Wealth as a Determinant of Comparative Advantage*

José Wynne†

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Abstract

This paper shows that a country's wealth drives its comparative advantage when sectors in the economy face differential access to credit. Wealthier nations exhibit a comparative advantage toward goods produced in sectors facing more severe financial imperfections, typically smaller firms. Empirically this paper documents that those sectors are also labor intensive. Consequently this theory partially offsets traditional sources of comparative advantage and offers an explanation for Trefler's missing trade mystery and the Leontief paradox. Furthermore, the theory makes the relation between trade and income distribution endogenous.

1 Introduction

International trade theory bases its prediction on traditional sources of comparative advantage. These predictions have been challenged by two major empirical findings. Leontief (1953) finds that the US content of trade in 1947 was labor intensive when the opposite is

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†Fuqua School of Business, Duke University.

expected from trade theory, giving birth to the Leontief paradox.[1] Trefler (1995) also shows that factor service trade is much smaller than predicted by the Heckscher-Ohlin-Vanek theory, a fact known as the missing trade mystery. This paper offers a new source of comparative advantage that reunites trade theory with Leontief and Trefler's findings.

The basic intuition is that wealth alleviates financial imperfections in labor intensive sectors, typically populated by small firms. This effect offsets traditional sources of comparative advantage that grant wealthier nations advantage in capital intensive sectors. I model this intuition with a two period lived overlapping generation economy where one of the sectors is characterized by an imperfection in credit markets due to moral hazard. All effects appear production avoiding demand side effects of income inequality, already studied by Hunter and Markusen (1988). I show that two economies with otherwise equal characteristics but with different wealth distributions will exhibit dissimilar comparative advantages.[2] Wealthier economies have a comparative advantage to export the good produced in sectors with financial imperfections because these societies have richer entrepreneurs who are better able to overcome incentive problems in borrowing-lending relations. Wealthier entrepreneurs are less dependent on external finance and hence mitigate the agency problem in credit contracts. More incentives imply lower failure rates which translate into lower lending rates, inducing entrepreneurs to expand production in the small firm sector and then driving the country's comparative advantage. Additionally in the absence of non-convexities in production at the firm level, nations with equal per capital income but with a more egalitarian distribution of wealth will also exhibit a comparative advantage in the sector featuring financial imperfections.

The model builds on the idea that some sectors in the economy are typically populated by smaller firms which are more likely to be financially constrained. Many of these firms are family firms managed by their owners where the entrepreneurs' personal wealth determines

[1] In Section 5 I discuss related literature by Leamer (1980), Brecher and Choudhri (1982) and Trefler (1993).

[2] The wealth and income distribution terms are used interchangeably as they have the same implications in my model. Importantly, by "distribution" I not only refer to second and higher moments characteristics but also the first.

the amount borrowed from banks. As the assets utilized for production often have low resale value, firms don't have enough collateral to offer, making incentive or agency issues in financial relations a central problem for their competitiveness. On the other hand when for technology reasons the scale of production at the firm level is large in a sector –like in the iron and steel industry or petroleum refinery–, monitoring costs per unit of output are usually much lower, alleviating the agency problem.

To explore the dynamic implications of this theory generations are assumed to be linked by dynasties where parents leave bequests to their children, a feature that introduces persistence in the distribution of wealth. When technology and prices remain constant, it is shown that it takes time for countries to converge to the steady state income distribution and production level, then passing through different phases of trade patterns in its development process. At initial stages, economies exhibit a comparative advantage in the sector characterized by no -or less- financial frictions leaning its trade pattern toward the small firm sector at more advanced stages.

Wealth can explain Trefler's missing trade mystery and the Leontief paradox. Trefler (1995) shows that trade is missing unless his empirical exercise had omitted factors that are scarce in poor countries. Wealth can be that omitted factor. Leontief (1953) finds that in 1947 the US content of exports was labor intensive when the opposite is expected from a relatively labor scarce country. This theory can help explain both findings when we allow for factor neutral technological differences across countries. A better technology gives comparative advantage to capital intensive sectors as capital is allowed to move. Empirically this paper documents that the small firm sectors are indeed labor intensive. Since countries with higher total factor productivity are also wealthier, the financial source of comparative advantage offsets (at least partially) the technological one. In other words, wealthier nations exhibit a comparative advantage in the big firm sectors because of technology and at the same time, in the small firm sector due to financial reasons. Furthermore these economies will have relative capital abundance. These features square with Leontief's finding if the financial effect dominates, and with Trefler's missing trade since wealth reduces the predicted gains from trade.

The model with financial frictions nests the case without them, which allows to take it to the data and test whether wealth drives trade. I analytically derive an expression from the model demonstrating that the comparative advantage in the small firm sector is determined by technology and the degree of financial imperfections. I aggregate trade data for 28 industrial sectors (3 digit level of classification) into small and big firm sectors by country as in the model in various ways. Wage are used to capture cross country differences in total factor productivity and the average success rate exactly as suggested by the model. Loosely speaking, the empirical evidence supports the main ideas of this theory, that is: 1) wages (or total factor productivity) negatively affect the comparative advantage of the small firm sector, agreeing with the finding that they are labor intensive, 2) financial frictions matter for trade, and 3) financial failure decreases with wealth. Furthermore the results seem robust to aggregation and other issues.

This theory also offers a new insight to the traditional literature linking trade and income distribution.[3] The mainstream of the literature has focused in only one way of this relation. In that view, trade and technology determine factor prices and then the distribution of income. This theory suggests an endogenous link since the distribution of wealth affects the productive performance of the economy and that drives trade. A drop in the relative price of the good produced by small firms harm entrepreneurs and delays the accumulation of wealth affecting future trade. I show that this change in prices has both a static and a dynamic adverse effect on managerial talent and makes the trade pattern lean towards sector B both on impact and in subsequent periods. While addressing the main issues in this literature requires a model with skilled and unskilled labor, this theory shows the potential of endogenizing the distribution of income for understanding the role of trade in determining the skill premia.

This paper relates to other previous and contemporaneous work. Rajan and Zingales (1996) show in a study for a large number of countries that those industrial sectors which need less external finance grow disproportionately faster in countries with less developed financial markets. In the same spirit Braun (2002) argues that collateral is important for

[3] See Feenstra and Hanson (2001) for a survey on this literature.

specialization and growth since industries whose assets are relatively less tangible are larger and grow faster in countries with more developed financial systems. Although these studies focus on the role of financial development in economic growth and my work is about trade, it provides us with evidence that industrial sectors with dissimilar needs for external finance exhibit different performance over time due to financial imperfections.

Beck (2002) studies the link between financial development and international trade in a 30-year panel of 65 countries. Building on previous theoretical work by Kletzer and Bardhan (1987), he shows that better financial institutions can be a source of comparative advantage in sectors that rely on external finance. Although complementary, my work differs from these in that mine is not an institutional story: wealth drives a country's comparative advantage by making the degree of financial development endogenous.

Fischer (1992) and Ranjan (2001) also show that the distribution of income can have dynamic effects on trade: the former by affecting the accumulation of physical capital which is mobile between industries but immobile between countries; the latter by impacting the accumulation of human capital. But in both cases a country's comparative advantage is always driven by factor endowments, the accumulation of which is affected by income distribution dynamics.

To the best of my knowledge, the closest theoretical references to the role of wealth distribution as a pattern of trade come from the development area. Most of these articles debate the relationship between credit market imperfections and economic growth, an idea stated by Schumpeter back in 1911.[4] Part of this literature focuses on the income distribution dynamics along stages of economic development in closed economies with imperfect credit markets.[5] Among this group of papers I acknowledge Lloyd-Ellis and Bernhardt (2000) who develop some very interesting tools that I utilize in the dynamic analysis. Their paper focuses on a different issue however: they want to match the Kuznet's curve and other macroeconomic regularities. Moreover, they model financial imperfections in such a way that there is no default in equilibrium. While having default is not essential for wealth to be a

[4] See Greenwood and Jovanovic (1990) and King and Levine (1993).

[5] See Torvik (1993), Banerjee and Newman (1993), Galor and Zeira (1993), Benabou (1996a) and (1996b), Piketty (1997), Aghion and Bolton (1997) and Bhattacharya (1998).

determinant of comparative advantage, it buys two very attractive results. First, the mass of entrepreneurs that defaults decreases over the development process, reducing intermediation costs in the economy. Second, total factor productivity in the small firm sector increases endogenously along the development path. Therefore, richer countries have a higher total factor productivity and lower intermediation costs, being both results endogenous to the process of development. This turns out to be important because then the model exhibits bigger labor than capital augmenting productivity differences across countries, agreeing with findings in Trefler's (1993) explanation of the Leontief paradox.

2 Environment

Consider a small open economy populated by an infinite sequence of two period lived overlapping generations and with two productive sectors, A and B. At each period t a mass one of young agents is born. Youngsters become old at $t+1$, at which time they reproduce at a one to one rate, implying no population growth. Each agent j is endowed with $l_j \in [0, \bar{l}]$ units of labor when young, where the random variable l_j is *i.i.d.* across generations and is drawn from a distribution $h(l_j)$ with mean 1 and cumulative distribution $H(l_j)$. This randomness resembles differences in wage income across the population and allows the asymptotic distribution of income to have some degree of inequality for all possible parameter values. When old, each agent become an entrepreneur with probability μ or remain a worker with one unit of labor with probability $1-\mu$. Labor is contracted at the beginning of each period. Entrepreneurs have access to the following technology

$$y_t^A = \begin{cases} F^A(k_t^A, l_t^A, 1) & \text{w/prob } e \\ 0 & \text{o.w.} \end{cases} \tag{1}$$

where $F^A(k_t^A, l_t^A, 1) = (k_t^A)^\alpha (l_t^A)^\beta$ and $\alpha + \beta < 1$ –one indivisible unit of entrepreneurial ability is required for production. Capital and labor inputs are required at the beginning of the period while output takes place at the end of it. Also, output is subject to an idiosyncratic risk inherent to each project, with two possible realizations: "successful" or "unsuccessful". The probability of the project being successful is given by e which is the entrepreneur's

effort devoted to management: production or marketing activities. By assumption the effort is unobservable (or unenforceable) to other agents, introducing a credit market failure that is studied below.

Technology in sector B is given by a standard constant return to scale production function that depends on capital and labor. Thus

$$y_t^B = F^B(k_t^B, l_t^B) \tag{2}$$

Timing of production is the same as in the A sector and capital and labor inputs across sectors are assumed to be perfect substitutes. This sector does not require a manager, or is less management intensive, compared to technology in the A sector and there are no (or fewer) incentive issues regarding production. This feature implies that firms in sector B are able to borrow from banks at the international interest rate since credit contracts are efficient. For concreteness, I let sector A be an industrial sector where technology determines a small or medium firm size in equilibrium.[6] On the contrary, sector B is characterized by firms producing at a large scale.[7] The relatively small size of individual loans that takes place in sector A makes monitoring an inefficient task in credit contracts, something that doesn't happen in the B sector where the large scale of borrowing makes monitoring optimal.

Generations are linked as dynasties, and preferences not only depend on their own consumption but also on the bequest b left to their successors, independent of becoming an entrepreneur or not. This feature introduces persistence in the distribution of income in a way that becomes clear below.[8] For analytical simplicity I assume that agents consume only when they become old. Furthermore,

$$U_t = (c_t^A)^\gamma (c_t^B)^\psi b_t^{1-\gamma-\psi} - \frac{a}{n+1} e_t^{n+1} \tag{3}$$

[6] The apparel, pottery or wood furniture industries are some examples of these sectors.

[7] Say, iron and steel and petroleum refineries.

[8] Introducing infinitely lived agents would have the same feature regarding persistence, although it would make the conclusions regarding patterns of trade less clear. In a model with infinitely lived agents intertemporal trade arises, contaminating the conclusion regarding comparative advantage with the intertemporal component of trade.

where utility is assumed to be homogeneous of degree one in consumption and bequests, and decreasing in effort since a and n are positive.[9] Note that these preferences imply no income effect on the supply of effort and an indirect utility function that is linear in income, thus avoiding dealing with risk sharing issues in the analyzing.

In what follows I assume that goods A and B are both tradeable and good B is the *numeraire*. Also, I assume that capital and goods markets are perfectly integrated with the rest of the world and that agents are not allowed to migrate (although this assumption is not needed when the world share the same technology in sector B).

Finally, the initial distribution of bequests across agents j are given by $G_0(b_j)$, $b_j \in [0, \bar{b}_0]$.

3 First best: Perfect enforcement

In this section I solve the model under the assumption that effort is observable and perfectly enforceable. When this is the case, I show that income distribution is irrelevant both for production and trade.

Since goods A and B are assumed to be tradeable and this is a small economy, prices are determined in the rest of the world. The (relative) price of good A is denoted as P^A and assumed to be constant over time. At each period t total labor endowment in the economy is given by $L = 2 - \mu$, since there is a mass one of young agents with one unit of labor on average plus a fraction $1 - \mu$ of the old generation with a unit labor endowment. Constant returns and free entry in sector B imply

$$\pi_t^B(w_t, r_t) = 0 \tag{4}$$

where π_t^B is the indirect profit function in the B sector. Since the interest rate is given from the rest of the world, wages of this economy are pinned down by technology in this sector. Assuming no changes in the interest rate and technology, wages will be constant (w).

