

Financial Development and Production Structures

by

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Abstract:

In this paper, we develop a theoretical framework for, and conduct empirical tests of how, production structures are jointly determined by factor endowments and financial development. On the theoretical side, we introduce an external finance constraint into the GDP function and derive an estimable equation for how sectoral shares are influenced by endowments and finance. On the empirical side, we use data from 1980-2000 for 48 countries and 28 sectors. We show that finance arguably has a more significant impact on production structures than do factor endowments. Our ranking of the estimated output responsiveness of these industries to external finance is positively, but not significantly, correlated with the well known Rajan-Zingales (RZ) index of how dependent industries are on external finance at the aggregate level. This should not be surprising, as trade theory does not generally predict that input intensities are sufficient to explain output responsiveness. Thus policymakers should not rely on the RZ index to predict how actions designed to increase access to external finance will affect their economies.

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I. Introduction

In neoclassical general equilibrium trade models, production structures (as measured by shares of sectoral output in GDP) are determined by technology and factor endowments. Influential works include Leamer (1984), Maskus (1985), Bowen et al. (1987), Staiger (1988), and Davis and Weinstein (2001), which evaluate how factor endowments determine production structures and international trade, and Trefler (1993, 1995) and Harrigan (1997), which investigate how cross-country differences in both technology and factor endowments determine international specialization.

On the other hand, a growing empirical finance literature has investigated the role of finance in determining industrial growth. Pioneered by Rajan and Zingales (RZ, 1998) and followed by Beck and Levine (2002), Carlin and Mayer (2003), Claessens and Laeven (2003), Fishman and Love (2004), among many others, this literature demonstrates that in countries with more developed financial systems, industries more reliant on external finance are likely to grow faster relative to other industries.

In this paper we connect these two fields by introducing an external finance constraint into the standard GDP function used in neoclassical analysis, and examining how production structures are jointly determined by factor endowments, technology, and financial development. We show that the maximization problem of the GDP function with an external finance constraint is a concave programming problem under standard conditions and thus, the solution to its Kuhn-Tucker conditions gives a global maximum. We then propose an empirical model and estimate how production structures are determined by the level of financial development and factor supplies.²

² Our paper thus relates to the emerging literature on financial development and international trade. Kletzer and Bardhan (1987), Baldwin (1989), Beck (2002), Matsuyama (2005), Wynne (2005), Ju and Wei (2005, 2008), and Antras and Caballero (2009) study the role of finance in determining patterns of production and trade in theory. Beck (2003), Svaleryd and Vlachos (2005), Do and Levchenko (2007), and Manova (2008a, b) all use the RZ type of specification to test the effect of financial development on trade

Our theory shows that sectoral output shares in GDP are a function of factor endowments, and financial development. Using annual data from 1980-2000 from 48 countries and 28 manufacturing industries at 3-digit ISIC Rev. 2, we estimate an unbalanced panel equation for output share for each sector. We use a dynamic panel estimator and treat financial development and factor endowments as endogenous regressors. Our approach directly measures each industry's output response to financial development.

The empirical results indicate that financial development has a statistically significant effect on output share for about 30% of our sectors at the 0.05 level or better and 45% of them at the 0.10 level or better. Moreover, all the significant coefficients for financial development are positive. In contrast, aggregate physical capital, skilled labor and unskilled labor have significant effects for about 25%, 20% and 20% of the sectors respectively at the 0.10 level or better. The significant coefficients for factor endowments vary in sign. These results demonstrate the importance of incorporating finance into the study of production structures.

We also allow for heterogeneous effects of financial development and factor endowments across countries and find significant evidence of country heterogeneity in the data. We find that the effect of financial development on sectoral shares is significantly heterogeneous in 6 sectors, aggregate physical capital's effect is significantly heterogeneous in 5 sectors, skilled labor's in 10 sectors and unskilled labor's in 6 sectors. The significant coefficients for country heterogeneity vary in sign for financial development and the factor endowments.

patterns.

Our aggregate estimated effects of financial development on output shares and the RZ index of dependence on external finance are positively and significantly correlated. Given our allowance for country heterogeneity, we can also calculate the response of sectors to financial development for each country individually. The RZ index is positively correlated with our estimated effects of financial development on sectoral shares for each of the 48 countries in our sample. However, only 6 of these country specific correlations are significant at the 0.10 level or better.

The lack of strong correlation between our measures of output response and the RZ index of input intensity should not be surprising to students of international trade. Once the standard model is pushed beyond the two-good, two-factor case, the strong version of the Rybczynski theorem cannot be proved. In fact, Opp, Sonnenschein and Tombazos (2009) show that, even in the classical two goods, two factors, and two countries economy, if consumer preferences in each country favor the exported good, a “reverse Rybczynski” effect is possible.

Finally, we show that applying the RZ approach of constraining the output responses to be proportional to the input intensities does not produce significant results in our dynamic panel with endogenous regressors approach. Our work thus shows that while Rajan and Zingales were correct about the importance of finance for industry growth, the assumption that input intensity is sufficient to predict output elasticity is not empirically supported.

The rest of paper is organized as follows. In section II, we develop the theory of the GDP function with an external finance constraint. Section III derives the translog GDP function for our empirical estimation and describes the data. In section IV, we discuss basic estimation results. In section V, we compare our approach and the Rajan-Zingales approach (and some of its variants). Section VI concludes, while the appendix

gives the mathematical proof for the existence of the GDP maximization with the external finance constraint along with some extensions.

II. Theory

In this section, we present a GDP function with an external finance constraint, which serves as the basis of our empirical framework. We focus on the connection between physical capital and financial capital. In the classical GDP function, it is assumed that physical capital is freely mobile across sectors and therefore the marginal product of physical capital is equal to the interest rate in all sectors. When the capital market is imperfect, the above assumption no longer holds. As discussed in Holmstrom and Tirole (1997), Shleifer and Wolfenzon (2002), Stulz (2005), and specified by Ju and Wei (2008), the marginal product of physical capital is shared between investors, financial intermediaries, and entrepreneurs. Our external finance constraint therefore requires that the sum of revenues from internal and external financial capitals and from financial intermediaries is less than or equal to the revenue generated from the physical capital. We will first study the external finance constraint and then introduce it into the GDP function.

IIA. The External Finance Constraint

There are N sectors and M factors in the economy. Let the production function for a representative firm in sector i be $f_i(v_i, K_i)$, where $v_i = (v_{i1}, \dots, v_{iM-1})^T$ is the vector of inputs other than physical capital. We denote the M -th factor, $v_{iM} = K_i$, as physical capital and p_i as the product price. Let $f_i(\cdot)$ be constant returns to scale. The marginal product of physical capital is $p_i \frac{\partial f_i(v_i, K_i)}{\partial K_i}$, and the total revenue generated

by physical capital equals $p_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i$. Let A_i^N and A_i^X be the amounts of internal finance (internal financial capital owned by entrepreneurs) and external finance (external financial capital owned by outside investors), respectively. The external finance constraint is:

$$p_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i - q_i A_i^N - c A_i^X \geq r A_i^X. \quad (1)$$

Here q_i is the return to internal finance, c is the cost of financial intermediation, and r is the interest rate. The left hand side is the revenue received by outside investors from firm i , which equals total capital revenue minus payments to internal capital and the cost of intermediation. In order for investors to participate the project, the revenue received from the project must be no less than the opportunity cost, $r A_i^X$.

