P_k} &= \frac{\sigma}{\sigma-1}\frac{1}{\varphi_k(j)}\frac{w_k}{P_k}, \\ y_{d,k}(j) &= \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{\varphi_k(j)}{w_k/P_k}\right)^{\sigma}\frac{R_k}{P_k}, \\ \pi_{d,k}(j) &= \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{\varphi_k(j)}{w_k/P_k}\right)^{\sigma-1}R_k.\end{aligned} \tag{B-4}$$

Likewise, the expressions for the exporting firm are the following (per unit mass of Foreign consumer):

$$\begin{aligned}\frac{p_{x,k}(j)}{P_k^*} &= \frac{\sigma}{\sigma-1}\frac{w_k/P_k^*}{\varphi_k(j)}\tau_k^*, \\ y_{x,k}(j) &= \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\left(\frac{\varphi_k(j)}{w_k/P_k^*}\right)^{\sigma}\frac{R_k^*}{P_k^*}\left(\tau_k^*\right)^{-\sigma}, \\ \pi_{x,k}(j) &= \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{\varphi_k(j)}{w_k/P_k^*}\right)^{\sigma-1}R_k^*\left(\tau_k^*\right)^{1-\sigma}.\end{aligned} \tag{B-5}$$

Based on the value of φ, agents in both sectors (and countries) chose whether to be self-employed or a production worker. Conditional on being self-employed, and therefore running a firm, some will also choose to become exporters. Formally, for each sector $k \in \{A, B\}$, and country, we have two cutoffs:

$$\begin{aligned}\varphi_{d,k} &= \sigma^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma-1}\left(\frac{w_k}{P_k}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{R_kL}{P_k}\right)^{\frac{-1}{\sigma-1}}, \\ \varphi_{x,k} &= \sigma^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma-1}\tau_k^*\left(f_k\right)^{\frac{1}{\sigma-1}}\left(\frac{w_k^*}{P_k^*}\right)^{\frac{\sigma}{\sigma-1}}\left(\frac{R_k^*L^*}{P_k^*}\right)^{\frac{-1}{\sigma-1}}.\end{aligned} \tag{B-6}$$

The first one ($\varphi_{d,k}$) determines the employment decision, while the second one ($\varphi_{x,k}$) pins down the exporting decision.

B.2.1 Closing the Model

Therefore, there are twenty variables to be determined: eight cutoffs ($\varphi_{d,A}$, $\varphi_{x,A}$, $\varphi_{d,B}$, $\varphi_{x,B}$, $\varphi_{d,A}^*$, $\varphi_{x,A}^*$, $\varphi_{d,B}^*$, $\varphi_{x,B}^*$), four wages (w_A, w_B, w_A^*, w_B^*), four aggregate revenues (R_A, R_B, R_A^*, R_B^*), and four aggregate prices (P_A, P_B, P_A^*, P_B^*)—so we can set $P_B^* = 1$. To close the model we use the equations for labor market clearing, aggregate prices, trade balance, inter-industry substitution, and the cutoffs.

First, the labor market clearing condition is now the following:

$$\int_{\varphi_{d,k}}^{\infty} L\frac{y_{d,k}(\varphi)}{\varphi}dG_k(\varphi) + \int_{\varphi_{x,k}}^{\infty} L^*\tau_k^*\frac{y_{x,k}(\varphi)}{\varphi}dG_k(\varphi) + f\left(L_k - G_k\left(\varphi_{x,k}\right)\right) = G_k\left(\varphi_{d,k}\right).$$

On the left-hand side, the first term is the labor employed in production for the domestic market, the second term is the labor employed in the production for export, and the third term is the labor used for the fixed cost of exporting. In turn, the right-hand side is the total amount of production workers in sector k. If we assume the Pareto distribution and we use the expressions for y from (B-4) and (B-5) along with equation (B-6), we can rewrite the last expression as follows:

$$\left(1+(\sigma-1)\frac{\alpha_k}{\alpha_k+1-\sigma}\right)\left[\left(\frac{\varphi_{0,k}}{\varphi_{d,k}}\right)^{\alpha_k}+f_k\left(\frac{\varphi_{0,k}}{\varphi_{x,k}}\right)^{\alpha_k}\right]=1.$$

Note that this expression implies that there is a negative relation between the mass of self-employed and the mass of exporters. Also, note that there are four expressions like this, one for each country and each sector k.