The agents' problem works as follows. At the beginning of each period all old agents become entrepreneurs or continue being workers, and they count on a certain inherited wealth

[9] Further restrictive assumptions on these parameters are introduced later.

plus labor income from youth. As workers they supply their labor endowment inelastically and invest their savings at the rate r for the period. As entrepreneurs they decide how much to invest in the firm and how much to save at the rate r. Finally at the end of the period they consume goods A and B and leave some bequest. Their demand functions are given by,

$$\begin{aligned} c_j^A &= \gamma W_j / P^A \\ c_j^B &= \psi W_j \\ b_j &= (1-\gamma-\psi) W_j \end{aligned} \tag{5}$$

where W_j is the agent j's wealth, determined by inheritance, labor income from youth and project outcome or labor income from adulthood.

Let b^j be the amount inherited by an agent j. Then if the agent doesn't become an entrepreneur, his wealth at the moment of consumption is given by

$$W_j = \left(b^j + w[l_j(1+r)+1]\right)(1+r). \tag{6}$$

Matters are different when agents turn out to be entrepreneurs. Whatever the wealth is at the end of each agent's adulthood, individual demands for consumption and bequest is still given by (5). Expected utility is then

$$E_W[U_j] = sE_W(W_j) - \frac{a}{n+1}e^{n+1} \tag{7}$$

where I let $s \equiv (\frac{\gamma}{P^A})^\gamma \psi^\psi (1-\gamma-\psi)^{1-\gamma-\psi}$. Note that expected utility depends only on expected end of period wealth and not on any other moments of its distribution due to the homogeneity assumption on preferences.

Let $N_j = b^j + (1+r)wl_j$ be the entrepreneur's net worth at the end of youth, given by labor endowment and wealth inherited.[10] Then the entrepreneur decides how to distribute savings between his own firm and banks. To determine that, I first compute the entrepreneur's problem assuming he can only save by investing in the firm. Therefore I compute the entrepreneur's indirect utility as a function of the amount invested within the firm N_j (the firm's net worth).

[10] Agents with different inheritance but with the same wealth at the end of their youth are assumed to be indistinguishable.

Let d be the amount borrowed from the bank and i the interest rate on the debt contract. Under perfect enforcement, both lending interest rates and the amount borrowed can be made functions of net worth and effort. Optimal financial contracts in this case can be derived from the following problem,[11]

$$\max_{k^A,l^A,e,i,d} EU = se\left[P^A(k^A)^\alpha(l^A)^\beta - [1+i(e,N_j)]d(e,N_j)\right] - \frac{a}{n+1}e^{n+1} \tag{8}$$

subject to

$$e[1+i(e,N_j)]d(e,N_j) - (1+r)d(e,N_j) \geq 0 \tag{9}$$

$$r_k k^A + wl^A \leq d(e,N_j) + N_j \tag{10}$$

where r_k is the rental rate of capital assumed to be the same across sectors to simplify notation. The objective function is the expected return, given by the probability of the project being successful times the proceeds of the firm after paying back debts, minus disutility of the effort exerted by the entrepreneur in his own project. Equation (9) is the bank's participation constraint. Financial contracts have to satisfy the non-negative profit condition for banks. Equation (10) is the firm's resource constraint: total expenditure on inputs should be financed by either net worth or debt.

From Equation (9) we obtain that $(1+i) = \frac{(1+r)}{e}$.[12] Because the lending interest rate can be contracted as a function of the entrepreneur's effort, we can make use of this expression to get rid off the lending rate in the objective function. With the help of Equation (10) the problem is now:

$$\max_{k^A,l^A,e} EU = s\left[eP^A(k^A)^\alpha(l^A)^\beta - (1+r)(r_k k^A + wl^A) + (1+r)N_j\right] - \frac{a}{n+1}e^{n+1}$$

where first order conditions for inputs imply

$$k^{A*} = \left[\frac{P^A}{(1+r)}\left(\frac{\alpha}{r_k}\right)^{1-\beta}\left(\frac{\beta}{w}\right)^{\beta}\right]^{\frac{1}{1-\alpha-\beta}} e^{*\frac{1}{1-\alpha-\beta}} \tag{11}$$

$$l^{A*} = \left[\frac{P^A}{(1+r)}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha-\beta}} e^{*\frac{1}{1-\alpha-\beta}} \tag{12}$$

[11] I drop the time subscript for convenience.

[12] The financial contract is riskless for banks since they are able to completely diversify idiosyncratic risks.

Further simplifying the problem in terms of effort. Our first order condition for effort is finally

$$ae^{*n} = s\left[\frac{P^A}{(1+r)^{\alpha+\beta}}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{\beta}\right]^{\frac{1}{1-\alpha-\beta}} e^{*\frac{\alpha+\beta}{1-\alpha-\beta}} \tag{13}$$

In order for the solution to be interior the marginal revenue out of effort should be steeper than the marginal cost this implies that second order conditions for a maximum are satisfied if and only if $n \geq \frac{\alpha+\beta}{1-\alpha-\beta}$. Furthermore I will assume that no entrepreneur has incentives to put a level of effort that produces successful projects all the time. This means that $e^* < 1$ or $\frac{s}{a}\left[\frac{P^A}{(1+r)^{\alpha+\beta}}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{\beta}\right]^{\frac{1}{1-\alpha-\beta}} < 1$. In what follows I let

$$z \equiv \left[\frac{P^A}{(1+r)}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{\beta}\right]^{\frac{1}{1-\alpha-\beta}} \tag{14}$$

and I assume that the two conditions on parameters always hold.

Financial contracts also have closed form solutions given by

$$i^* = \frac{1+r}{e^*} - 1 \tag{15}$$

$$d^* = \max\left[\frac{(\alpha+\beta)a}{s}e^{*n+1} - N_j, 0\right] \tag{16}$$

where the lending rate is only a function of the effort, while the amount of credit depends on effort and net worth, other than technology and prices. If net worth is big enough to cover the whole cost of production, borrowing is not needed.

The indirect expected utility function for the entrepreneur that invests an amount N_j is given by

$$U^{FB*} = \frac{e^{*n+1}a(1-\alpha-\beta)}{(n+1)}\left[n - \frac{\alpha+\beta}{1-\alpha-\beta}\right] + s(1+r)N_j \tag{17}$$

which is positive by assumption even in the case where $N_j = 0$.[13] The entrepreneurs' indirect expected utility is given by the sum of net utility gains from being an entrepreneur plus income from inheritance and labor income during youth.

The main result of this section, obtained by other scholars in different frictionless contexts, is summarized in the following proposition.

[13] Superscript FB stands for first best.

Proposition 1 *Under perfect enforcement, the firms' scale of production (given by capital and labor inputs) is independent of the entrepreneur's net worth.*

The proof follows immediately by observing that the solution for labor and capital in Equations (11) to (13) is independent of N_j.

With this result at hand, the aggregate demand for capital and labor in sector A are given by

$$\begin{aligned} K^A &= \mu k^{A*} \\ L^A &= \mu l^{A*} \end{aligned} \tag{18}$$

Plugging Equation (13) into (12) gives

$$l^{A*} = \frac{\beta a e^{*n+1}}{w(1+r)s} \tag{19}$$

Also, aggregate labor supply is given by $(2-\mu)$. Wages are determined in sector B as long as labor demand in sector A is less than total endowment ($L^A \leq 2-\mu$) or

$$\frac{\beta a e^{*n+1}}{w(1+r)s} \leq \frac{2-\mu}{\mu} \tag{20}$$

This condition implies that the labor endowment is big enough to have both sectors A and B active even under perfect enforceability.[14]

It is important to note that by Equations (5)-(7) aggregate demand for consumption of goods A and B are independent of income inequality -given by higher moments of the income distribution determined by $G(b_j)$ and $H(l_j)$-, since individual demand functions are linear in wealth. From this result I derive the following statement.

Proposition 2 *Under perfect enforcement, comparative advantage of a small open economy like the one described above is independent of both per capita income and income inequality.*

The proof follows from Proposition 1 and the linear relationship between aggregate consumption for goods A and B and wealth. Thus under perfect enforcement, two similar small

[14] Labor demand under imperfect enforcement is lower than in the first best.

open economies –similar in the sense of preferences, aggregate labor endowment and technology as those described above– will have the same comparative advantage regardless of their income distribution. I come back to this point later.

3.1 Income distribution dynamics under perfect enforcement

Although under perfect enforcement income distribution is irrelevant as a pattern of trade, I describe the evolution of the distribution over time because it helps for comparison with the case of imperfect credit markets.

Given an initial distribution of bequests we can compute the next period distribution of both bequests and wealth and hence, those for all successive generations.[15] Let N^* be the total cost under first best. An entrepreneur with wealth $N_j < N^*$ gets an actual income of

$$I_j = \begin{cases} (1+r)ze^{*\frac{\alpha+\beta}{1-\alpha-\beta}}\left[1-(\alpha+\beta)e^*\right]+(1+r)N_j & if\ successful \\ (1+r)N_j & o.w. \end{cases} \tag{21}$$

Furthermore, income for an agent that becomes a worker when old is given by $I_j = (1+r)(N_j+w)$. Let $\phi \equiv (1-\gamma-\psi)(1+r)$. Thus, the bequests function in the first best case is determined as follows

$$b(N_j) = \begin{cases} \phi\left\{ze^{*\frac{\alpha+\beta}{1-\alpha-\beta}}\left[1-(\alpha+\beta)e^*\right]+N_j\right\} & \text{w.prob } e^*\mu \\ \phi N_j & \text{w.prob } (1-e^*)\mu \\ \phi(N_j+w) & \text{w.prob } 1-\mu \end{cases}$$

where $N_j = b^j + (1+r)wl_j$, where b is the amount inherited by the agent.

From this bequest function and any initial distribution of bequests, we can follow the evolution of the income distribution over time. In what follows I assume that saving rates in this economy are lower than the interest rate so that sustained growth can only be accomplished

[15] Each entrepreneur has the option to fully finance his project with borrowing and completely diversify the risk or only finance externally what he cannot fund by himself (or any combination of these two alternatives). Due to the homogeneity of preferences, entrepreneurs are indifferent between these options. I assume that when this is the case the entrepreneur chooses to fully fund the project by borrowing (which would be the case if preferences have some degree of risk aversion).

with technological progress.

$$\phi \equiv (1-\gamma-\psi)(1+r) < 1 \tag{22}$$

For future references, we state the results regarding income distribution with the following proposition.

Proposition 3 *Under perfect enforcement, there is a unique stationary, ergodic distribution of bequests $G_{\infty}^{FB}(b)$ and wealth $F_{\infty}^{FB}(N)$ for the economy described above, with $b \in [0, \bar{b}^{FB}]$ and $N \in [0, \bar{b}^{FB} + (1+r)w\ \bar{l}]$, where*

$$\bar{b}^{FB} = \frac{\phi}{1-\phi}\left\{ze^{*\frac{\alpha+\beta}{1-\alpha-\beta}}\left[1-(\alpha+\beta)e^{*}\right] + (1+r)w\ \bar{l}\right\} \tag{23}$$

Proof. See the mathematical appendix.

In the next section I describe the behavior of the economy when credit markets are imperfect and compare the distributions of wealth under these two cases.

4 Second best: Imperfect enforcement

In this case, financial contracts cannot be written as functions of the effort level since it is unobservable to other agents. As I show below, this assumption will generate drastic changes to the performance of sectors in the economy. In this case, the entrepreneur's problem becomes

$$\max_{k^A, l^A, e} EU = se\left[P^A(k^A)^{\alpha}(l^A)^{\beta} - [1+i(N_j)]d(N_j)\right] - \frac{a}{n+1}e^{n+1} \tag{24}$$

subject to

$$r_k k^A + w l^A \leq d(N_j) + N_j \tag{25}$$

$$i(N_j), d(N_j) \qquad given \tag{26}$$

where financial contracts are given for the entrepreneur and are only functions of his wealth.

The first order conditions of this problem give us

$$\alpha P^A (k^A)^{\alpha-1} (l^A)^{\beta} = r_k(1+i) \tag{27}$$

$$\beta P^A (k^A)^{\alpha} (l^A)^{\beta-1} = w(1+i) \tag{28}$$

$$sP^A (k^A)^{\alpha} (l^A)^{\beta} - s[1+i(N_j)]d(N_j) = ae^n \tag{29}$$

Solving for capital and labor and plugging the result into Equation (29) we obtain

$$(1-\alpha-\beta)s\left[\frac{P^A}{(1+i)^{\alpha+\beta}}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{\beta}\right]^{\frac{1}{1-\alpha-\beta}} + s(1+i)N_j = ae^n \tag{30}$$

Now equilibrium conditions in the banking sector imply that $1+i = \frac{1+r}{\hat{e}}$, where $\hat{e}$ is the bank's expectation of the entrepreneur's effort level exerted under that contract, also a function of his wealth. Under rational expectations $\hat{e} = e$. Plugging these two conditions into Equation (30) gives us the following optimality condition for effort under imperfect enforcement,

$$s(1-\alpha-\beta)(1+r)ze^{\frac{\alpha+\beta}{1-\alpha-\beta}} + \frac{s(1+r)N_j}{e} = ae^n \tag{31}$$

where z is a function of parameters as stated in (14). This expression implicitly defines an optimal effort level as a function of the entrepreneur's net worth ($e(N_j)$). Solving for e allows us to work backwards and solve for the rest of the variables (both financial and nonfinancial). Equation (31) gives us the first result of this section. Note that the optimal level of effort invested by the entrepreneur is now dependent on the entrepreneur's net worth. This is necessarily inefficient because all entrepreneurs have the same managerial ability regardless of their income endowment.