We define the industry's dependence on external finance as

$$\phi_i = \frac{A_i^X}{A_i^N + A_i^X}. \quad (2)$$

Rajan and Zingales (1998) assume ϕ_i to be identical for all countries. In contrast, ϕ_i in our model may vary across countries. Using (2) and noting that the equality holds in (1) in equilibrium, we have

$$\frac{p_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i - \mu_i A_i^X}{A_i^X} = r \quad (3)$$

where $\mu_i = \left(\frac{1}{\phi_i} - 1\right)q_i + c$.

Using (3), we can write the external finance constraints for N sectors as follows:

$$\frac{p_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i - \mu_i A_i^X}{A_i^X} = \frac{p_j \frac{\partial f_j(v_j, K_j)}{\partial K_j} K_j - \mu_j A_j^X}{A_j^X} \text{ for } i \neq j, \quad (4)$$

$$\sum_{i=1}^N A_i^X = A^X. \quad (5)$$

Here A^X is the supply of total external finance in the country. A^X represents the size of

the financial market and is used as a measure of the level of financial development. There are N equations in the system of (4) and (5), which gives a solution of A_i^X as the function of A^X , v_i , K_i , μ_i , and p_i .

IIB. GDP Function

With the assumption of perfect competition, the amounts produced in each industry will maximize gross domestic product (GDP) for the economy. That is, for given prices, $p = (p_1, \dots, p_N)$, the industry outputs of the competitive economy will be chosen to maximize GDP. The standard GDP maximization problem is constrained by endowments of resources. We extend the standard approach to include both resource constraints and the external finance constraint. Thus, the GDP function maximization problem with an external finance constraint is defined as

$$\begin{aligned} \max G &= \sum_{i=1}^N p_i f_i(v_i) \\ \text{subject to } \sum_{i=1}^N v_i &\leq V, \text{ (4) and (5).} \end{aligned} \tag{6}$$

Here $V = (V_1, \dots, V_{M-1}, V_M)$ is the vector of fixed factor endowments. In the Appendix we show that the above problem is a concave programming problem under standard conditions and thus, the solution to its first order conditions gives the global maximum value of GDP as a function of product prices, factor endowments, and the level of financial development. That is, $G = G(p, V, A^X)$.

Note that constraints (4) and (1) are equivalent in equilibrium. Let the Lagrange multiplier for (1) be λ_i . We assume that the elasticity of supply with respect to physical

capital is constant. That is, $\frac{\partial f_i(v_i, K_i) K_i}{\partial K_i} = \eta_i f_i(v_i, K_i)$. Using the envelope theorem, we have

$$\frac{\partial G(p, V, A^X)}{\partial p_i} = (1 + \lambda_i \eta_i) f_i(v_i) = (1 + \lambda_i \eta_i) x_i(p, V, A^X), \text{ for } i = 1, \dots, N \quad (7)$$

where $x_i(p, V, A^X)$ is the output supply. This result will be used in the next section for the derivation of sectoral output shares.

III. An Empirical Model and Data

In this section, based on the above GDP function with external finance constraints, we first develop an empirical model and then discuss issues involving a gradual adjustment to equilibrium and our estimation technique. We finally describe the data.

III.A. An Empirical Model

The GDP function $G(p, V, A^X)$ is the solution function for the maximization problem (6). There are three sets of exogenous variables; product prices $p = (p_1, \dots, p_N)$, factor endowments $V = (V_1, \dots, V_M)$, and the supply of total external finance A^X . While the general functional form of $G(p, V, A^X)$ is unknown, due to the work of Christensen, Jorgenson, and Lau (1973), we know that $G(p, V, A^X)$ can be approximated by a translog function of variables p , V , and A^X , which is a second-order Taylor approximation in logarithms to an arbitrary function.³ More formally, we assume that

³ Our paper also relates to the literature on the translog GDP function which was introduced by Diewert (1974), and later applied in international trade by Woodland (1982), Kohli (1991, 1993), Harrigan (1997), and Feenstra (2004), among others.

$$\begin{aligned}
\ln G(p, V, A^X) &= \alpha_0 + \sum_{i=1}^N \alpha_i \ln p_i + \sum_{k=1}^M \beta_k \ln V_k + \frac{1}{2} \sum_{i=1}^N \sum_{j=1}^N \alpha_{ij} \ln p_i \ln p_j \\
&+ \frac{1}{2} \sum_{k=1}^M \sum_{h=1}^M \beta_{kh} \ln V_k \ln V_h + \sum_{i=1}^N \sum_{k=1}^M \delta_{ik} \ln p_i \ln V_k \\
&+ \beta_X \ln A^X + \frac{1}{2} \sum_{k=1}^M \beta_{kX} \ln V_k \ln A^X + \frac{1}{2} \beta_{XX} (\ln A^X)^2 \\
&+ \sum_{i=1}^N \delta_{iX} \ln p_i \ln A^X.
\end{aligned} \tag{8}$$

Linear homogeneity of the GDP function in prices and factors implies that

$$\begin{aligned}
\sum_{i=1}^N \alpha_i &= 1, \text{ and } \sum_{i=1}^N \alpha_{ij} = \sum_{i=1}^N \delta_{ik} = 0, \\
\sum_{k=1}^M \beta_k + \beta_X &= 1, \text{ and } \sum_{k=1}^M \beta_{kh} + \beta_{kX} = \sum_{k=1}^M \delta_{ik} + \delta_{iX} = 0.
\end{aligned} \tag{9}$$

Differentiating equation (8) with respect to $\ln p_i$ we obtain

$$\frac{\partial \ln G(p, V, A^X)}{\partial \ln p_i} = \alpha_i + \sum_{j=1}^N \alpha_{ij} \ln p_j + \sum_{k=1}^M \delta_{ik} \ln V_k + \delta_{iX} \ln A^X. \tag{10}$$

Using equation (7), we obtain

$$\frac{\partial \ln G(p, V)}{\partial \ln p_i} = \frac{p_i \partial G(p, V)}{G \partial p_i} = (1 + \lambda_i \eta_i) S_i$$

where $S_i = p_i x_i / G$ is the share of sector i 's output in GDP. Thus equation (10) can be written as

$$S_i = \alpha_i + \sum_{j=1}^N \alpha_{ij} \ln p_j + \sum_{k=1}^M \delta_{ik} \ln V_k + \delta_{iX} \ln A^X. \tag{11}$$

We have abused notation a bit in (11) by using the same notation to represent the parameters in (10) divided by $(1 + \lambda_i \eta_i)$. Using the restriction $\sum_{k=1}^M \delta_{ik} + \delta_{iX} = 0$, equation