Second, we can write the price aggregator for sector k,

$$1=\int_{j\in J_k}\left(\frac{p_{d,k}(j)}{P_k}\right)^{1-\sigma}dj+\int_{j\in J_k^*}\left(\frac{p_{x,k}^*(j)}{P_k}\right)^{1-\sigma}dj.$$

If we plug the expressions for optimal pricing from (B-4) and (B-5) into this equation, we obtain the following:

$$w_kL_k\frac{\alpha_k}{\alpha_k+1-\sigma}\left(\frac{\varphi_{0,k}}{\varphi_{d,k}}\right)^{\alpha_k}+f_k^*w_k^*L_k^*\frac{\alpha_k^*}{\alpha_k^*+1-\sigma}\left(\frac{\varphi_{0,k}^*}{\varphi_{x,k}^*}\right)^{\alpha_k^*}=\frac{R_kL}{\sigma}.$$

Once again, there are four expressions like this, one for each country and each sector k.

Third, from expression (B-2) and using $R_k=P_kY_k$, we can express inter-industry substitution in the following way:

$$\frac{R_A}{R_B}=\left(\frac{P_A}{P_B}\right)^{\frac{-\mu}{1-\mu}}.$$

This expression relates aggregate revenues and prices across the two sectors. Note that there is an analogous expression for the Foreign country.

Fourth, we impose trade balance between Home and Foreign. Thus, the following condition needs to hold:

$$L^*\left[\int p_{x,A}(j)\,y_{x,A}(j)\,dj+\int p_{x,B}(j)\,y_{x,B}(j)\,dj\right]=L\left[\int p_{x,A}^*(j)\,y_{x,A}^*(j)\,dj+\int p_{x,B}^*(j)\,y_{x,B}^*(j)\,dj\right].$$

After plugging in the expressions for prices and quantities, we can rewrite the trade balance condition as follows:

$$\begin{aligned}&f_Aw_AL_A\frac{\alpha_A}{\alpha_A+1-\sigma}\left(\frac{\varphi_{0,A}}{\varphi_{x,A}}\right)^{\alpha_A}+f_Bw_BL_B\frac{\alpha_B}{\alpha_B+1-\sigma}\left(\frac{\varphi_{0,B}}{\varphi_{x,B}}\right)^{\alpha_B}\\ =\;&f_A^*w_A^*L_A^*\frac{\alpha_A^*}{\alpha_A^*+1-\sigma}\left(\frac{\varphi_{0,A}^*}{\varphi_{x,A}^*}\right)^{\alpha_A^*}+f_B^*w_B^*L_B^*\frac{\alpha_B^*}{\alpha_B^*+1-\sigma}\left(\frac{\varphi_{0,B}^*}{\varphi_{x,B}^*}\right)^{\alpha_B^*}.\end{aligned}$$

Finally, using these equations and the cutoffs' definition (B-6), we calculate the elasticities at the symmetric equilibrium. The system looks as follows when we do so with respect to τ_A:

$$
\begin{pmatrix}
\phi & f & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \phi & f & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi & f & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi & f & 0 & 0 & 0 & 0 & 0 \\
-\frac{1}{\alpha} & 0 & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & \frac{1}{-1+\sigma} & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -\frac{1}{\alpha} & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{-1+\sigma} & 0 & 1 \\
0 & 0 & -\frac{1}{\alpha} & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & \frac{1}{-1+\sigma} & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -\frac{1}{\alpha} & 0 & -\frac{\sigma}{-1+\sigma} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{-1+\sigma} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{\alpha} & 0 & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & \frac{1}{-1+\sigma} & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{-1+\sigma} & 0 & 1 & 0 & 0 & -\frac{1}{\alpha} & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{1}{\alpha} & 0 & 0 & -\frac{\sigma}{-1+\sigma} & 0 & \frac{1}{-1+\sigma} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{-1+\sigma} & 0 & 1 & 0 & 0 & 0 & -\frac{1}{\alpha} & 0 & -\frac{\sigma}{-1+\sigma} & 0 & 0 & 0 \\
\phi & 0 & 0 & 0 & \phi & 0 & -f-\phi & 0 & 0 & 0 & 0 & f & 0 & 0 & f & 0 & 0 & 0 & 0 \\
0 & f & 0 & 0 & f & 0 & 0 & 0 & 0 & 0 & \phi & 0 & 0 & 0 & \phi & 0 & -f-\phi & 0 & 0 \\
0 & 0 & \phi & 0 & 0 & \phi & 0 & -f-\phi & 0 & 0 & 0 & 0 & 0 & f & 0 & f & 0 & 0 & 0 \\
0 & 0 & 0 & f & 0 & f & 0 & 0 & 0 & 0 & 0 & 0 & \phi & 0 & 0 & \phi & 0 & -f-\phi & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & \frac{\mu}{1-\mu} & -\frac{\mu}{1-\mu} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & \frac{\mu}{1-\mu} \\
0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & -1 & -1 & -1 & 0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
\varepsilon_{d,A} \\ \varepsilon_{x,A} \\ \varepsilon_{d,B} \\ \varepsilon_{x,B} \\ \varepsilon_{w,A} \\ \varepsilon_{w,B} \\ \varepsilon_{R,A} \\ \varepsilon_{R,B} \\ \varepsilon_{P,A} \\ \varepsilon_{P,B} \\ \varepsilon^*_{d,A} \\ \varepsilon^*_{x,A} \\ \varepsilon^*_{d,B} \\ \varepsilon^*_{x,B} \\ \varepsilon^*_{w,A} \\ \varepsilon^*_{w,B} \\ \varepsilon^*_{R,A} \\ \varepsilon^*_{R,B} \\ \varepsilon^*_{P,A}
\end{pmatrix}
$$

$$
= \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}'.
$$

Note: each ε_i represents the log-derivative of i with respect to τ_A. At the symmetric equilibrium, $\phi = \tau^\alpha f^{\frac{\alpha}{\sigma-1}}$. Note that $\phi > f$ because $\alpha > 1$, $\alpha > \sigma - 1$ and $\tau > 1$.

From the system we obtain the following:

$$\begin{aligned}
\varepsilon_{d,A} - \varepsilon_{d,B} &= \frac{d\log\left(\frac{\Psi_{d,A}}{\Psi_{d,B}}\right)}{d\log\tau_A} \\
&= \frac{f\alpha}{(f+\phi)} \frac{f\sigma\left(\frac{\sigma-1}{\sigma}\right)\left(f(\sigma-1)+\phi+(2\alpha-1)\sigma\phi\right)}{(\sigma-1)^2(\phi-f)^2+2fd\left[(\alpha+\mu)\sigma-\alpha\sigma\mu\frac{\sigma}{\sigma-1}\right]} > 0
\end{aligned}$$

Intuitively, the object $\varepsilon_{d,A} - \varepsilon_{d,B}$ captures the effect that a change in Home's sector A trade costs has on domestic self-employment in sector A relative to the effect it has on domestic self-employment in sector B. It is straightforward to check that if we differentiate with respect to the trade costs of sector B, we obtain an analogous expression:

$$\frac{d\log\Psi_{d,B}/\Psi_{d,A}}{d\log\tau_B} > 0.$$

Both results combined imply the following:

$$\frac{d\log\left(\frac{\Psi_{d,A}}{\Psi_{d,B}}\right)}{d\log\frac{\tau_A}{\tau_B}} > 0. \tag{B-7}$$

Given that we are evaluating the system around the symmetric equilibrium, it is important to consider the relative effects. That is, around the symmetric equilibrium, the self-employment rate and trade costs are the same for both sectors. Therefore, equation (B-7) is our actual object of interest, as it implies that if trade costs for sector A increase relative to those of sector B, then we should observe that self-employment in industry A should increase relative to sector B—and this is precisely what we observe in Figure IV.