Figure 1 display the relation between the entrepreneur's effort and his wealth.

Letting $N_j = 0$ and ruling out $e = 0$, since it is not an arbitrage free competitive solution of our financial contract, we are able to obtain the corresponding effort level.

$$e(0) = \left[\frac{s(1+r)z(1-\alpha-\beta)}{a}\right]^{\frac{(1-\alpha-\beta)}{n-(n+1)(\alpha+\beta)}} = (1-\alpha-\beta)^{\frac{(1-\alpha-\beta)}{n-(n+1)(\alpha+\beta)}} e^* \tag{32}$$

where the exponent is positive under the previous assumption. Expression (32) shows that under no net worth, the effort level exerted by the entrepreneur is a proportion (<1) of the

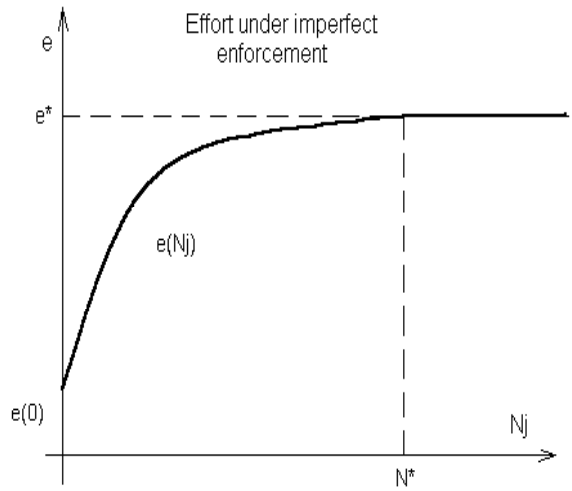


Figure 1:

efficient effort level e^*. Notice that under reasonable parameter values the difference between this two effort levels can be huge.[16]

Differentiating the optimality condition for effort and using it in the differentiated equation give us

$$\frac{de}{dN_j} = \frac{e}{\left[[n(1-\alpha-\beta)-(\alpha+\beta)]ze^{\frac{1}{1-\alpha-\beta}}+(n+1)N_j\right]} > 0 \tag{33}$$

which is positive under previous assumptions. The entrepreneur's effort is increasing in wealth because as the amount invested in the project by the entrepreneur increases, the conflict of interests between entrepreneurs and banks is mitigated. If the entrepreneur has enough wealth to fully finance the project, the agency costs disappear as there is no borrowing. Note that when $N_j = wl^{A*} + r_k k^{A*}$ or the entrepreneurs wealth is big enough to finance the efficient scale of operations obtained in Section 3, $N^* = (\alpha+\beta)ze^{\frac{1}{1-\alpha-\beta}}$. Plugging this net worth level into the optimality condition for effort under imperfect enforceability gives us the first best solution for effort e^*. If the entrepreneur's wealth is bigger than N^* optimality requires to invest N^* in the firm and save the rest at the interest rate r.

[16] For example, for parameter values of $\alpha = .4$, $\beta = .5$ and $n = 10$ the effort level exerted by an entrepreneur with no wealth ($e(0)$) is just a tenth of the efficient effort level (e^*).

Additionally, Equation (33) shows that the optimal effort is a concave function of the entrepreneur's wealth. Before going further I summarize the results obtained in the following proposition.

Proposition 4 *Under imperfect enforcement, the optimal effort level exerted by the entrepreneur, $e(N_j)$, is an increasing and concave function of his net worth N_j and is bounded below by $e(0)$ and above by the efficient effort level, e^*, implying that the optimal scale of operations depends on the entrepreneurs' wealth. Moreover, there is aggregate underinvestment in sector A.*

Obtaining the optimal effort $e(N_j)$ allows us to solve for the financial contracts by plugging this effort level into Equations (15) and (16).The indirect expected utility function of an entrepreneur with wealth N_j is now

$$U^*(N_j) = s(1-\alpha-\beta)(1+r)ze^{\frac{1}{1-\alpha-\beta}} + s(1+r)N_j - \frac{a}{n+1}e^{n+1} \tag{34}$$

Using the optimality condition for effort and assuming $N_j < N^*$ gives

$$U^*(N_j) = \frac{n}{n+1}ae(N_j)^{n+1} \tag{35}$$

Entrepreneurs' welfare under imperfect enforcement is then lower than under perfect enforcement. This is explained by the fact that when $N_j < N^*$ the entrepreneur's welfare is increasing in effort and hence in net worth, and when $N_j \geq N^*$ the inefficiency disappears (no borrowing).

Aggregation in the case of imperfect credit markets is also possible, although less trivial since now each entrepreneur's output will depend on his own wealth. Figure 2 displays the relation between an individual firm's equilibrium output level and its owner's wealth.

The levels $y^A(N^*)$ and $y^A(0)$ correspond to the incentive compatible entrepreneurs' output levels, contingent on being successful, for the extreme cases where their wealth is N^* and 0 respectively. Again, when the entrepreneurs' wealth is enough to finance their own

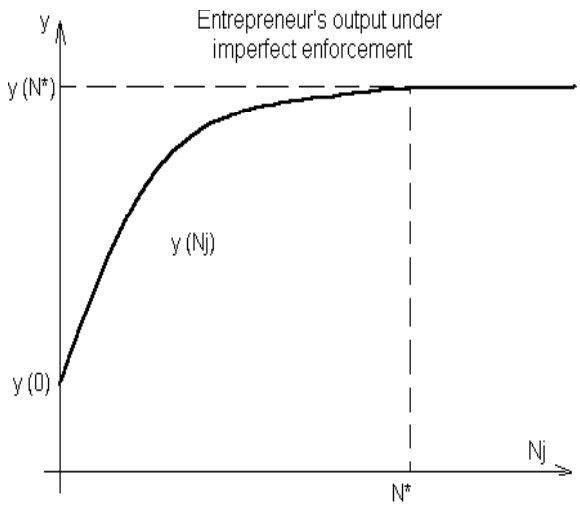


Figure 2:

projects, the output level is efficient. In general there is underinvestment in this sector though as Proposition 4 states. This function is

$$y^A = (1+r)ze(N_j)^{\frac{\alpha+\beta}{1-\alpha-\beta}}$$

Taking into account that only a fraction $e(N_j)$ of entrepreneurs with wealth N_j survives, aggregate output in sector A is

$$Y^A = (1+r)\mu z \int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N) \tag{36}$$

where

$$F(N) \equiv \int_0^N \int_0^x h\left(\frac{x-b}{w(1+r)}\right) \; dG(b)dx \tag{37}$$

and $N = b + lw(1+r)$.

It is convenient to rearrange the expression for aggregate output in sector A as follows

$$Y^A = \mu(1+r)zE_N\left[e(N)^{\frac{1}{1-\alpha-\beta}}\right] \tag{38}$$

Having stated aggregate output in Sector A as in Equation (38) we can now study the effect of income distribution on production in this sector. First, let $Q(N) = e(N)^{\frac{1}{1-\alpha-\beta}}$.

Then, after some tedious algebra it can be shown that

$$\frac{d^2Q(N)}{dN^2} = \frac{e^{\frac{\alpha+\beta}{1-\alpha-\beta}-1+n}s(1+r)(n+1)a}{(1-\alpha-\beta)\left[(n+1)ae^n - s(1+r)ze^{\frac{\alpha+\beta}{1-\alpha-\beta}}\right]^2}\frac{de}{dN}\left(\frac{\alpha+\beta}{1-\alpha-\beta}-n\right) \leq 0 \quad (39)$$

Because $Q(N)$ is a concave function of wealth we are able make the following statement.

Proposition 5 *Let $F_i(N)$ be the end of youth distribution of wealth of Country i. Under imperfect enforcement, if $F_2(N)$ first order stochastically dominates $F_1(N)$ or $F_2(N)$ second order stochastically dominates $F_1(N)$, then $Y_2^A > Y_1^A$.*

Proof. See the mathematical appendix.

From this proposition it results that

Corollary 6 *Under imperfect enforcement, if country 2 has otherwise the same characteristics as country 1 but $F_2(N)$ second order stochastically dominates $F_1(N)$, then country 2 has a comparative advantage over country 1 in producing good A.*

By Proposition 5 country 2 will produce more of good A. Moreover, it will produce less of good B because it is not only the case that (on average) entrepreneurs in country 2 will have greater incentives to produce over those in country 1, but also this country will allocate more labor into sector A than country 1 as the first order conditions (27)-(29) show.[17]

It is worth comparing the cases of perfect and imperfect credit markets. While under perfect enforcement the comparative advantage in producing good A for two countries with otherwise equal characteristics but with different income distributions are the same –as stated in Proposition 2; in the case of imperfect enforcement, two countries with different income distributions will exhibit dissimilar comparative advantages. The country with a dominant

[17] Solving for individual labor demand as a function of effort gives

$$l^A = \left[\frac{P^A}{1+r}\left(\frac{\alpha}{r_k}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha-\beta}} e(N)^{\frac{1}{1-\alpha-\beta}}$$

Aggregating accross entrepreneurs and applying Theorem 1 in Hadar and Rusell (1971) to this expression shows that the country exhibiting second order stochastic dominance will allocate more labor in sector A.

income distribution in the second order sense will export (import) more (less) of the A good. Moreover, a country that suffers from an adverse shock that increases its income inequality in the second order sense, keeping its per capita income the same, will reduce its comparative advantage in sector A and might end up reverting its pattern of trade from the bank intensive sector to the non intensive one.[18] The same reasoning applies to two countries with otherwise equal characteristics (including per capita income) but with different income distribution in the second order sense.

Under imperfect credit markets the income distribution and trade dynamics are simultaneously determined. Next I center the attention in this link.

4.1 Income distribution and trade dynamics under imperfect enforcement

In this section I describe the law of motion for bequests and wealth in the economy as well as the trade pattern dynamics of the model. An entrepreneur with wealth $N_j < N^*$ gets an

[18] Such an economy will exhibit a lower Gini Coeficient. See that a better Gini Coeficient implies a bigger area under the Lorentz curve. Let L_i be such area when the distribution of wealth is given by $F_i(N)$.

$$L_i = \frac{\int_0^{\bar{N}} \int_0^{N} x dF_i(x) dF_i(N)}{E_{F_i}(N)}$$

Integrating by parts twice and assuming mean preservation we get

$$2E(N)\left[L_1 - L_2\right] = \int_0^{\bar{N}} I(F1 > F2)\left[F_1(x)^2 - F_2(x)^2\right] dx$$

where the indicator function takes values one or minus one.

Since $F_1^2 - F_2^2 = (F_1 - F_2)(F_1 + F_2)$, this expression can be integrated by parts once again with the following result

$$2E(N)\left[L_1 - L_2\right] = \int_0^{\bar{N}} \int_0^{N} I(.)\left[F_2(x) - F_1(x)\right] dx \; d\left[F_1(N) + F_2(N)\right]$$

since mean preservation implies $\int_0^{\bar{N}} I(.)\left[F_2(x) - F_1(x)\right] dx = 0$. Because F_2 dominates F_1 in the second order sense, then $L_2 > L_1$ and the Gini Coeficient for country 2 is better than under country 1.

actual income of

$$I_j = \begin{cases} (1-\alpha-\beta)(1+r)ze(N_j)^{\frac{\alpha+\beta}{1-\alpha-\beta}} + \frac{(1+r)N_j}{e(N_j)} & if\ successful \\ 0 & o.w. \end{cases} \tag{40}$$

since entrepreneurs risk all their wealth in their projects as lending rates decrease with the firms' net worth.

Using the optimality condition (Equation (31)) gives

$$I_j = \begin{cases} \frac{a}{s}e(N_j)^n & if\ successful \\ 0 & o.w. \end{cases}$$

As before, income for an agent that becomes a worker when old is given by $I_j = (1+r)(N_j + w)$. The law of motion for bequests under imperfect enforcement is

$$b_j = \begin{cases} \phi\left\{\frac{ae(N_j)^n}{(1+r)s} + \max[N_j - N^*, 0]\right\} & \text{w.prob } e(N_j)\mu \\ \phi \max[N_j - N^*, 0] & \text{w.prob } [1-e(N_j)]\,\mu \\ \phi(N_j + w) & \text{w.prob } 1-\mu \end{cases} \tag{41}$$

where again $N_j = b^j + (1+r)l_j w$.

Let

$$B^E(N) = \phi\left\{\frac{ae(N_j)^n}{(1+r)s} + \max[N_j - N^*, 0]\right\} \tag{42}$$

$$B^W(N) = \phi(N_j + w) \tag{43}$$

where superscripts E and W stand for entrepreneur and worker. The law of motion for bequests and wealth can be better understood with the help of Figure 3. As in the first best case, three curves describe the possible levels of bequest that an agent with wealth N can leave to his successor, $B^E(N)$, $B^W(N)$ and $\phi \max[N_j - N^*, 0]$. The worse scenario comes from being an unsuccessful entrepreneur. On the other hand, the highest bequest occurs when an agent with wealth $N \geq N_0$ becomes a successful entrepreneur or an agent with wealth $N < N_0$ becomes a worker.[19] The 45 degree line describe the set of points for which $N = b$. Under imperfect enforcement, the offspring of an entrepreneur with wealth $N > N_0$ can at most have an end of youth wealth of $B^E(N) + (1+r)w\ \bar{l}$. Thus, in the long run,

[19] In fact, parameter values determine whether $e(0)$ is bigger or lower than ϕw.