(11) can be further written as

$$S_i = \alpha_i + \sum_{j=1}^N \alpha_{ij} \ln p_j + \sum_{k=2}^M \delta_{ik} \ln \frac{V_k}{V_1} + \delta_{iX} \ln \frac{A^X}{V_1} . \quad (12)$$

The share of sector i in GDP is expressed in equation (12) as a function of product prices p_j , factor endowments V_k , and the level of financial development A^X . This relationship should hold across countries and over time. Thus, we add country subscript c and year subscript t to equation (12)

$$S_{ict} = \alpha_i + \sum_{j=1}^N \alpha_{ij} \ln p_{jct} + \sum_{k=2}^M \delta_{ik} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iX} \ln \frac{A_{ct}^X}{V_{1ct}} . \quad (13)$$

Because internationally comparable data on industry prices are not available, we follow Harrigan (1997) and assume that trade equalizes prices across countries at a point in time up to a mean-zero error term ε_{ict} and a country-specific mean. That is,

$\sum_{j=1}^N \alpha_{ij} \ln p_{jct} = d_{ic} + d_{it} + \varepsilon_{jct}$. Then equation (13) becomes⁴

$$S_{ict} = \alpha_i + d_{ic} + d_{it} + \sum_{k=2}^M \delta_{ik} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iX} \ln \frac{A_{ct}^X}{V_{1ct}} + \varepsilon_{ict} \quad (14)$$

Note that the parameters may vary across countries, as technology, institutions, and conditions in financial markets differ. To capture the parameter variation across countries, we assume that the country heterogeneity can be captured by a linear function of relative GDP per capita. That is,

$$\delta_{ik} \equiv \delta_{ik} + \delta_{ikY} \ln \frac{Y_c}{\bar{Y}}, \delta_{iXc} \equiv \delta_{iX} + \delta_{iXY} \ln \frac{Y_c}{\bar{Y}} \quad (15)$$

where Y_c is the average GDP per capita in country c over the sample period, and

$\bar{Y} = \frac{1}{C} \sum_c Y_c$ is the world average of GDP per capita. Therefore, equation (14) can be

written as

$$\begin{aligned}
S_{ict} = & \alpha_i + d_{ic} + d_{it} + \sum_{k=2}^M \delta_{ik} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iX} \ln \frac{A_{ct}^X}{V_{1ct}} \\
& + \sum_{k=2}^M \delta_{ikY} \ln \frac{Y_c}{Y} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iXY} \ln \frac{Y_c}{Y} \ln \frac{A_{ct}^X}{V_{1ct}} + \varepsilon_{ict}.
\end{aligned} \tag{16}$$

With this equation in hand, we now turn our attention to estimating the effects of financial development and factor endowments on production structures.

IIIB. Gradual Adjustment to Equilibrium and Estimation Technique

In equation (16) we assume that factors can be reallocated immediately in response to changes in prices and aggregate factor supplies. However, if the adjustment to equilibrium is slow in the short run, equation (16) should be modified by including lagged output shares:

$$\begin{aligned}
S_{ict} = & \gamma_i S_{ic,t-1} + \alpha_i + d_{ic} + d_{it} + \sum_{k=2}^M \delta_{ik} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iX} \ln \frac{A_{ct}^X}{V_{1ct}} \\
& + \sum_{k=2}^M \delta_{ikY} \ln \frac{Y_c}{Y} \ln \frac{V_{kct}}{V_{1ct}} + \delta_{iXY} \ln \frac{Y_c}{Y} \ln \frac{A_{ct}^X}{V_{1ct}} + \varepsilon_{ict}.
\end{aligned} \tag{17}$$

In this model, δ_{ik} and δ_{iX} represent the short-run effect of traditional endowments and financial development on specialization, respectively. The long-run effects of traditional endowments and financial development are given by $\delta_{ik} / (1 - \gamma_i)$ and $\delta_{iX} / (1 - \gamma_i)$, respectively.⁵

Another important statistical issue is that the aggregate factor supplies and

⁴ Note that it is straightforward to allow for Hicks-neutral technology differences across countries. In this case, the d_{ic} in equation (16) also control for the cross-country technology differences. See Harrigan and Zakrajsek (2000) for more details.

⁵ In the steady-state equilibrium, $S_{ict} = S_{ic,t-1}$. Thus, the long-run effect of financial development is $\delta_{iX} / (1 - \gamma_i)$.

external finance may be endogenous. The demand for external finance may be higher when countries move toward industries that are intensive in their use of external financing. That is, the pattern of specialization could determine the development of the financial system. This is the relative output channel in determining the size of financial market as studied in Ju and Wei (2008).

Do and Levchenko (2007) find strong evidence that trade patterns can shape the level of financial development. A similar argument can be made for traditional endowments. However, we expect that the endogeneity problem would be more severe for financial development because changes in the supply of external finance can occur faster than changes in the supply of physical capital and labor.

We thus estimate equation (17) using the Arellano-Bond dynamic panel estimator treating the supply of external finance and factor endowments as endogenous regressors. That is, we allow the supply of external finance and traditional endowments to be correlated with the contemporaneous error term. In this case, the right-hand side time-variant variables lagged by at least two years are used as instruments.

Our approach differs from existing studies that run cross-country regressions and address the endogeneity of external finance using the law of origin and other time-invariant measures of institutions (Rajan and Zingales, 1998; Beck and Levine, 2002). Note however that, because our specification includes country fixed effects, those time-invariant institutional variables are effectively controlled for. Furthermore, although Harrigan (1997) also estimates a dynamic model, he assumes that the aggregate factor supplies are exogenous.

IIIC. Data

Data on industry-level value added for 28 manufacturing industries (at the 3-digit ISIC Rev. 2) come from the United Nations Industrial Development Organization (UNIDO). GDP data come from the World Development Indicators. We measure the quantity of external finance as the sum of stock market capitalization and private credit by deposit money banks and other financial institutions, which are taken from Beck et al. (2000) who subsequently have updated the data to 2005. Physical capital stocks are constructed using the gross fixed capital formation series from the World Development Indicators and applying a 15-year double declining balance method (Leamer, 1984, pages 230-234). The initial year is 1963.

The data are deflated using domestic investment price indexes with PPP adjustments from the Penn World Tables 6.1. Endowments of skilled and unskilled labor come from the Barro-Lee database. Following Barro and Lee (2000), skilled workers are those who completed at least a secondary education and unskilled workers are all others. Land endowment data are taken from the World Development Indicators and are measured as arable land. Our sample covers 48 countries for the period 1980-2000. The choice of countries is dictated by the availability of data on the supply of external finance and industry-level value added. Table A.1 in the appendix lists the countries and industries included in sample.

IV. Main Results

Our main results are presented in Table 1. Each row of the table contains the result of estimating equation (17) above for a particular industry. The dependent variable is the share of industry value added in GDP. The supply of external finance, physical capital, skilled and unskilled labor is normalized by the supply of land.

Each column gives the estimated coefficient and t-statistic for the variable listed at the head of the column for each of the 28 industries. Sample size varies across the equations with 631 being the minimum sample size and 659 the maximum. Standard errors that are robust to heteroskedasticity and autocorrelation and clustered by country are used to construct t-statistics that are given in italics below the coefficients.