Similarly, we can study the effects of changes in trade costs at Home on Foreign self-employment:

$$\varepsilon^*_{d,A} - \varepsilon^*_{d,B} = \frac{d\log\left(\frac{\Psi^*_{d,A}}{\Psi^*_{d,B}}\right)}{d\log\tau_A} = \frac{d\log\left(\frac{\Psi_{d,A}}{\Psi_{d,B}}\right)}{d\log\tau^*_A} = \eta_{d,A} - \eta_{d,B} =$$

$$= \frac{f\alpha}{(f+\phi)} \frac{(\sigma-1)^2(\phi-f)^2+f(\phi-f)(\sigma-1)^2+\mu\sigma(\sigma-1)f^2+f\phi\sigma\left(3\mu(\sigma-1)-2\alpha\sigma\left(\mu-\frac{\sigma-1}{\sigma}\right)\right)}{(\sigma-1)^2(\phi-f)^2+2fd\left[(\alpha+\mu)\sigma-\alpha\sigma\mu\frac{\sigma}{\sigma-1}\right]} > 0.$$

Note that since we evaluate around the symmetric equilibrium, this is the same as the effect of a change in Foreign trade costs on Home self-employment. By an analogous argument to the case just described, it follows that:

$$\frac{d\log\left(\frac{\Psi_{d,A}}{\Psi_{d,B}}\right)}{d\log\frac{\tau^*_A}{\tau^*_B}} > 0. \tag{B-8}$$

Intuitively, equation (B-8) implies that if trade costs for (Foreign) sector A increase relative to those of (Foreign) sector B, then we should observe that self-employment in (Home) industry A should increase relative to (Home) sector B—and this is precisely what we observe in Figure V.

C Additional Details about the Figures

C.1 Country Codes for Figure I

#	Code	Country
1	AR	Argentina
2	AU	Australia
3	BG	Bulgaria
4	CA	Canada
5	CL	Chile
6	HR	Croatia
7	EC	Ecuador
8	SV	El Salvador
9	EU	European Union
10	HK	Hong Kong, China
11	IS	Iceland
12	ID	Indonesia
13	IL	Israel
14	JP	Japan
15	KR	South Korea
16	KG	Kyrgyz Republic
17	MV	Maldives
18	MU	Mauritius
19	MX	Mexico
20	MD	Moldova
21	NZ	New Zealand
22	NO	Norway
23	PK	Pakistan
24	PA	Panama
25	PE	Peru
26	PH	Philippines
27	QA	Qatar
28	SG	Singapore
29	TH	Thailand
30	TT	Trinidad and Tobago
31	TR	Turkey
32	US	United States
33	VE	Venezuela

C.2 Country Codes for Figure II

#	Code	Country
1	AT	Austria
2	BE	Belgium
3	CY	Cyprus
4	CZ	Czech Republic
5	EE	Estonia
6	FR	France
7	DE	Germany
8	GR	Greece
9	HU	Hungary
10	IE	Ireland
11	IT	Italy
12	LV	Latvia
13	LT	Lithuania
14	MT	Malta
15	PL	Poland
16	PT	Portugal
17	SK	Slovakia
18	SI	Slovenia
19	ES	Spain
20	GB	United Kingdom

C.3 Industry Codes for Figures III–VI

NAICS	Industry
311	Food Manufacturing
312	Beverage and Tobacco Product Manufacturing
313	Textile Mills
314	Textile Product Mills
315	Apparel Manufacturing
316	Leather and Allied Product Manufacturing
321	Wood Product Manufacturing
322	Paper Manufacturing
323	Printing and Related Support Activities
324	Petroleum and Coal Products Manufacturing
325	Chemical Manufacturing
326	Plastics and Rubber Products Manufacturing
327	Nonmetallic Mineral Product Manufacturing
331	Primary Metal Manufacturing
332	Fabricated Metal Product Manufacturing
333	Machinery Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliances, and Components
336	Transportation Equipment Manufacturing
337	Furniture and Related Product Manufacturing
339	Miscellaneous Manufacturing

D Measurement of Self-Employment

In the United States, the Bureau of Labor Statistics (BLS) is the agency that collects data on self-employment. It does so through the Current Population Survey (CPS).

> "Since January 1994, employed respondents in the monthly CPS have been asked the question: "Last week, were you employed by government, by a private company, a nonprofit organization, or were you self-employed?" Respondents who say that they were employed by government, a private company, or a nonprofit organization are classified as wage and salary workers. Individuals who say that that they are self-employed are asked, "Is this business incorporated?" Respondents who say yes are the incorporated self-employed and are classified as wage and salary workers; respondents who say no are classified as unincorporated self-employed, the measure that typically appears in BLS publications." (Hipple 2010, page 18).

However, in our dataset we also include the incorporated self-employed—since in the theory we model the self-employed as agents who run/own firms, we think it is appropriate to include these individuals in our sample.

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