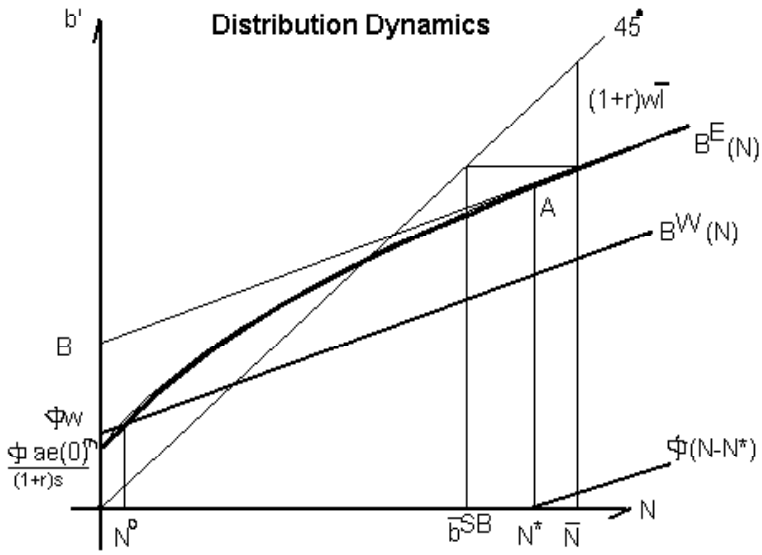


Figure 3:

all dynasties that initially started with a wealth bigger than $\bar{N}$ will run down wealth even if all successors get the maximum labor endowment in youth ($\bar{l}$) and become entrepreneurs, in which case they end up at $\bar{N}$. Thus, in the long run independent of initial conditions the wealth distribution is bounded above by $\bar{N}$ while the distribution of bequests is bounded above by $B^E(\bar{N})$ shown as $\bar{b}^{SB}$ in Figure 3.

By the same token, the wealth distribution has a lower bound of zero since the offspring of an unsuccessful entrepreneur with the lowest youth labor endowment will have no end of period wealth. Given the assumptions on the initial distribution of bequests and youth labor endowments, we can compute the law of motion for the distribution of wealth for each generation. I summarize this result in the following statement.

Proposition 7 *Under imperfect enforcement, the law of motion for the distribution of bequests is given by*

$$G_{t+1}(b) = \begin{cases} \int_0^b v_t(x)dx & \forall b \in (0,\infty) \\ 1 - \int_{x\in(0,\infty)} v_t(x)dx & b = 0 \end{cases} \tag{44}$$

where v_t is defined as

$$v_t(b) = \mu e\left(B^{E-1}(b)\right) I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \int_{B^{E-1}(b)-(1+r)w\bar{l}}^{B^{E-1}(b)} h\left(\frac{B^{E-1}(b)-x}{(1+r)w}\right) dG_t(x) +$$

$$\mu[1-e^*] \int_{\frac{b+\phi N^*-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b+\phi N^*}{\phi}} h\left(\frac{b+N^*\phi-x\phi}{\phi(1+r)w}\right) dG_t(x) +$$

$$(1-\mu)I(b>\phi w) \int_{\frac{b-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b-w\phi}{\phi}} h\left(\frac{b-\phi(x+w)}{(1+r)w\phi}\right) dG_t(x) \qquad (45)$$

Proof. See the mathematical appendix.

The distribution of wealth for every period can be directly inferred from this proposition. All agents with characteristics (l, b) satisfying $N = b + (1+r)wl$ have the same wealth at the end of their youth. With the sequence of distributions of bequests across the population given by Proposition 7, the end-of-youth distribution of wealth for every period is determined using Equation (37).

Another result that follows from the previous proposition is the existence of an ergodic distribution for both wealth and bequests.

Proposition 8 *Under imperfect enforcement, there is a unique, stationary, ergodic distribution of bequests $G_\infty^{SB}(b)$ and wealth $F_\infty^{SB}(N)$ for the economy described above, with $b \in [0, \bar{b}^{SB}]$ and $N \in [0, \bar{b}^{SB} + (1+r)w\,\bar{l}]$, where $\bar{b}^{SB}$ and $\bar{N}$ are the fixed points of the following mapping,*[20]

$$\bar{b}^{SB} = B^E\left[\bar{b}^{SB} + (1+r)w\,\bar{l}\right]$$
$$\bar{N} = B^E(\bar{N}) + (1+r)w\,\bar{l}\,.$$

Proof. See the mathematical appendix.

It is worth noting that under perfect enforcement, the law of motion for bequests (and hence wealth) can be observed from Figure 3 by letting $B^E(N)$ be equal to the first best level of bequest left by successful entrepreneurs given by the segment AB. For any distribution of wealth, the distributions of bequests and the next generation's wealth under perfect

[20] The ergodic sets of bequests and wealth are not necessarily convex.

enforcement first order stochastically dominates those under imperfect enforcement. This result extends to the ergodic distributions. The reason is just that the payoff for successful entrepreneurs is higher under no credit frictions and hence agents in the economy become wealthier.

By proving the existence of an asymptotic distribution of wealth and bequests, Proposition 8 also shows that there is a unique long run pattern of trade for this economy. The dynamic trade pattern in the transition from any initial distribution of wealth (or bequests) is in general dependent on this initial condition. Nevertheless, some general conclusions can be derived under some (plausible) initial conditions on the distribution of wealth or bequests. Let $\bar{Y^A}$ be the asymptotic aggregate output level in sector A (the one corresponding to the asymptotic wealth distribution).

Proposition 9 *Under imperfect enforcement, if for some t G_t first order stochastically dominates G_{t-1}, then Y_t^A converges monotonically to $\bar{Y^A}$.*

Proof. See the mathematical appendix.

This proposition suggests that under plausible conditions, a small open economy like the one described above is likely to exhibit a pattern of trade where initially the country imports good A an eventually ends up exporting it (or importing less).

Figure 4 describes the pattern of trade dynamics under the initial conditions given in Proposition 9 in the presence of credit market imperfections. The vertical axis represents aggregate demand and production levels of good A while the horizontal axis represents the corresponding aggregate demand and production levels of good B. The line $\overline{OC_0C}$ shows the income expansion path, which is a straight line because of the assumptions made on agents preferences. The curves represent the production possibility frontier corresponding to the initial period $t = 0$ and the asymptotic production possibility frontier for the limit as $t \to \infty$. Given the relative price of good A, assumed to be constant over time, aggregate production at time t is described by point P_0 while aggregate demand by C_0, indicating that the economy starts importing good A and exporting good B. As time passes the production possibility frontier expands because there are more entrepreneurs with higher wealth levels that put

more effort into management in sector A. All the production possibility frontiers share the same point $\bar{B}$ corresponding to the case where all labor is allocated in this sector, since there is no productive role for wealth in sector B.[21] While consumption expands through the income expansion path, production follows a path given by $\overline{P_0P}$. Since sector A becomes more and more efficient, the economy moves resources (capital and labor) from sector B towards A. Thus, while the economy starts with a comparative advantage in sector B, its trade pattern is eventually reversed toward sector A.

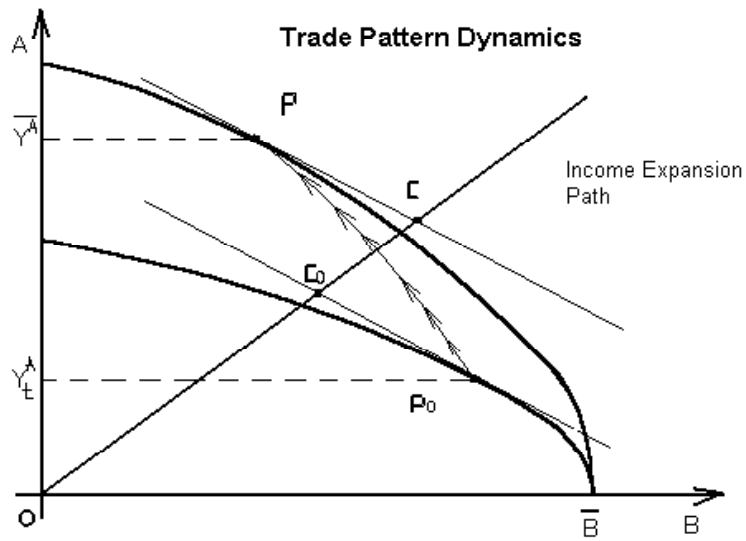


Figure 4:

While prices and technology remain constant, the sector characterized by imperfect credit access experiences a slow process of development, and the share of this sector's output on GDP grows as the economy develops.

From Proposition 9 follows

Corollary 10 *Under imperfect enforcement, if for some t G_t first order stochastically dominates G_{t-1}, then the mass of entrepreneurs that defaults decreases and total factor productivity increases along the path of development.*

[21] The slopes of the production possibility frontiers are infinite at this point because technology in Sector A exhibits decreasing returns to scale.

Wealthier entrepreneurs have more incentives to succeed since they further internalize the cost of failure. Thus as societies get richer in the development process entrepreneurs are better able to overcome incentive issues in financial contracts. Note that the productive capacity of these entrepreneurs is determined by prices, technology and incentives, which are all the same regardless of the country these entrepreneurs live in. It is for this reason that there will be trade even though all factors of production and technology are freely mobile.

Finally, it is interesting to notice that under perfect enforcement, the economy doesn't exhibit any dynamic trade pattern and it goes right away to a production-demand point that is even more extreme than $P - C$. With perfect credit markets in the small firm sector the production possibility frontier will expand further along the A axis, leading to more specialization towards the A sector.

5 Trade under the lens of the theory

How does this theory contribute to our understanding of international trade flows? Acknowledging wealth (or financial imperfections) as a source of comparative advantage can complement the way we think about at least three major issues in the field. First, it provides an explanation for Trefler's "missing trade mystery". Second, it offers an alternative rationalization for the Leontief paradox. Third, it adds to our understanding of the relation between trade and the distribution of income. In this section I look at the first two in some detailed while I offer some insights cast by the theory on the third one, leaving a more comprehensive analysis for the future.

Trefler (1995) shows that factor service trade is much smaller than its factor-endowments prediction of the Heckscher-Ohlin-Vanek theorem. As he points out, "unless there are omitted factors that are scarce in poor countries, [the data] is inconsistent with the spirit and the letter of a theory whose cornerstone is factor abundance". I now explain why wealth and more generally financial frictions can explain, at least partially, "the case of missing trade".

Balanced trade in this model implies

$$Y^A P^A + Y^B = C^A P^A + C^B \tag{46}$$

Our assumption on preferences imply that aggregate demands are such that $C^A = kC^B$. Plugging this into our balance trade equation results in

$$C^B = \frac{Y^A P^A + Y^B}{kP^A + 1} \tag{47}$$

Let $NT^A = [Y^A - C^A]P^A$ be net trade for sector A (the small firm sector). With this definition, the balanced trade condition and the income expansion path we derive the following expression

$$\frac{NT^A}{Y^A P^A + Y^B} = \frac{P^A Y^A}{Y^A P^A + Y^B} - \frac{kP^A}{kP^A + 1} \tag{48}$$

Simply stated Equation (48) is the net trade of the small firm sector normalized by total value of output. Note that $Y^A/Y^B = k$ implies no trade since prices under autarchy are the same than under free trade (points C and P in Figure 4 lay on the same ray passing through the origin).

For simplicity let $F^B(k,l) = Ak^\nu l^{1-\nu}$. Using the FOC in this sector and the aggregate resource constraint for labor ($L^A + L^B = 2 - \mu$) we obtain

$$Y^B = A\left[\frac{\nu w}{(1-\nu)r_k}\right]^\nu \left(2 - \mu - \frac{\beta z \mu}{w}\int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N)\right) \tag{49}$$

Zero profit conditions for this sector relates wages to productivity such that[22]

$$Y^B = \frac{w(1+r)}{(1-\nu)}\left(2 - \mu - \frac{\beta z \mu}{w}\int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N)\right) \tag{50}$$

Re-expressing the net trade equation for sector A using Equations (36) and (50) gives

$$\frac{NT^A}{Y^A P^A + Y^B} = \frac{(1-\nu)P^A X}{2 - \mu + X\left[(1-\nu)P^A - \beta\right]} - \frac{kP^A}{kP^A + 1} \tag{51}$$

where X is defined as

$$X \equiv \frac{z\mu}{w}\int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N) \tag{52}$$

The net trade in the small firm sector as a fraction of total output increases with X and it is only determined by it. Hence trade flows are determined by X. When countries share the

[22] The condition is total cost equal to total revenue or $C^*(Y^B) = Y^B$.

same technology, trade is only determined by the distribution of income. A richer country will have a comparative advantage in the small firm sector, as it was mentioned before.