Column 1 shows that the estimated coefficients on lagged output range from 0.36 to 0.77 and are statistically significant for all industries, which indicates that the gradual adjustment in industrial production patterns should not be ignored.

We are particularly interested in the impact of financial development (i.e., an increase in the supply of external finance) on specialization. This is captured by the estimated coefficients on the supply of external finance and its interaction with the log of GDP per capita⁶ shown in columns 2 and 3. Since the log of GDP per capita is expressed relative to the sample average, the coefficient on the supply of external finance in column 2 measures the impact of financial development on specialization for a representative country with average per capita income.

As shown in column 2 of Table 1, an increase in the supply of external finance is estimated to raise the output shares of most manufacturing industries. In particular, financial development has statistically significant effects on the production of 9 (13) out of 28 manufacturing industries at the 0.05 (0.10) or better significance level. *All* of these statistically significant coefficients are positive. The specific industries that are significantly affected by finance are Food (311), Textiles (321), Leather (323), Footwear (324), Wood Products (331), Other Chemicals (352), Pottery (361), Non-metal Products (369), Iron & Steel (371), Electric Machinery (383), Transportation Equipment (384),

⁶The log of GDP per capita is an average over the sample period for each country. The results change little when the log of GDP per capita in 1990 (the middle year of the sample period) is used.

Professional Goods (385), and Other Industries (390).⁷

Column 3 presents our results testing for country heterogeneity in the effect of external finance on sectoral shares. Overall the sign patterns are mixed, with 10 positive and 18 negative coefficients. Six industries show significant country heterogeneity with respect to the effect of finance. In three cases, Food (311), Textiles (321), and Leather (323), the direct effect of finance is positive and significant but the interaction term of finance and per-capita GDP is negative and significant. In these industries, as countries become wealthier relative to the sample average, the effect of external finance on sectoral share falls. In one case, Other Industries (390), both the direct effect of finance and the interaction term are positive and significant. In this sector, as countries become wealthier the effect of the supply of external finance on the sector's share in national GDP becomes greater. Finally there are two cases, Petroleum (353) and Rubber (355) where the direct effect of external finance is negative and insignificant while the interaction term with per-capita GDP is negative and significant. Here, as countries become wealthier relative to the mean, increased external finance lowers the sectoral shares of these two industries. In sum, 15 of the 28 manufacturing industries have at least one significant coefficient with respect to the availability of external finance.

Columns 4 – 9 of Table 1 present the analogous results for our factor endowments, physical capital, skilled labor, and unskilled labor. The coefficients on the supply of endowments represent the Rybczynski effects for a representative country with the sample average per capita income.

For the case of physical capital, 7 industries show significant Rybczynski effects.

⁷ Interestingly, many of these industries (e.g., Food, Textiles, Leather, Footwear, Pottery, Non-metal Products, Iron & Steel) have a relatively low Rajan-Zingales index of dependence on external finance. The relationship between our estimate of the sectoral output response to external finance and the Rajan-Zingales index will be detailed in the next section.

Except for Plastic Products, physical capital has negative Rybczynski effects for the other 6 industries most of which are labor intensive. Either skilled or unskilled labor has significant Rybczynski effects only for 5 industries. Their effects are mixed. These results are largely consistent with Harrigan (1997) who finds weak Rybczynski effects of physical capital and labor when estimating a dynamic model of sectoral output shares. On the other hand, columns 7 and 9 show that there exists substantial country heterogeneity in the response of sectoral shares to the supply of skilled and unskilled labor.

The coefficients we have been discussing so far are the short-run effects of factor supplies and external finance on sectoral shares. In our dynamic model, the long run effect can also be calculated. As the long-run effect of financial development is calculated by $\delta_{ix} / (1 - \gamma_i)$, it is larger than the short-run effect for all industries.

The magnitude of the estimated effects is large in some cases. For example, for the transportation equipment industry and food industry, the estimated coefficients on the supply of external finance are 0.115 and 0.086, which suggests that a 10% increase in the supply of external finance raises the industry output share in GDP by 1.15 and 0.86 percentage points, respectively. For comparison, in 1990 the share of transportation equipment and food in GDP was 1.3%, and 2.3%, respectively.

To summarize, Table 1 reveals that external finance is an important factor determining production structures of more than half of our manufacturing industries. In fact, finance has perhaps a more significant influence on production structures than do factor endowments. In addition, for many industries there exists substantial country heterogeneity in the impact of external finance and factor supplies on specialization.

Based on the translog GDP function and our estimated parameters, it is straightforward to derive the Rybczynski elasticity of external finance, i.e., the percentage change in sectoral output in response to a percentage increase in the supply of

external finance. This analysis is presented in the appendix.

V. Comparison to the Rajan-Zingales Approach

In this section we compare the results from our approach of directly estimating the effects of external finance on industry shares to the Rajan-Zingales (RZ) approach of constraining the differences across industries to be proportional to a pre-calculated index of dependence on external finance. We do this by first comparing our ranking of industry responses to their ranking of dependence on external finance and second by estimating a model using our data and technique that imposes the constraint implied by the RZ approach.

A. Sectoral output responses to external finance

As noted, we can use our results to make predictions for the sectoral output response to financial development. In the RZ type of specification, the effect of financial development on industrial output is captured by the industry's dependence on external finance, ϕ_i . For example, the RZ index of external finance dependence as updated by Do and Levchenko (2007, Table 1) is 0.6 for the Machinery industry and 0.08 for the Beverage industry. Thus the RZ specification implies that for a given percentage increase in the supply of external finance, the increase in the output share of Machinery should be $0.6/0.08 = 7.5$ times as large as that of Beverages for all countries.

In contrast, our specification allows us to directly estimate the response of sectors to increases in external finance and also account for country heterogeneity in the sectoral output responses to financial development. Specifically, the impact of financial development on industry i 's output share in country c can be estimated as

$$\delta_{iX} + \delta_{iXY} \ln(Y_c / \bar{Y}) .$$

Using this, we can create a ranking of which sectors are most responsive to increases in external finance specific to each country in our sample. In Table 2 we report the results from constructing these rankings and calculating the rank correlation between them and the RZ index of dependence on external finance.

The first row of Table 2 is labeled “World Average” and it is the result obtained from using our estimated sectoral response coefficients and assuming a representative country with the sample average level of per capita income. The rank correlation between the world average sectoral output responsiveness to financial development (δ_{iX}) and the RZ index is 0.33 which is not significant at the 0.05 level and barely so at the 0.10 level.

The subsequent rows report rank correlations between our country specific sectoral responsiveness to external finance and the RZ index. All of them are positive, but no countries have correlations that are significant at the 0.05 level. We do note that the countries whose estimated sectoral responses best match the predictions made by the RZ index are all middle income countries.

This is an important contribution of our paper. The directly estimated sectoral output responses to increased external finance vary across countries and are not generally strongly correlated with the RZ index that is so widely used in the literature. Of course there is no theoretical reason to believe that a ranking of how dependent industries are on external finance should be perfectly correlated with how industries actually respond to increases in the supply of external finance.