This expression also allows to take into consideration factor and sector neutral technological differences across countries. By allowing those differences and assuming that total factor productivity are the same across sectors (although different across countries) we can generalize the model in a useful way. The model is adapted by replacing P^A by $P^A A$ in z. Under this assumption, X can be expressed as

$$X \equiv \left[\frac{P^A \alpha^\alpha \beta^\beta}{r_k^{\alpha-\nu} \nu^\nu (1-\nu)^{1-\nu}}\right]^{\frac{1}{1-\alpha-\beta}} \int_0^\infty \left[\frac{e(N)}{w^{\nu-\alpha}}\right]^{\frac{1}{1-\alpha-\beta}} dF(N) \tag{53}$$

This expression shows that comparative advantage is driven by technology (or wages since these variables are tied by the zero profit condition for firms in sector B), and by the distribution of income. Whether countries with better technology have a comparative advantage over the small or big firm sector depends on the intensity of use of capital in both sectors. In general, countries with better technology will exhibit a comparative advantage in the capital intensive sector since the interest rate and the cost of capital are the same for all countries under the small open economy assumption. On the other hand, wealthier societies will have a comparative advantage in the small firm sector unambiguously, because they have wealthier entrepreneurs with higher success rates.

How can this theory contribute to explain the "missing trade"? Notice that as long as the big firm sector is capital intensive compared to the small firm sector (or $\nu \geq \alpha$) the technological and the financial forces work in opposition to each other. The intuition behind it is actually quite simple. Richer societies exhibit higher total factor productivity and hence a comparative advantage to produce capital intensive goods, which are produce by big firms under our assumption on capital intensity ($\nu \geq \alpha$). My theory predict that this source of comparative advantage will be partially offset by the financial friction effect driven by the distribution of income. Those very same richer societies will exhibit a comparative advantage to produce the labor intensive good, produced by small firms! Naturally the financial theory can be considered a suspect in the "missing trade" mystery only if the big firm sector is capital intensive relative to the small firms one.

I show next that evidence suggests that small firm sectors are indeed labor intensive. I use data on 28 industrial sector (3 digit level of classification) for the US and for 24 OECD economies for 1992 (see Data Appendix). In this case I have selected these economies because its is more likely that they are less affected by financial imperfections, allowing for a better measurement of purely technological differences across sectors.[23] The variables computed are: the reciprocal of the labor intensity $(1 - wl/VA)$, two measures of firm size, value added per establishment and number of workers per establishments, and the labor productivity (defined as value added per worker), for the 28 industrial sectors for the US and the aggregate of 24 OECD economies. Table 1 reports the correlation across the sectors for the US and the OECD economies.

Correlation Across US Manufacturing Sectors (1992)

	1-wl/VA	VA per Estab	Workers per Estab	Labor Productivity
1-wl/VA	1			
VA per Estab	0.68	1		
Workers per Estab	0.64	0.86	1	
Labor Productivity	0.81	0.96	0.80	1

Correlation Across 24 OECD Manufacturing Sectors (1992)*

	1-wl/VA	VA per Estab	Workers per Estab	Labor Productivity
1-wl/VA	1			
VA per Estab	0.78	1		
Workers per Estab	0.75	0.96	1	
Labor Productivity	0.91	0.95	0.92	1

* 3 digit list: AUT, CAN, DNK, ESP, FIN, FRA, GBR, DEU, GRC, HUN, IRL ITA, JPN, KOR, MEX, NLD, NOR, NZL, POL, PRT, SWE, TUR, USA.

Table 1

First note that the correlation between the two size variables are .86 for the US and .92 for OECD economies. Thus focusing on one or the other is not relevant. Second, and most importantly, the correlation between size and the reciprocal of labor intensity are significantly positive both for the US (.64 or .81) and the 24 OECD economies together (.75 or .91), showing that big firm sectors are capital intensive while small firm sectors are labor intensive. Furthermore, productivity exhibits high positive correlations with the reciprocal

[23] Alternatives set of countries don't change the result.

of labor intensity and both measures of size, providing further support to the idea that bigger firms are capital intensive.

This evidence shows that the financial theory can in principle contribute to explain why there is missing trade since big firm sectors are indeed capital intensive. But the evidence is silent on the question of whether this theory is (at least partially) responsible for the mystery.

Combining Equations (51) with (53) we obtain

$$\frac{NT^A}{Y^A P^A + Y^B} = \Gamma\left(\int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N), w\right) \tag{54}$$

where $\Gamma_1 > 0$ and $\Gamma_2 < 0$. The beauty of this expression is that it allows for testing the hypothesis that financial frictions matter for trade. Under the null hypothesis wealth does not determine the countries' comparative advantage while effort is determined by Equation (13) (again P^A is replaced by AP^A). Furthermore

$$\frac{NT^A}{Y^A P^A + Y^B} = \Gamma\left(e^{*\frac{1}{1-\alpha-\beta}}, w\right) \tag{55}$$

Net trade is only determined by technology via higher wages and a lower e^* (as the small firm sector is labor intensive, costs increase more than revenues in sector A).

I now proceed to estimate the relation between these variables for a cross section of countries for 1997. The year was picked to maximized the number of countries with available data. First I rank the 28 industrial sector by firm size (value added per establishment) in ascending order.[24] This rank is presented in Table 2. Then trade data at 3 digit level is utilized to estimate NT^A by aggregating exports minus imports for the first k sectors, characterized by having smaller firms. In this way I conducted a two sector exercise to follow the model closely. Trade flows were normalized by assigning a fraction $k/28$ of the countries' overall trade balance to the net trade aggregate for the small firm sectors and $(28-k)/28$ to the rest. Thus we make sure that $NT^A = -NT^B$ and hence all results we obtain regarding the small firm sectors comply with those regarding the big firm sector. In this way, estimating our Expression (54) is sufficient to infer NT^B. Total valued added in

[24] Results are not sensitive to the alternative definition of size.

manufacturing was used for $Y^A P^A + Y^B$. Wages are in 1997 dollars (PPP adjusted). Finally, our variable $\int_0^\infty e(N)^{\frac{1}{1-\alpha-\beta}} dF(N)$ was approximated by $\int_0^\infty e(N) dF(N)$, the average success rate of small firms (or one minus the failure rate), since we have data for the ratio of total loan loss to gross loans for each country. The data is coming from BankScope database, containing financial statements for an unbalanced panel of 13200 banks from various countries going from 1995 until 2002. I could not ask for a better proxy, although the number of banks in the database by 2002 is greater than that for our year. Having more banks per country is important to cover a broader spectrum of the lending relationships (not only the big banks-big firms relations) due to the variance in the ratio across banks within countries. For this reason I have only included countries with data on more than 3 banks.[25] The number of countries for which we have the three variables available are 32.

The functional form that seems to fit my model well, and that I use from here on, is the following

$$\frac{NT^A}{Y^A P^A + Y^B}_{ik} = \alpha_{0k} + \alpha_{1k} \log(w_i) + \alpha_{2k} \log \left[\int_0^\infty e(N) dF(N)_i \right] + \varepsilon_{ik} \tag{56}$$

where index i corresponds to countries, and index k to the number of small firm sectors aggregated in NT^A. I conduct a one tail test where the null hypothesis is $H_0 : \alpha_{2k} = 0$ and the alternative is $H_1 : \alpha_{2k} > 0$ as suggested by the theory.[26] Of course we also expect $\alpha_{1k} < 0$ since greater wages (or higher total factor productivity) should imply that the country exhibits a comparative advantage in big and capital intensive firms.

Table 2 shows the results of the k (OLS) regressions for all possible levels of aggregations ($k = 1, ..., 27$). For example the kth row shows the results of the regression where the k sectors with smaller firms (listed in the second column) were grouped in Sector A while the rest where included in Sector B. In parenthesis I present the t-statistics for the coefficients.

[25] The set of countries with 4 or more remains the same. Including all countries with data on at least one bank increase the set of country by 5. Qualitative results are robust to these changes.

[26] Note that under the null, e^* should be lower for wealthier countries as explained before. Then, rejecting H_0 is sufficient for our purpose.

Determinants of Comparative Advantage

Dependent variable: $NT^A/(Y^A P^A + Y^B)$.

k	Manufacturing sectors	Constant	Wages	Success Rate	R^2	R^2 Adj.
1	Other manufactured products	0.045	-0.015	0.465		
		(4.29)	(-4.52)	(2.14)	0.416	0.375
2	Furniture except metal	0.077	-0.023	0.592		
		(4.13)	(-3.81)	(1.52)	0.342	0.296
3	Wood products except furniture	0.139	-0.036	1.335		
		(4.85)	(-3.91)	(2.24)	0.345	0.300
4	Leather products	0.167	-0.044	1.389		
		(4.54)	(-3.76)	(1.82)	0.329	0.282
5	Printing and publishing	0.186	-0.049	1.444		
		(4.04)	(-3.32)	(1.51)	0.279	0.229
6	Pottery china earthenware	0.215	-0.055	1.596		
		(3.82)	(-3.09)	(1.36)	0.251	0.199
7	Other non-metallic mineral products	0.236	-0.061	1.624		
		(3.47)	(-2.83)	(1.15)	0.222	0.168
8	Wearing apparel except footwear	0.333	-0.098	2.391		
		(4.72)	(-4.34)	(1.62)	0.405	0.364
9	Fabricated metal products	0.310	-0.099	2.845		
		(3.70)	(-3.71)	(1.63)	0.325	0.279
10	Machinery except electrical	0.164	-0.069	3.477		
		(.89)	(-1.17)	(.90)	0.048	-0.018
11	Textiles	0.134	-0.084	1.634		
		(.68)	(-1.34)	(.40)	0.063	-0.002
12	Miscellaneous petroleoum and coal products	0.160	-0.089	1.733		
		(.81)	(-1.42)	(.42)	0.071	0.006
13	Plastic products	0.165	-0.092	1.700		
		(.82)	(-1.44)	(.40)	0.073	0.009
14	Footwear except rubber of plastic	0.199	-0.101	1.872		
		(.96)	(-1.55)	(.44)	0.084	0.021
15	Glass and products	0.221	-0.107	1.966		
		(1.06)	(-1.62)	(.45)	0.091	0.028
16	Non-ferrous metals	0.317	-0.124	3.236		
		(1.54)	(-1.89)	(.75)	0.113	0.052
17	Rubber products	0.333	-0.128	3.355		
		(1.58)	(-1.91)	(.77)	0.115	0.054
18	Professional and scientific equipment	0.330	-0.131	3.443		
		(1.54)	(-1.92)	(.77)	0.117	0.056
19	Machinery electric	0.243	-0.125	3.084		
		(1.13)	(-1.82)	(.69)	0.107	0.045
20	Food Products	0.351	-0.137	4.894		
		(1.59)	(-1.95)	(1.07)	0.116	0.055
21	Paper and products	0.349	-0.133	5.017		
		(1.55)	(-1.85)	(1.07)	0.105	0.044
22	Iron and steel	0.315	-0.121	4.638		
		(1.52)	(-1.84)	(1.08)	0.105	0.043
23	Other chemicals	0.274	-0.111	4.450		
		(1.27)	(-1.63)	(.99)	0.084	0.021
24	Transport equipment	0.109	-0.075	3.733		
		(.46)	(-.99)	(.75)	0.035	-0.032
25	Beverages	0.129	-0.077	3.385		
		(.63)	(-1.18)	(.79)	0.046	-0.019
26	Industrial chemicals	0.018	-0.024	1.425		
		(.18)	(-.75)	(.67)	0.022	-0.045
27	Petroleum refineries	-0.030	0.008	-0.234		
		(-2.99)	(2.48)	(-1.12)	0.177	0.120
	Tobacco					

Note: No of observations=32. Year 1997.

Table 2

Few comments on these results. First, results comply with the theory very well since the coefficients for wages are all negative and for our financial variable are all positive at all levels of aggregations except the last one. The last sector is Tobacco. Because this sector is heavily taxed in most countries, the value added in this sector turns out to be higher than otherwise. Consequently the value added per establishment turn out to be much higher than

what it would be without such high taxes, overestimating the plant size of this sector and misplacing it towards the very end of the ranking. Second while signs are robust to levels of aggregations, we can only reject the null hypothesis $H_0 : \alpha_{2k} = 0$ at a 5% confidence (t-statistic > 1.7) for few levels of aggregation. Third, the t-statistics of the coefficient fall as the number of sectors included in the small firm group rises. Interestingly, the same happens with the significance of the wage coefficient which leads me to conjecture that the natural partition between small and big firm sectors occurs at lower levels of aggregations (say for $k \leq 10$).

There are two reasons that potentially contribute to the observed low significance of the coefficients. One is the number of observation which is only 32, the other is the correlation between the variables (log of wages and log of average survival rate) which turns out to be .55. The cure asks for more data, and for that I follow two alternatives routes.

One way suggested by the literature is to estimate our coefficients with country to country comparisons.[27] This could be useful because the number of possible comparisons out of n countries is $\frac{n^2-n}{2}$. In our case $n = 32$ and hence the number of comparisons is 496. The theory implies that if one country has higher wages than another, everything else equal, then that country should tend to have a comparative advantage in the big and capital intensive sector. Equivalently for our financial variable (success rate). This would imply estimating the following model

$$\frac{NT^A}{Y^A P^A + Y^B}_{ik} - \frac{NT^A}{Y^A P^A + Y^B}_{jk} = \alpha_{1k} \log(\frac{w_i}{w_j}) + \alpha_{2k} \log \left[\frac{\int_0^\infty e(N) dF(N)_i}{\int_0^\infty e(N) dF(N)_j} \right] + \varepsilon_{ijk} \qquad (57)$$

Table 3 presents the results of the k (OLS) regressions.

[27] See Debaere (2003).

Determinants of Comparative Advantage

Dependent variable: $NT^A/(Y^A P^A + Y^B)_i - NT^A/(Y^A P^A + Y^B)_j$.

k	Manufacturing sectors	Wages	Success Rate	R^2	R^2 Adj.
1	Other manufactured products	-0.015	0.465		
		(-18.66)	(8.83)	0.412	0.411
2	Furniture except metal	-0.023	0.592		
		(-15.74)	(6.29)	0.321	0.320
3	Wood products except furniture	-0.036	1.335		
		(-16.13)	(9.25)	0.340	0.338
4	Leather products	-0.044	1.389		
		(-15.50)	(7.50)	0.320	0.318
5	Printing and publishing	-0.049	1.444		
		(-13.72)	(6.22)	0.265	0.263
6	Pottery china earthenware	-0.055	1.596		
		(-12.75)	(5.61)	0.231	0.229
7	Other non-metallic mineral products	-0.061	1.624		
		(-11.68)	(4.74)	0.202	0.201
8	Wearing apparel except footwear	-0.098	2.391		
		(-17.92)	(6.71)	0.380	0.379
9	Fabricated metal products	-0.099	2.845		
		(-15.30)	(6.73)	0.323	0.322
10	Machinery except electrical	-0.069	3.477		
		(-4.82)	(3.73)	0.042	0.040
11	Textiles	-0.084	1.634		
		(-5.51)	(1.64)	0.059	0.057
12	Miscellaneous petroleoum and coal products	-0.089	1.733		
		(-5.85)	(1.74)	0.068	0.066
13	Plastic products	-0.092	1.700		
		(-5.93)	(1.66)	0.071	0.069
14	Footwear except rubber of plastic	-0.101	1.872		
		(-6.40)	(1.80)	0.083	0.081
15	Glass and products	-0.107	1.966		
		(-6.67)	(1.87)	0.090	0.089
16	Non-ferrous metals	-0.124	3.236		
		(-7.80)	(3.11)	0.111	0.110
17	Rubber products	-0.128	3.355		
		(-7.88)	(3.16)	0.114	0.112
18	Professional and scientific equipment	-0.131	3.443		
		(-7.94)	(3.19)	0.115	0.113
19	Machinery electric	-0.125	3.084		
		(-7.53)	(2.84)	0.102	0.100
20	Food Products	-0.137	4.894		
		(-8.05)	(4.40)	0.103	0.101
21	Paper and products	-0.133	5.017		
		(-7.63)	(4.40)	0.091	0.089
22	Iron and steel	-0.121	4.638		
		(-7.59)	(4.44)	0.092	0.090
23	Other chemicals	-0.111	4.450		
		(-6.71)	(4.10)	0.064	0.062
24	Transport equipment	-0.075	3.733		
		(-4.09)	(3.11)	-0.004	-0.006
25	Beverages	-0.077	3.385		
		(-4.85)	(3.27)	0.010	0.008
26	Industrial chemicals	-0.024	1.425		
		(-3.10)	(2.77)	-0.041	-0.043
27	Petroleum refineries	0.008	-0.234		
		(10.23)	(-4.62)	0.164	0.162
	Tobacco				

Note: No of observations=496. Year 1997.

Table 3

Note that the coefficients (signs and absolute values) are exactly the same than in the previous regressions. This is because the first and second models are estimating the same coefficients for wages and success rates. Also note that the significance of those coefficients are now very high, the reason being that we are now making 32 observations speak for 496. This is the consequence of assuming independence between country comparisons. Can we

really assume that a comparison between the US and France is independent of that between the US and UK for example? It turns out that assuming this implies a really complex covariance structure across countries net trade (that I am not even sure it is feasible). Note that our second model can be re-written as

$$AY = AX + A\Xi \tag{58}$$

where A is a ($\frac{n^2-n}{2}$ by n) matrix with zeros, a one and a negative one in each row. Also Y, X and Ξ are n by 1. Under the assumption of independence across countries it turns out that the variance-covariance matrix of $A\Xi$ in our second model is a matrix of rank $n-1$ that takes into account the dependence structure of the errors. When we take this dependence into account with a generalized least squares approach the t-statistics are corrected to those found in our first model, washing out the significance of the results.

This analysis alert us on the possible flaws of the second approach. Yet I have included these pair-wise country regressions because it shows that higher levels of significance can be accomplished when we assume more complex dependence structures across errors in Ξ.

The second approach to our problem of few observations is to include more years in the regression, though at the risk of contaminating our test with changes in variables such as the relative price of final goods. Keeping this caveat in mind, the data set was expanded in two ways: 1) including data for 1998 and 1999 (the last year for which I have trade data),[28] and 2) expanding the number of countries by estimating missing data on wages using the tight cross country relation between GDP per capita and wages ($R2$ of more than 80% for each of the three years considered).[29] This approach allows us to estimate wages when missing through the per capita GDP. The number of countries is now 47 in 1997 and 48 in 1998 and 1999.

[28] Dollar denominated wage data for 1996 is not available at the Department of Commerce and it is hard to constructing from alternative sources

[29] The model used for this estimation is

$$\log(w_{ti}) = a_{t0} + a_{t1}\log(\text{per capita } GDP_{ti}) + \varepsilon_{ti}$$

with i and t being the country and year indexes.

Table 4 presents the results of the (OLS) regressions of our first model using the expanded data set.

Determinants of Comparative Advantage

Dependent variable: $NT^A/(Y^A P^A + Y^B)$.

k	Manufacturing sectors	Constant	Wages	Success Rate	R^2	R^2 Adj.
1	Other manufactured products	0.039	-0.027	0.325		
		(1.94)	(-4.07)	(1.76)	0.106	0.094
2	Furniture except metal	0.110	-0.031	0.610		
		(4.42)	(-3.83)	(2.64)	0.099	0.086
3	Wood products except furniture	0.181	-0.036	0.800		
		(4.19)	(-2.51)	(2.00)	0.048	0.035
4	Leather products	0.223	-0.049	1.026		
		(4.40)	(-2.91)	(2.18)	0.062	0.048
5	Printing and publishing	0.279	-0.046	1.289		
		(3.93)	(-1.96)	(1.96)	0.035	0.022
6	Pottery china earthenware	0.351	-0.049	1.616		
		(3.72)	(-1.58)	(1.85)	0.028	0.014
7	Other non-metallic mineral products	0.402	-0.047	1.831		
		(3.50)	(-1.24)	(1.72)	0.022	0.008
8	Wearing apparel except footwear	0.597	-0.086	2.608		
		(4.23)	(-1.85)	(1.99)	0.034	0.021
9	Fabricated metal products	0.556	-0.074	2.485		
		(4.00)	(-1.62)	(1.93)	0.030	0.016
10	Machinery except electrical	0.207	-0.019	1.026		
		(2.76)	(-.78)	(1.47)	0.015	0.001
11	Textiles	0.216	-0.064	1.163		
		(3.09)	(-2.77)	(1.80)	0.053	0.040
12	Miscellaneous petroleoum and coal products	0.286	-0.064	1.485		
		(3.47)	(-2.37)	(1.94)	0.044	0.030
13	Plastic products	0.290	-0.078	1.608		
		(3.44)	(-2.80)	(2.06)	0.057	0.043
14	Footwear except rubber of plastic	0.349	-0.090	1.860		
		(3.70)	(-2.89)	(2.13)	0.060	0.047
15	Glass and products	0.405	-0.089	2.130		
		(3.78)	(-2.53)	(2.14)	0.051	0.037
16	Non-ferrous metals	0.449	-0.086	2.219		
		(4.01)	(-2.34)	(2.14)	0.046	0.033
17	Rubber products	0.496	-0.083	2.450		
		(3.87)	(-1.96)	(2.06)	0.037	0.024
18	Professional and scientific equipment	0.488	-0.091	2.545		
		(3.81)	(-2.15)	(2.14)	0.042	0.029
19	Machinery electric	0.143	-0.104	1.227		
		(1.47)	(-3.25)	(1.37)	0.070	0.057
20	Food Products	0.207	-0.121	1.395		
		(2.24)	(-3.99)	(1.63)	0.103	0.090
21	Paper and products	0.217	-0.109	1.485		
		(2.52)	(-3.86)	(1.86)	0.096	0.083
22	Iron and steel	0.187	-0.098	1.123		
		(2.40)	(-3.80)	(1.56)	0.094	0.081
23	Other chemicals	0.107	-0.069	0.802		
		(1.39)	(-2.74)	(1.13)	0.051	0.038
24	Transport equipment	-0.063	-0.038	0.272		
		(-.80)	(-1.48)	(.38)	0.016	0.002
25	Beverages	-0.014	-0.049	0.043		
		(-.22)	(-2.33)	(.07)	0.047	0.034
26	Industrial chemicals	-0.122	-0.013	-0.511		
		(-2.13)	(-.66)	(-.96)	0.018	0.004
27	Petroleum refineries	-0.100	0.021	-0.466		
		(-2.98)	(1.88)	(-1.49)	0.027	0.014
	Tobacco					

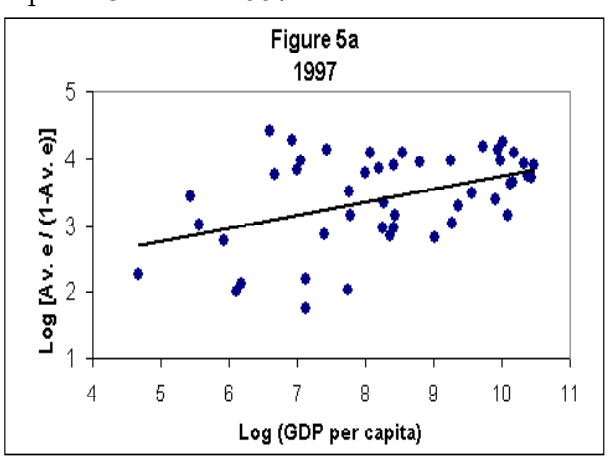
Note: No of observations=143. Years 1997, 1998 and 1999.

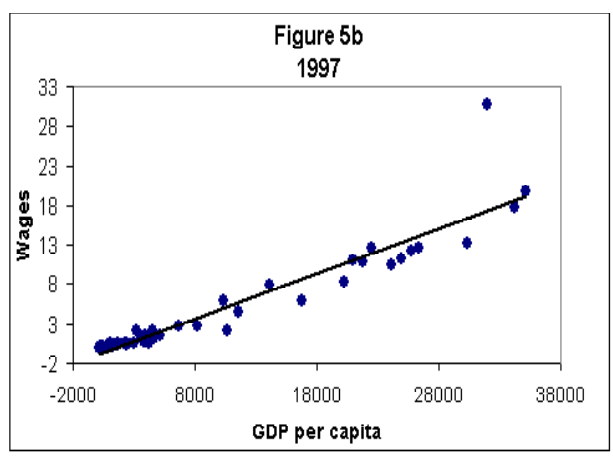
Table 4

The main characteristics of the results in our first exercise remain. Signs are as predicted by the theory both for wages and for our financial variable except in the last two sectors. As before, the level of significance falls towards levels of aggregation where more sectors are

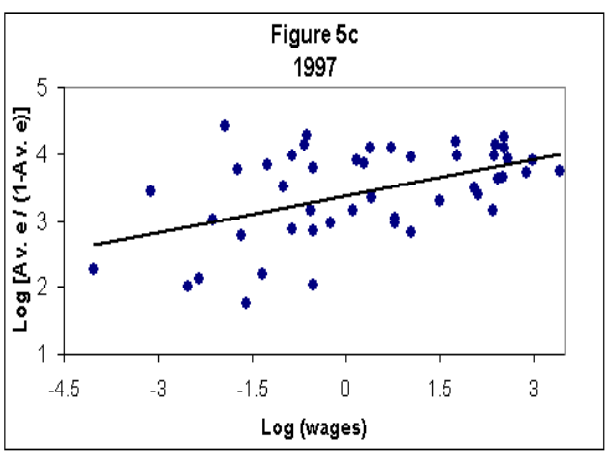
included in the small firm sector. The difference is that now we can reject the null hypothesis of financial frictions being unimportant for trade at a 5% level (t-statistic > 1.66) in 18 of the 27 possible sector aggregations. Moreover, in 10 of these 18 cases the null hypothesis is rejected at a 2.5% (t-statistic > 1.98) confidence level. Finally, the good properties of the results remained intact when the years 1997 and 1999 were individually removed as well as when dummy variables for years were included in the regressions.[30]

While each of this three ways of testing the model have some drawback –for example the lack of data, assuming a complex covariance between countries or mixing years where relative prices might have changed– the robustness of the signs across levels of aggregations and different procedures supports the main two ideas. That is, that financial frictions matter for trade and that financial friction and productivity differences work in opposite directions, offering an explanation for the missing trade mystery. But one more relevant piece of evidence is still needed. Do wealthier nations have higher success rates? Figure 5a plots the $Log\left[\frac{\int edF}{1-\int edF}\right]$, a monotonic transformation of the average success rate against the log of per capital GDP for 1997.





[30] The dummy variables were all insignificant and the t-statistics of the coeficients for wages and the average success rate were very similar to those in Table 4.