As the theory of international trade illustrates, the sectoral factor intensity and the sectoral output responses to changes in factor endowments can be very different in

models with more than two goods or more than two factors of production.⁸ When the number of sectors is greater than the number of factors like the case considered in this paper, in general the Rybczynski theorem no longer holds. Further, Opp, Sonnenschein and Tombazos (2009) recently show that even in the classical two goods, two factors, and two countries economy, if preferences in each country favor the exported good, a reverse Rybczynski theorem may hold. That is to say, an increase in the endowment of a factor of production can lead to an absolute decrease in the production of the commodity using that factor intensively.

This distinction is important for policy. Since input intensities are not sufficient to predict output elasticities, policymakers should not rely on the RZ index to predict how actions designed to increase access to external finance will affect the economy.

B. An Rajan-Zingales style regression model

As we have noted, existing empirical studies on the relationship between financial development and specialization have largely adopted the RZ specification which pools countries and industries (e.g., Beck, 2002; Beck and Levine, 2002; Carlin and Mayer, 2003; Claessens and Laeven, 2003; Fishman and Love, 2004; Svaleryd and Vlachos, 2005; Do and Levchenko, 2007; Manova, 2008a, b). The key explanatory variable in these specifications is the interaction between the industry-specific dependence on external finance and the country-specific financial development. A positive coefficient on the interaction term indicates that financially developed countries have a comparative advantage in industries that depend more on external funds. Rajan and Zingales (1998) use US firm data to construct their measure of dependence on external finance.

⁸ Readers are guided to Chapter 3 in Jones and Kenen (1984) and Chapter 3 in Feenstra (2004) for more discussion.

We extend the Rajan-Zingales specification by including traditional factor endowments. Specifically, we estimate the following equation:

$$S_{ict} = \xi S_{ic,t-1} + a_i + d_c + d_t + \beta_x \left(\phi_i \cdot \ln \frac{A_{ct}^x}{V_{1ct}} \right) + \sum_{k=2}^M \beta_k \left(\omega_{ik} \cdot \ln \frac{V_{kct}}{V_{1ct}} \right) + \mu_{ict} \quad (18)$$

where a_i , d_c , and d_t are dummy variables for industry, country, and time; ϕ_i is the Rajan-Zingales index of industry i 's dependence on external finance; ω_{ik} is factor k 's intensity in industry i , and μ_{ict} is the error term. Industry factor intensities (i.e., industry-level shares of skilled labor, unskilled labor, and industry-level capital-labor ratios) are calculated using the NBER-CES Manufacturing Industry Database for US manufacturing industries. The share of skilled labor is defined as the share of non-production workers, and the share of unskilled labor is the share of production workers.

Because the modified specification pools data over years and adds controls for country, industry and year fixed effects, the identification exploits a combination of within-country over time variation in factor supplies and cross-industry variation in factor intensities. Manova (2008a) adopts a similar specification to examine the effect of equity market openness on exports.

As before, we allow for dynamic adjustment of output shares to changes in factor supplies and treat the right hand side variables in the model as endogenous regressors by using an Arellano-Bond estimator which takes first differences of the original estimating equation to remove the fixed effects and uses the levels of lagged factor supplies as instruments for the differenced factor supplies. Standard errors are robust to heteroskedasticity and autocorrelation and are clustered by country.

The results are shown in Table 3. The main finding is that neither increased factor supplies nor external finance have any significant effect on output shares when the

differential response across sectors is forced to be proportional to the differences in factor intensities across sectors and the factor supplies are treated as endogenous.

Note that this is the same estimation technique and set of instruments that produced a lot of significant results when we directly estimated the effect of increased factor supplies or increased availability of external finance industry by industry. Yet, when we force the differences in response across industries to be proportional to the differences in factor intensities, we do not find any significant results. Thus, in a dynamic panel setting including traditional factors of production, and treating factor endowments and finance as endogenous, we cannot confirm the Rajan-Zingales result.⁹

VI. Robustness Check with an expanded sample

The panel regressions in Table 1 average around 650 observations each and the RZ type panel regression in Table 3 contains a little over 14,000 observations. The main constraint on sample size we face is that the current version of the World Bank data set only gives stock market capitalization data for several of our countries beginning in 1989 (see Table A1 for details). However, earlier versions of this data base did have earlier information on stock market capitalization and one of us had this earlier data on file from a previous project. We contacted the World Bank researchers who created the database and they told us that splicing the old data with the new was acceptable.¹⁰

⁹ When we estimate our RZ style equation using a static panel with exogenous regressors, we do get the RZ result. These findings are not reported in the paper but are available from the authors on request.

¹⁰ This is based on the private communication with Thorsten Beck and Ed Al-Hussainy. The earlier stock market capitalization data that we employ is available from us on request. We were told that the older data would be put back into the next update of the World Bank dataset on Finance.

When we do this, our sample size expands greatly, as shown in appendix table A2. We gain additional observations for many of the rich countries in our sample and also can add 6 additional countries, for a total of 54. Table 4 reports the results from re-estimating the equations in Table 1 on the new sample. Now the individual panel regressions average close to 900 observations each.

Overall, our results are quite robust to this expansion of the sample. Finance is still more often significant than the traditional factors of production and we still observe a lot of significant country heterogeneity as shown by the number of significant interaction terms in the equations. We do see some changes in which industries are affected by increases in the supply of external finance. Specifically, Non-metal Products and Transportation Equipment lose significance, while Furniture, Petroleum Refineries, Rubber Products, Glass, and Metal Products are now estimated to have significant output responses with respect to the supply of external finance.

Table 5 contains our update of Table 3 using the expanded sample. Here we find, as before, that constraining differences in output responses across industries to be perfectly correlated with the differences in input intensities fails to produce significant results.¹¹

In sum, making use of the earlier World Bank data to expand the sample reinforces and even strengthens the results reported earlier in the paper.

VII. Conclusion

This paper adds an external finance constraint to the standard GDP function maximization problem and derives an estimating equation where sectoral shares of output

¹¹ When we re-calculate the correlations of our estimated output elasticities and the RZ index using the results from Table 4, the correlations are even weaker than those reported in Table 2 of the paper.

are functions of the availability of external finance and of traditional factor supplies.

When we estimate this model for 28 manufacturing industries across 48 countries using annual data from 1980 – 2000, we find that the supply of external finance is at least as important as the supply of traditional factors in determining patterns of specialization.

We then create a ranking of how responsive industries are to an increased supply of external finance and compare that ranking to Rajan and Zingales' ranking of how dependent industries are on external finance. This is a very relevant comparison because many papers adopt an estimating equation that forces industry differences in response to external finance to be perfectly correlated with the RZ index of external finance dependence. We find a positive but not significant correlation between our directly estimated ranking of industry responsiveness and the RZ index.