The graphs show a positive association between the variables as suggested by the theory. The correlation is in fact .44 for 1997, and similar for other years. While this plot shows that wealthier nations indeed have higher average success rates, the variance is high, specially for countries with low per capital GDP. Moreover the variance seems unlikely to be driven by differences in second or higher moments of the distribution of income. This suggests to me that income distribution might not be the only driver of financial imperfection, although I leave this issue for the future. For completeness Figure 5b shows the relation between wages and per capita GDP for 1997 since we have used the second to estimating the first when missing. Lastly, Figure 5c shows that the success rate and wages are positively correlated also as predicted by the theory.[31]

Given the way the financial source of comparative advantage operate, this theory offers an explanation to the puzzling finding by Leontief (1953) which asserts that in 1947 the US content of exports was labor intensive.[32] Because the country is capital abundant, this finding seems to contradict the fundamental HOV theorem giving birth to the so-called Leontief's paradox. Leamer (1980) demonstrates that the paradox rests on a conceptual misunderstanding though, and that when correct calculations are done the United States is revealed by trade to be relatively abundant in capital compared with labor. Brecher and Choudhri (1982) resurrect the paradox by arguing that correct calculations also imply that

[31] The correlation of the variables in Figure 5c is .49.

[32] See Leamer (1984) for a survey on the Leontief's paradox as well as other puzzling findings for Japan and West Germany.

the United States was revealed by trade to be labor abundant compared with an average of all resources. From this angle Leontief's finding is indeed back in contradiction with the HOV theory. But it is not in contradiction with our financial theory. The evidence in Table 1 suggest that small firms are labor intensive. As mentioned before, productivity differences and financial imperfections as determinants of comparative advantage then work in opposition to each other. Countries with higher productivity will exhibit a relative abundance of capital compared with labor. Thus, Leontief's finding is consistent with our theory if the second source of comparative advantage dominates. Unfortunately, whether that was indeed the case for the US in 1947 is difficult to establish.

The theory proposed here complements Trefler's (1993) explanation of this paradox. Following a suggestion by Leontief, he argues that the finding about the US factor content of trade is less paradoxical when we take into account factor augmenting international productivity differences. From this view, a one year labor service in the US was equivalent to many years of foreign labor service in 1947 due to differences in technology. Crucial to that story is his finding on labor augmenting productivity differences being greater than those for capital. My theory complies with Trefler's explanation although in essence it only requires factor neutral technological differences. Because effort is unobservable, the model with financial imperfections generates bigger total factor productivity differences in the small firm sector. Since this sector is labor intensive, the model predicts greater labor than capital augmenting productivity differences across countries.

Finally this theory also adds to the literature on trade and income distribution. The literature on these issues link trade and the distribution of income in the following way: when countries open for trade they face new relative prices which, given the technology, affect factor prices and for this reason the distribution of income. In this (traditional) view, there is no feedback from the distribution of income to trade. Because in the theory developed here income distribution works as a determinant of comparative advantage, the relationship between income distribution and trade is now two ways.

In the context of this model, changes in the relative price of the final goods (P^A) do affect relative factor prices; wages, rental rate of capital and profits (for managerial talent). A fully

anticipated drop in the relative price of the final good produced by small firms reduces profits and increases the value of labor and capital relative to all other goods. While w and r_k do not change as they are pinned down by Equation (4) and the small open economy assumption, the relative price of labor and capital to good A rises. It is surprising that labor is not harm by a fall in P^A since sector A uses labor intensively. But this is a feature of the model.[33] On the other hand, entrepreneurs will be generally worse off under imperfect enforcement. By differentiating Condition (31) and using it again to simplify the expression we obtain that $\frac{\partial e}{\partial P^A} > 0$, under the sufficient condition that entrepreneurs need some external finance to produce, which is generally the case. Thus because the utility increases with effort by Equation (35), a drop in the relative price of goods produced by these entrepreneurs reduces their profits an hence their incentives to succeed. This effect can also be seen from Figure 1 and the fact that e_0 is a linear function of e^* which depends negatively on P^A from Condition (13).

But the story does not end here as long as financial imperfections are present. A drop in the final price of good A also has dynamic implications since it affects the distribution of income an hence future trade patterns. It is in this sense that this theory departs from the traditional approach. Figure 3 helps as understand the dynamics after a drop in P^A. Because the level of effort exerted by entrepreneurs falls with their revenues, the bequest function of successful entrepreneurs ($B^E(N,)$) shifts down as Expression (41) indicates. Also for the same reason, the mass of successful entrepreneurs falls. Finally N^* shifts to the left induced by lower efficient effort level e^*. Then the distributions of bequest and next period income are negatively affected (in the first order sense) by the fall in P^A.[34] If the economy was accumulating wealth as in Proposition 9 and if the shock was permanent, growth would be slowed down from this point on. In terms of Figure 4, the shock implies smaller production possibility sets after the shock compared with those without it, due to lower wealth and lower incentives to succeed. Overall, a decrease in P^A has both a static and a dynamic adverse effect on managerial talent and then the trade pattern leans towards sector B both

[33] The explanation is that sector A uses managerial talent intensively relative to labor.

[34] If the fall in P^A is unexpected the impact on the distribution (in the first order sense) is even more adverse.

on impact and in subsequent periods.

6 Final remarks and extensions

The model describes an economy with two sectors with different characteristics. One sector has a technology that needs management as an indivisible factor of production and operates at a small scale and where the monitoring costs of managerial activities are too big compared to the overall cost of production. In such sectors, agency problems in financial contracts affect entrepreneurial incentives to succeed, the profitability of firm and the scale of production. Incentives improve with the entrepreneurs' wealth because when they are less dependent on external finance agency problems are mitigated. The other sector is assumed to be a frictionless one: there are sectors that operate at such a big scale that monitoring costs of financial relations are negligible compared to the total cost of production, like the iron and steel industry or the petroleum refineries sector, facilitating their access to credit markets.

Because smaller firms are also labor intensive this source of comparative advantage works in the opposite direction compared with traditional sources. Wealthier nations have higher total factor productivity and capital abundance, giving them a comparative advantage in capital intensive industries (the big firm sector). But this theory argues that at the same time these countries should exhibit a comparative advantage in small firm (labor intensive) sectors because of their better access to credit, offsetting the traditional sources. Due to this offsetting effect this theory offers an explanation for Trefler's missing trade mystery and the Leontief paradox.

Furthermore, since agents leave bequest to their offspring the distribution of income will be history dependent. This feature introduces persistence in the distribution of wealth and consequently the trade pattern dynamics of the economy, endogenizing the relation between trade and income distribution.

I conclude by making few additional observations for future research. Assuming constant wages (or technology) and final prices is important for the dynamics of the model but it does not affect the main message. While the law of motion for the distribution of wealth

described in Proposition 7 could be adapted, the asymptotic results of Proposition 3, 8 and 9 would not hold if there is growth in the economy. Extending the analysis in that direction while including skilled and unskilled labor could be important for the discussion on the role of trade in driving the skill premia.

Additionally, the empirical analysis suggests that even though financial imperfections are important, wealth might not be the only driver. The cost of borrowing could also be driven by institutional forces such as intermediation costs or differences in bankruptcy laws. While the model can handle these differences via the parameter a, further empirical effort should be made to disentangle how much of the action is driven by institutions versus the nations' wealth.

Finally, in the absence of convexities in production in the small firm sector the model exhibits specialization and trade traps, like in Torvik (1993), Banerjee and Newman (1994) and Boyd and Smith (1997). In this environment optimal dynamic import tariffs can help a country gradually overcome the development trap.

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Mathematical Appendix

Proof of Proposition 3. First note that if there is an ergodic distribution of bequests then there is an ergodic distribution of wealth and vice versa. From the law of motion of bequests, $\frac{db_j}{dN_j} = (1-\gamma-\psi)(1+r) < 1$. Since the best outcome any agent could expect is given by the one corresponding to a successful entrepreneur, we look at the first part of the expression for bequests to determine the upper bound of the ergodic set of this variable. By replacing the entrepreneur's upper level of wealth $N = \bar{b} + (1+r)w\ \bar{l}$ given by the luckiest agent with the maximum level of bequest, we obtain the following condition for $\bar{b}$.

$$\bar{b} = (1-\gamma-\psi)\left\{(1+r)ze^{*\frac{\alpha+\beta}{1-\alpha-\beta}}\left[1-(\alpha+\beta)e^{*}\right] + (1+r)\left[\bar{b} + (1+r)w\ \bar{l}\right]\right\}$$

from which $\bar{b}$ can be derived.

Considering that the worst thing that can happen to a dynasty with wealth N_j is to become an unsuccessful entrepreneur for many periods and get no labor endowment in all these periods, we can compute the lower bound of the ergodic set for bequests as

$$\underline{b} = (1-\gamma-\psi)(1+r)\ \underline{b}$$

which completes the description of the support of the limiting distribution.

I postpone the proof showing that the limiting distributions for wealth and bequests under perfect enforcement exist and are stationary until after I described the limiting distributions under imperfect enforcement. ■

Proof of Proposition 5. The result follows from a couple of theorems by Hadar and Russell (1971) to whom I refer the reader for proofs. Adapted to this application, they are:

THEOREM 1. Let $Y_i^A = \mu(1+r)zE_{F_i(N)}\left[e(N)^{\frac{1}{1-\alpha-\beta}}\right]$ for $i = 1, 2$. If $\frac{de(N)^{\frac{1}{1-\alpha-\beta}}}{dN} \geq 0\ \forall N$, with strict inequality for some N, and if $F_2(N)$ first order stochastically dominates $F_1(N)$, then $Y_2^A > Y_1^A$.

THEOREM 2. Let $Y_i^A = \mu(1+r)zE_{F_i(N)}\left[e(N)^{\frac{1}{1-\alpha-\beta}}\right]$ for $i = 1, 2$. If $\frac{d^2e(N)^{\frac{1}{1-\alpha-\beta}}}{dN^2} \leq 0$ $\forall N$, with strict inequality for some N, and if $F_2(N)$ second order stochastically dominates $F_1(N)$, then $Y_2^A > Y_1^A$. ■

Proof of Proposition 7. In this proof I show how to derive $v_t(b)$, since the rest follows directly from this result. Assume a given distribution of bequests $g_t(b)$. By Expression (42),

the next period bequest b' depends on the previous bequest b only through N, implying that entrepreneurs with different inheritances might leave the same bequest to their successor as long as their end of youth wealth are equivalent and they are successful. Unsuccessful entrepreneurs leave bequests if and only if their wealth was more than the amount invested in the project (if $N > N^*$). Also see that it is possible for a worker of the old generation to leave the same bequest as a successful entrepreneur (if $B^E(N_j) = B^W(N_i)$) or the same as unsuccessful one (if $\phi \max(N - N^*) = B^W(N_i)$). This means the mass of agents that inherit the same bequest can be offspring of either entrepreneurs (successful or not) or workers.

To compute the mass of agents first note that at every point in time the mass of agents can be described by a density function $f_t(b, l)$ on their characteristics (b, l). This density function integrates one over the support of this distribution. With this in hand, we are able to compute the mass of successful entrepreneurs with the same wealth $N = b + (1 + r)wl$, that bequest the same amount. Summing across them we obtain

$$\int_{N-(1+r)w\bar{l}}^{N} \mu e(N) f_t\left(x, l = \frac{N-x}{(1+r)w}\right) dx = \mu e(N) \int_{N-(1+r)w\bar{l}}^{N} h\left(\frac{N-x}{(1+r)w}\right) dG_t(x)$$

which is only a function of the entrepreneur's wealth. Notice that this mass can be also expressed in terms of the amount these entrepreneurs will leave to their successors. The link between these variables is given by $B^E(N)$ or by $B^{E-1}(b)$ for all $b \geq \frac{\phi a e(0)^n}{(1+r)s}$.

By the same reasoning all agents becoming workers might leave the same bequest as these entrepreneurs as long as they have a wealth $y = b + (1 + r)wl$ such that

$$B^E(N) = \phi\left[(1 + r)wl + b + w)\right]$$

where $\phi = (1 - \gamma - \psi)(1 + r)$. This also works for all $B^E(N) \geq \phi w$

The mass of these agents is determined by

$$(1-\mu) \int_{\frac{B^E(N)-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{B^E(N)-w\phi}{\phi}} h\left(\frac{B^E(N) - \phi(x+w)}{(1+r)w\phi}\right) dG_t(x)$$

Additionally, unsuccessful entrepreneurs might leave bequests if they had more than enough to fully finance their investment projects. They will also leave $B^E(N)$ as a bequest

as long as their wealth at youth is $B^E(N) = \phi\left[(1+r)wl + b - N^*\right]$. Their mass is

$$\mu[1-e^*] \int_{\frac{B^E(N)+\phi N^* - \phi(1+r)w\bar{l}}{\phi}}^{\frac{B^E(N)+\phi N^*}{\phi}} h\left(\frac{B^E(N)+N^*\phi - x\phi}{\phi(1+r)w}\right) dG_t(x)$$

where the effort level exerted is efficient because these entrepreneurs invested N^* in the firm.

Finally, $v_t(b)$ can be computed by summing across all these agents, and taking into account the link between N and b

$$\begin{aligned} v_t(b) &= \mu e\left(B^{E-1}(b)\right) I\left(b \geq \frac{\phi a e(0)^n}{(1+r)s}\right) \int_{B^{E-1}(b)-(1+r)w\bar{l}}^{B^{E-1}(b)} h\left(\frac{B^{E-1}(b)-x}{(1+r)w}\right) dG_t(x) + \\ & \mu[1-e^*] \int_{\frac{b+\phi N^* - \phi(1+r)w\bar{l}}{\phi}}^{\frac{b+\phi N^*}{\phi}} h\left(\frac{b+N^*\phi - x\phi}{\phi(1+r)w}\right) dG_t(x) + \\ & (1-\mu) I(b \geq \phi w) \int_{\frac{b-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b-w\phi}{\phi}} h\left(\frac{b-\phi(x+w)}{(1+r)w\phi}\right) dG_t(x) \end{aligned}$$

where $I(.)$ are indicator functions. ■

Proof of Proposition 8. The upper and lower bounds of the ergodic set for bequest are easily derived. Moreover, for any (finite) upper bound for the initial distribution of bequest ($\bar{b}_0$), there is a sequence of upper bounds for successive distributions given by $B^E\left(\bar{b}_{n-1} + (1+r)wl\right)$. To show that the distribution of bequests is stationary follows from proving that Expressions (44) and (45) define a mapping $v_{t+1}(b) = T(v_t(b))$ that is contracting.

By plugging (44) into (45) we obtain

$$\begin{aligned} v_{t+1}(b) &= \mu e\left(B^{E-1}(b)\right) I\left(b \geq \frac{\phi a e(0)^n}{(1+r)s}\right) \int_{B^{E-1}(b)-(1+r)w\bar{l}}^{B^{E-1}(b)} v_t(x) h\left(\frac{B^{E-1}(b)-x}{(1+r)w}\right) dx + \\ & \mu e\left(B^{E-1}(b)\right) I\left(b \geq \frac{\phi a e(0)^n}{(1+r)s}\right) \left[1 - \int_{x\in(0,\bar{b}_t)} v_t(x) dx\right] \int_{B^{E-1}(b)-(1+r)w\bar{l}}^{B^{E-1}(b)} h\left(\frac{B^{E-1}(b)-x}{(1+r)w}\right) dx + \end{aligned}$$

$$\mu[1-e^*] \int_{\frac{b+\phi N^*-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b+\phi N^*}{\phi}} v_t(x) h\left(\frac{b+N^*\phi-x\phi}{\phi(1+r)w}\right) dx +$$

$$\mu[1-e^*]\left[1-\int_{x\in(0,\bar{b}_t)} v_t(x)dx\right] \int_{\frac{b+\phi N^*-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b+\phi N^*}{\phi}} h\left(\frac{b+N^*\phi-x\phi}{\phi(1+r)w}\right) dx +$$

$$(1-\mu)I(b\geq\phi w) \int_{\frac{b-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b-w\phi}{\phi}} v_t(x) h\left(\frac{b-\phi(x+w)}{(1+r)w\phi}\right) dx +$$

$$(1-\mu)I(b \geq \phi w)\left[1-\int_{x\in(0,\bar{b}_t)} v_t(x)dx\right] \int_{\frac{b-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b-w\phi}{\phi}} h\left(\frac{b-\phi(x+w)}{(1+r)w\phi}\right) dx$$

Also, after some algebra it can be shown that

$$T\left(v_t(b)+a\right) = T\left(v_t(b)\right) + a[.] - a[.]\,\bar{b}_t$$

where [.] is given by

$$\begin{aligned}
[.] &= \mu e\left(B^{E-1}(b)\right) I\left(b \geq \frac{\phi a e(0)^n}{(1+r)s}\right) \int_{B^{E-1}(b)-(1+r)w\bar{l}}^{B^{E-1}(b)} h\left(\frac{B^{E-1}(b)-x}{(1+r)w}\right) dx + \\
&\quad \mu[1-e^*] \int_{\frac{b+\phi N^*-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b+\phi N^*}{\phi}} h\left(\frac{b+N^*\phi-x\phi}{\phi(1+r)w}\right) dx + \\
&\quad (1-\mu)I(b \geq \phi w) \int_{\frac{b-w\phi-\phi(1+r)w\bar{l}}{\phi}}^{\frac{b-w\phi}{\phi}} h\left(\frac{b-\phi(x+w)}{(1+r)w\phi}\right) dx
\end{aligned}$$

where all the integrals in this expression are less than or equal to one. This implies that $[.] \leq 1$. For this reason it can be shown that Blackwell's sufficient conditions for a contraction are satisfied for any finite $\bar{b}_0$.[35] Hence a unique stationary distribution $v(b)$ exists and is given by the fixed point of the mapping ($v(b) = T(v(b))$. From this result, we conclude that unique stationary distributions of bequests ($G_\infty(b)$) and wealth ($W_\infty(b)$) exist.

[35] See Pg. 54 of Stokey and Lucas (1989).

Moreover, because the mapping T is contracting, $G_\infty(b)$ is the asymptotic distribution of the sequence of bequest distributions $\{G_0, G_1, ...\}$ defined by (44) and (45) and the initial G_0. ■

Proof of Proposition 9. This proof follows from Lloyds-Ellis and Bernhardt (2000). I split the proof into 3 steps. In step 1 I show that if G_t first order stochastically dominates (FSD) G_{t-1}, then F_t FSD F_{t-1}. In step 2 I prove that if F_t FSD F_{t-1} then G_t FSD G_{t-1}. Finally in step 3 I show the result that Y_t^A converges monotonically toward $\bar{Y^A}$.

Step 1. $N = b + (1+r)wl_j$, $l_j \perp b$. Note that $F_t(N)$ can be written as

$$F_t(N) = \int_{-\infty}^{\bar{l}} \int_{-\infty}^{N-(1+r)wl} h(l) dG_t(b) dl$$

or

$$F_t(N) = \int_{-\infty}^{\bar{l}} h(l) G_t(N - (1+r)wl) dl$$

Thus,

$$F_t(N) - F_{t-1}(N) = \int_{-\infty}^{\bar{l}} h(l) \left[G_t(N - (1+r)wl) - G_{t-1}(N - (1+r)wl)\right] dl$$

Then, if G_t FSD G_{t-1} then F_t FSD F_{t-1}.

Step 2. See that

$$\begin{aligned} G_{t+1}(b) &= G_{t+1}(0) + \mu I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \int_0^{B^{E-1}(b)} e(N) dF_t(N) + \\ & \mu(1-e^*) \int_{N^*}^{\frac{b+\phi N^*}{\phi}} dF_t(N) + \\ (1-\mu) I(b &> \phi w) \int_0^{B^{W-1}(b)} dF_t(N) \end{aligned}$$

where $G_{t+1}(0) = \mu \int_0^{N^*} [1 - e(N)] dF_t(N)$. Now also see that

$$G_{t+1}(0) + \mu(1-e^*) \int_{N^*}^{\frac{b+\phi N^*}{\phi}} dF_t(N) = \mu \int_0^{\frac{b+\phi N^*}{\phi}} [1 - e(N)] dF_t(N)$$

Then

$$G_{t+1}(b) = \mu \int_0^{\frac{b+\phi N^*}{\phi}} [1-e(N)]\, dF_t(N) + \mu I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \int_0^{B^{E-1}(b)} e(N) dF_t(N) +$$
$$(1-\mu) I(b > \phi w) F_t(B^{W-1}(b)) \tag{59}$$

Let the first term be R_1. Then this expression can be written as

$$R_1 = I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) R_1 + I\left(b \leq \frac{\phi a e(0)^n}{(1+r)s}\right) R_1$$

Furthermore, it is important to note that $B^{E-1}(b) < \frac{b+\phi N^*}{\phi}$. With this, Equation 46 becomes

$$\begin{aligned} G_{t+1}(b) &= \mu I\left(b \leq \frac{\phi a e(0)^n}{(1+r)s}\right) \int_0^{\frac{b+\phi N^*}{\phi}} [1-e(N)]\, dF_t(N) + \\ & \mu I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \int_0^{B^{E-1}(b)} dF_t(N) + \\ & \mu I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \int_{B^{E-1}(b)}^{\frac{b+\phi N^*}{\phi}} [1-e(N)]\, dF_t(N) + \\ (1-\mu) I(b &> \phi w) F_t(B^{W-1}(b)) \end{aligned} \tag{60}$$

Since

$$\begin{aligned} \int_x^X [1-e(N)]\, dF_t(N) &= F_t(X)\,[1-e(X)] - F_t(x)\,[1-e(x)] + \\ & \int_x^X F_t(N) e'(N) dN \end{aligned}$$

then Expression (47), after some simplification over the second term becomes

$$\begin{aligned} G_{t+1}(b) &= \mu I\left(b \leq \frac{\phi a e(0)^n}{(1+r)s}\right) \left\{ \begin{array}{c} F_t\left(\frac{b+\phi N^*}{\phi}\right)\left[1 - e\left(\frac{b+\phi N^*}{\phi}\right)\right] + \\ + \int_0^{\frac{b+\phi N^*}{\phi}} F_t(N) e'(N) dN \end{array} \right\} + \\ & \mu I\left(b > \frac{\phi a e(0)^n}{(1+r)s}\right) \left\{ \begin{array}{c} F_t\left(\frac{b+\phi N^*}{\phi}\right)\left[1 - e\left(\frac{b+\phi N^*}{\phi}\right)\right] + \\ F_t\left(B^{E-1}(b)\right) e\left(B^{E-1}(b)\right) + \int_{B^{E-1}(b)}^{\frac{b+\phi N^*}{\phi}} F_t(N) e'(N) dN \end{array} \right\} + \\ (1-\mu) I(b &> \phi w) F_t(B^{W-1}(b)) \end{aligned} \tag{61}$$

Because $e'(N) > 0$, it is straightforward to show that if $F_t(N) \leq F_{t-1}(N)\ \forall N$ and strictly lower for some N then G_{t+1}FSD G_t.

Step 3. From steps 1 and 2 it should be clear that if for some period t, G_t FSD G_{t-1}, then $F_{t+\tau}(N)$ FSD $F_{t+\tau-1}(N)\ \forall \tau > 0$. Then by Theorem 1 or 2, we get that $Y^A_{t+\tau} > Y^A_{t+\tau-1} \forall \tau > 0$, which gives the monotonicity result. Finally, by Proposition 8, $\lim_{t\to\infty} F_t(N) = F_\infty(N)$ implies that $\lim_{t\to\infty} Y^A_t = \bar{Y}^A$. ■

Data Appendix

The data used in Table 1 was taken from UNIDO industrial statistics database (3 digit). Wage data are from the International Trade Administration (ITA), U.S. Department of Commerce, where they perform a careful estimation of the dollar value of wages per hour for different economies using wage data from the International Labor Statistics. Wages were adjusted with a PPP index constructed using the GDP in current international dollars and the GDP in current US dollars from the World Development Indicators (WDI) Database, World Bank. Value added in Manufacturing in current US dollars and GDP per capita in current US dollars, used to estimate wages when missing, were taken from the same source. The output in Table 4 was computed deflating wages to 1997 dollars using US CPI inflation in 1998 and 1999 from the St. Louis Fed. Trade data (at 3 digit level) was taken from the World Bank Trade and Production Database.

The financial variable was constructed using Bankscope, a Database of an unbalanced panel of 13200 banks from various countries going from 1995 to 2002 with financial information. The average failure rate was computed by weighting the Loan Loss to Gross Loans ratio with Total Loans for all banks in the same country.

Table 5 reports the list of countries in the expanded sample used in Table 4.

Countries in Sample by Year

Country	1997	1998	1999	Country	1997	1998	1999
ARGENTINA	X	X	X	KENYA	X	X	X
AUSTRALIA			X	KOREA, REPUBLIC OF	X	X	X
AUSTRIA	X	X	X	LATVIA	X	X	X
BANGLADESH			X	MACAU	X	X	X
ARMENIA			X	MALAWI	X	X	X
BOLIVIA	X	X	X	MALAYSIA	X	X	
BULGARIA	X	X	X	MEXICO	X	X	X
CANADA	X	X		MOLDOVA, REPUBLIC OF	X	X	X
CHILE	X	X	X	NEPAL	X	X	X
CHINA	X	X	X	NETHERLANDS	X	X	X
DENMARK	X	X	X	NORWAY			X
ECUADOR		X	X	PAKISTAN	X		
ETHIOPIA	X	X	X	PANAMA	X	X	X
FINLAND	X			PERU	X	X	X
FRANCE		X	X	PHILIPPINES	X	X	X
GERMANY	X	X	X	POLAND	X	X	X
GREECE	X	X	X	PORTUGAL	X	X	X
GUATEMALA	X	X	X	SINGAPORE	X	X	X
HONDURAS	X	X	X	SOUTH AFRICA	X	X	X
HONG KONG	X	X	X	SPAIN	X	X	X
HUNGARY	X	X	X	THAILAND	X	X	X
INDIA	X	X		TRINIDAD AND TOBAGO	X	X	X
INDONESIA		X	X	TURKEY	X	X	X
IRELAND	X	X		EGYPT	X	X	X
ITALY	X	X	X	UNITED STATES	X	X	X
JAPAN	X	X	X	URUGUAY	X	X	X
JORDAN	X	X	X	VENEZUELA	X	X	X

Table 5