The paper makes two contributions, each in a different literature. For the trade literature on how factor endowments shape production structures, we show a way to incorporate external finance into the GDP function approach and show that external finance is at least as important as traditional factors in determining production structures. For the finance and growth literature, we show that while RZ were certainly correct that finance is important for growth, it is not automatically the case that the industries most dependent on external finance will have the greatest output response to increases in the supply of external finance.

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Appendices

Appendix I

In this appendix, we show that the GDP maximization problem (6) is a concave programming under standard conditions. Using (3), we rewrite the constraint (1) as

$$\theta_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i \geq A_i^X, \quad (19)$$

where $\theta_i = \frac{p_i}{\mu_i + r}$. Thus, combining constraints (1) and (5), we have

$$\sum_{i=1}^N \theta_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i \geq A^X. \quad (20)$$

The GDP maximization problem now is written as

$$\max_{v_i} G = \sum_{i=1}^N p_i f_i(v_i) \quad (21)$$

subject to

$$\sum_{i=1}^N v_i \leq V \quad (22)$$

$$A^X - \sum_{i=1}^N \theta_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i \leq 0. \quad (23)$$

Let $v_i = (v_{i1}, \dots, v_{iM})^T$ where v_{ij} is the usage of factor j in sector i . Assume that $f_i(v_i)$ is differentiable and concave in v_{ij} . Thus, the objective function $G = \sum_{i=1}^N p_i f_i(v_i)$ is

differentiable and concave in v_{ij} . The constraints in (22) are differentiable and convex since they are linear functions. We assume that $A^X - \sum_{i=1}^N \theta_i \frac{\partial f_i(v_i, K_i)}{\partial K_i} K_i$ is convex in v_{ij} and

K_i as $f_i(v_i)$ is a concave function. Therefore, all constraints are differentiable and convex so that the GDP maximization problem is a concave programming. Using the Kuhn-Tucker sufficiency theorem, the solution to the first order conditions of the problem then gives a global maximum.

Appendix II

In this Appendix, we derive the Rybczynski elasticity of external finance. Using the envelope theorem, we have

$$\frac{\partial G(p, V, A^x)}{\partial A^x} = \lambda^x, \quad (26)$$

where λ^x is the Lagrange multiplier for constraint (5), and it is the shadow price of external finance. We assume that λ^x is equal to the interest rate r . Note that the sectoral output is $x_i = S_i G / p_i$. Differentiating x_i with respect to the supply of external finance A^x , we obtain

$$\begin{aligned} \frac{\partial x_i}{\partial A^x} &= \frac{\partial S_i}{\partial A^x} \frac{G}{p_i} + \frac{S_i}{p_i} \frac{\partial G}{\partial A^x} = \frac{(\delta_{ix} + \delta_{ixY} \ln \frac{Y_c}{Y})}{A^x} \frac{G}{p_i} + \frac{r S_i}{p_i} \\ &= \left(\delta_{ix} + \delta_{ixY} \ln \frac{Y_c}{Y} + \frac{S_i r A^x}{G} \right) \frac{G}{A^x p_i} = \left(\delta_{ix} + \delta_{ixY} \ln \frac{Y_c}{Y} + S_i S_x \right) \frac{G}{A^x p_i}. \end{aligned}$$

Therefore, the Rybczynski elasticity of external finance (REEF) is

$$\eta_{xict} \equiv \frac{\partial x_i}{\partial A^x} \frac{A^x}{x_i} = \frac{\delta_{ix} + \delta_{ixY} \ln \frac{Y_c}{Y} + S_{ict} S_{xct}}{S_{ict}} = S_{xct} + \frac{\delta_{ix} + \delta_{ixY} \ln \frac{Y_c}{Y}}{S_{ict}}. \quad (27)$$

A country with a higher $REEF_i$ is more likely to specialize in sector i as the country increases the supply of external finance. Furthermore, $REEF_i$ also indicates the degree of political support from sector i for financial development in the country. A higher $REEF_i$ represents a larger expansion of sector i than other sectors through financial development, which usually brings stronger political support for financial development. We calculated the Rybczynski elasticity of external finance based on our estimated parameters reported in Table 1. The results are available upon request.

Table A.1. List of Countries and Industries

Country	Years Included	ISIC	Industry Name
Argentina	1988-2000	311	Food products
Australia	1989-2000	313	Beverages
Austria	1989-2000	314	Tobacco
Belgium	1989-2000	321	Textile
Bolivia	1995-1999	322	Apparel
Canada	1989-2000	323	Leather
Chile	1980-2000	324	Footwear
Cameroon	1980-2000	331	Wood products
Colombia	1980-2000	332	Furniture
Germany	1992-2000	341	Paper and products
Denmark	1989-2000	342	Printing and publishing
Ecuador	1993-2000	351	Chemicals
Egypt	1989-2000	352	Other chemicals
Spain	1989-2000	353	Petroleum refineries
Finland	1989-2000	354	Petroleum and coal products
France	1989-2000	355	Rubber products
United Kingdom	1989-2000	356	Plastic products
Greece	1980-2000	361	Pottery
Hong Kong	1991-2000	362	Glass
Hungary	1992-2000	369	Nonmetal products
Indonesia	1981-2000	371	Iron and steel
India	1980-2000	372	Nonferrous metal
Iran	1993-2000	381	Metal products
Italy	1989-2000	382	Machinery
Japan	1989-2000	383	Electric machinery
Kenya	1989-2000	384	Transportation equipment
Korea	1980-2000	385	Professional goods
Sri Lanka	1986-2000	390	Other industries
Mexico	1980-2000		
Malaysia	1980-2000		
Netherlands	1989-2000		
Norway	1989-2000		
New Zealand	1989-2000		
Pakistan	1980-2000		
Panama	1993-2000		
Peru	1989-2000		
Philippines	1980-2000		
Poland	1992-2000		
Portugal	1980-2000		
Singapore	1989-2000		
Sweden	1989-2000		
Thailand	1980-2000		
Tunisia	1991-2000		
Uruguay	1994-1999		
United States	1989-2000		
Venezuela	1981-2000		
South Africa	1989-2000		
Zimbabwe	1980-2000		

Table A.2. List of Countries in the Expanded Sample

Country	Years	Country	Years
Argentina	1980-2000	Italy	1980-2000
Australia	1980-2000	Japan	1980-2000
Austria	1980-2000	Kenya	1987-2000
Belgium	1980-2000	Korea	1980-2000
Bangladesh	1994-2000	Sri Lanka	1986-2000
Bolivia	1995-2000	Mexico	1980-2000
Canada	1980-2000	Malaysia	1980-2000
Chile	1980-2000	Netherlands	1980-2000
Cameroon	1980-2000	Norway	1981-2000
Colombia	1980-2000	New Zealand	1985-2000
Costa Rica	1984-2000	Pakistan	1980-2000
Germany	1991-2000	Panama	1993-2000
Denmark	1980-2000	Peru	1981-2000
Ecuador	1993-2000	Philippines	1980-2000
Egypt	1981-2000	Poland	1992-2000
Spain	1980-2000	Portugal	1980-2000
Finland	1983-2000	Singapore	1981-2000
France	1980-2000	El Salvador	1997-2000
United Kingdom	1980-2000	Sweden	1980-2000
Greece	1980-2000	Thailand	1980-2000
Guatemala	1996-2000	Tunisia	1988-2000
Hong Kong	1991-2000	Uruguay	1981-2000
Hungary	1992-2000	United States	1980-2000
Indonesia	1981-2000	Venezuela	1980-2000
India	1980-2000	South Africa	1980-2000
Ireland	1995-1999	Zambia	1996-2000
Iran	1993-2000	Zimbabwe	1980-2000

Table 1: Arellano-Bond Estimates of Dynamic Panel Models with Endogenous Endowments

ISIC	Lagged Share	Finance	GDPC* Finance	Capital	GDPC* Capital	Skilled	GDPC* Skilled	Unskilled	GDPC* Unskilled	Obs	χ^2	AR1 p val.	AR2 p val.
311	0.510 <i>5.937</i>	0.086 <i>2.142</i>	-0.122 <i>-2.203</i>	-0.223 <i>-1.225</i>	-0.012 <i>-0.079</i>	0.206 <i>0.838</i>	-0.031 <i>-0.191</i>	0.052 <i>0.190</i>	0.174 <i>0.745</i>	640	699	0.00	0.45
313	0.567 <i>7.856</i>	-0.014 <i>-0.435</i>	-0.027 <i>-0.636</i>	0.007 <i>0.057</i>	-0.057 <i>-0.738</i>	0.151 <i>1.362</i>	0.063 <i>0.667</i>	0.013 <i>0.105</i>	0.154 <i>1.356</i>	655	6727	0.01	0.34
314	0.498 <i>6.117</i>	-0.030 <i>-1.352</i>	0.011 <i>0.349</i>	-0.076 <i>-1.058</i>	-0.096 <i>-1.828</i>	-0.023 <i>-0.360</i>	0.107 <i>1.688</i>	0.047 <i>0.235</i>	0.161 <i>2.867</i>	636	34186	0.02	0.39
321	0.602 <i>6.807</i>	0.046 <i>1.651</i>	-0.091 <i>-2.301</i>	-0.366 <i>-2.217</i>	0.075 <i>1.172</i>	0.519 <i>2.498</i>	-0.124 <i>-1.769</i>	0.113 <i>0.598</i>	-0.007 <i>-0.086</i>	660	952	0.05	0.51
322	0.659 <i>9.883</i>	-0.006 <i>-0.370</i>	0.005 <i>0.235</i>	-0.053 <i>-1.110</i>	-0.110 <i>-2.210</i>	0.025 <i>0.340</i>	0.039 <i>0.898</i>	0.002 <i>0.013</i>	0.192 <i>2.584</i>	659	6894	0.02	0.87
323	0.601 <i>8.074</i>	0.006 <i>4.409</i>	-0.004 <i>-1.657</i>	-0.033 <i>-3.565</i>	0.000 <i>-0.050</i>	0.005 <i>0.641</i>	-0.002 <i>-0.358</i>	0.029 <i>2.537</i>	0.009 <i>1.270</i>	638	6782	0.00	0.66
324	0.475 <i>9.297</i>	0.007 <i>1.746</i>	0.004 <i>0.616</i>	-0.029 <i>-2.248</i>	0.001 <i>0.070</i>	0.033 <i>1.153</i>	-0.032 <i>-2.060</i>	-0.018 <i>-0.839</i>	-0.007 <i>-0.486</i>	650	3782	0.00	0.57
331	0.569 <i>7.049</i>	0.024 <i>3.485</i>	-0.010 <i>-0.788</i>	-0.094 <i>-2.517</i>	-0.017 <i>-0.626</i>	0.125 <i>2.407</i>	0.046 <i>1.497</i>	0.072 <i>1.588</i>	0.050 <i>1.081</i>	645	4899	0.00	0.56
332	0.636 <i>13.975</i>	0.007 <i>1.144</i>	0.001 <i>0.109</i>	-0.005 <i>-0.165</i>	-0.006 <i>-0.440</i>	0.006 <i>0.369</i>	-0.008 <i>-0.504</i>	-0.079 <i>-1.646</i>	0.010 <i>0.435</i>	645	8251	0.00	0.02
341	0.404 <i>5.990</i>	-0.005 <i>-0.272</i>	0.020 <i>1.264</i>	-0.035 <i>-0.462</i>	-0.066 <i>-2.090</i>	0.029 <i>0.665</i>	0.045 <i>1.943</i>	-0.106 <i>-1.117</i>	0.089 <i>1.877</i>	643	1457	0.00	0.11

Table 1 (cont).

342	0.510 <i>8.124</i>	0.011 <i>1.108</i>	-0.009 <i>-1.054</i>	-0.028 <i>-0.953</i>	-0.015 <i>-0.674</i>	0.068 <i>1.413</i>	0.002 <i>0.094</i>	-0.032 <i>-0.746</i>	0.035 <i>0.973</i>	638	650	0.00	0.37
351	0.460 <i>4.068</i>	-0.035 <i>-1.241</i>	-0.017 <i>-0.457</i>	0.104 <i>0.970</i>	-0.097 <i>-1.497</i>	0.108 <i>1.326</i>	0.085 <i>1.897</i>	0.178 <i>1.544</i>	0.182 <i>2.167</i>	639	358	0.01	0.82
352	0.546 <i>8.322</i>	0.047 <i>1.998</i>	-0.004 <i>-0.082</i>	-0.113 <i>-1.536</i>	-0.029 <i>-0.406</i>	-0.038 <i>-0.437</i>	0.071 <i>0.661</i>	0.183 <i>1.351</i>	0.059 <i>0.647</i>	645	1461	0.00	0.61
353	0.399 <i>5.420</i>	-0.024 <i>-0.558</i>	-0.137 <i>-2.376</i>	-0.009 <i>-0.045</i>	0.173 <i>1.760</i>	-0.151 <i>-1.097</i>	-0.187 <i>-1.215</i>	0.124 <i>0.458</i>	-0.120 <i>-0.935</i>	635	363	0.00	0.20
354	0.536 <i>2.705</i>	-0.003 <i>-0.496</i>	-0.019 <i>-1.234</i>	-0.005 <i>-0.226</i>	0.029 <i>1.243</i>	-0.031 <i>-1.304</i>	-0.052 <i>-1.775</i>	-0.056 <i>-1.541</i>	-0.030 <i>-1.091</i>	655	3671	0.16	0.53
355	0.431 <i>8.070</i>	-0.010 <i>-1.396</i>	-0.021 <i>-2.400</i>	0.041 <i>1.123</i>	0.016 <i>0.603</i>	0.013 <i>0.481</i>	-0.053 <i>-1.734</i>	-0.118 <i>-1.613</i>	-0.018 <i>-0.613</i>	642	5999	0.03	0.07
356	0.537 <i>8.310</i>	-0.004 <i>-0.475</i>	-0.003 <i>-0.315</i>	0.064 <i>2.152</i>	0.010 <i>0.760</i>	-0.024 <i>-0.730</i>	-0.008 <i>-0.353</i>	-0.059 <i>-0.830</i>	0.011 <i>0.414</i>	645	1804	0.00	0.68
361	0.519 <i>8.133</i>	0.006 <i>2.993</i>	0.004 <i>1.062</i>	-0.025 <i>-2.342</i>	-0.007 <i>-1.067</i>	-0.007 <i>-0.664</i>	0.007 <i>1.289</i>	0.030 <i>1.578</i>	0.006 <i>0.646</i>	646	1101	0.00	0.25
362	0.368 <i>3.360</i>	0.008 <i>1.409</i>	-0.006 <i>-1.490</i>	-0.021 <i>-1.440</i>	-0.002 <i>-0.284</i>	0.024 <i>2.056</i>	0.030 <i>3.286</i>	0.057 <i>2.186</i>	0.020 <i>1.673</i>	645	697	0.00	0.09
369	0.472 <i>7.418</i>	0.044 <i>2.227</i>	-0.002 <i>-0.109</i>	-0.093 <i>-1.502</i>	-0.026 <i>-0.701</i>	-0.057 <i>-0.783</i>	0.055 <i>1.133</i>	0.058 <i>0.592</i>	0.053 <i>1.099</i>	657	691	0.00	0.11
371	0.361 <i>7.169</i>	0.076 <i>2.487</i>	0.008 <i>0.240</i>	-0.347 <i>-3.151</i>	-0.094 <i>-1.257</i>	0.004 <i>0.028</i>	0.063 <i>1.053</i>	0.370 <i>2.498</i>	0.203 <i>2.062</i>	652	1854	0.00	0.19

Table 1 (cont).

372	0.363 <i>4.137</i>	-0.008 <i>-0.642</i>	-0.019 <i>-1.076</i>	-0.053 <i>-0.751</i>	0.015 <i>0.329</i>	-0.015 <i>-0.262</i>	-0.046 <i>-0.857</i>	-0.022 <i>-0.228</i>	0.012 <i>0.178</i>	657	1579	0.02	0.06
381	0.533 <i>7.157</i>	0.020 <i>1.065</i>	-0.001 <i>-0.023</i>	0.058 <i>0.838</i>	0.098 <i>2.286</i>	-0.160 <i>-1.914</i>	-0.165 <i>-2.137</i>	-0.228 <i>-1.776</i>	-0.156 <i>-2.674</i>	641	1547	0.00	0.17
382	0.593 <i>8.140</i>	0.013 <i>0.655</i>	-0.015 <i>-0.793</i>	-0.074 <i>-0.571</i>	0.091 <i>1.442</i>	0.174 <i>1.264</i>	-0.013 <i>-0.249</i>	-0.086 <i>-0.429</i>	-0.067 <i>-0.911</i>	655	466	0.00	0.83
383	0.775 <i>12.172</i>	0.041 <i>1.658</i>	-0.033 <i>-1.088</i>	0.040 <i>0.296</i>	0.044 <i>0.954</i>	0.024 <i>0.232</i>	-0.074 <i>-1.020</i>	-0.272 <i>-1.029</i>	-0.056 <i>-0.641</i>	652	17759	0.00	0.88
384	0.449 <i>5.912</i>	0.115 <i>2.657</i>	0.010 <i>0.293</i>	-0.149 <i>-1.576</i>	0.032 <i>0.672</i>	0.058 <i>0.589</i>	0.059 <i>1.040</i>	0.089 <i>0.584</i>	-0.012 <i>-0.170</i>	631	1399	0.00	0.22
385	0.418 <i>5.934</i>	0.008 <i>2.699</i>	0.000 <i>0.059</i>	-0.004 <i>-0.231</i>	-0.006 <i>-0.889</i>	0.001 <i>0.052</i>	0.017 <i>2.007</i>	0.001 <i>0.023</i>	0.011 <i>0.938</i>	648	570	0.00	0.36
390	0.406 <i>6.359</i>	0.006 <i>1.742</i>	0.012 <i>2.163</i>	-0.022 <i>-1.138</i>	-0.007 <i>-0.882</i>	-0.058 <i>-3.145</i>	-0.018 <i>-1.474</i>	-0.045 <i>-1.334</i>	0.000 <i>0.032</i>	654	1532	0.00	0.48

Each row reports a dynamic unbalanced panel estimation of equation (17) in the text. The dependent variable is the sectoral output share of GDP. Each estimation contains country and time fixed effects which are not reported here to save space. Lagged share is the lagged dependent variable. Finance, capital, skilled, and unskilled are all expressed in natural logs. GDPC represents the logarithm of GDP per capita relative to the sample average. Numbers in italics are t -statistics based on autocorrelation and heteroskedasticity robust standard errors that are clustered by country. We use lagged variables from time $t-2$ and earlier as instruments for the factor endowments, finance and their interaction with the log of GDP per capita.

Table 2: Spearman (Rank) Correlations Between the External Finance Effects and RZ Index

Country	Correlation	p value	Country	Correlation	p value
World					
Avg	0.33	0.08	ITA	0.27	0.19
USA	0.12	0.56	JPN	0.19	0.34
ARG	0.31	0.11	KEN	0.17	0.37
AUS	0.18	0.35	KOR	0.34	0.08
AUT	0.20	0.33	LKA	0.18	0.35
BEL	0.20	0.32	MEX	0.32	0.10
BOL	0.08	0.70	MYS	0.37	0.05
CAN	0.20	0.33	NLD	0.20	0.32
CHL	0.32	0.10	NOR	0.19	0.33
CMR	0.18	0.39	NZL	0.25	0.21
COL	0.22	0.27	PAK	0.17	0.40
DEU	0.20	0.32	PAN	0.24	0.22
DNK	0.19	0.33	PER	0.17	0.40
ECU	0.16	0.44	PHL	0.19	0.35
EGY	0.24	0.24	POL	0.31	0.10
ESP	0.25	0.20	PRT	0.26	0.19
FIN	0.24	0.23	SGP	0.21	0.28
FRA	0.21	0.28	SWE	0.20	0.32
GBR	0.23	0.23	THA	0.26	0.19
GRC	0.27	0.16	TUN	0.14	0.52
HKG	0.19	0.33	URY	0.32	0.11
HND	0.26	0.62	VEN	0.31	0.11
HUN	0.33	0.08	ZAF	0.31	0.10
IDN	0.19	0.33	ZWE	0.18	0.35
IND	0.19	0.35			
IRN	0.23	0.25			

Table 3: A Rajan-Zingales Style Dynamic Panel Model with Endogenous Endowments

Lagged Share	External Finance Dependence*Finance	Skilled Labor Share*Skilled	Unskilled Labor Share*Unskilled	Capital-labor Ratio*Capital	Obs	χ^2	AR1 p val.	AR2 p val.
0.453	-0.03	-0.138	0.147	-0.082	14349	250	0.00	0.21
<i>9.06</i>	<i>-1.18</i>	<i>-0.74</i>	<i>1.07</i>	<i>-0.69</i>				

This table reports a dynamic unbalanced panel estimation of equation (18) in the text. The observations are on industry i in country c and time t . The dependent variable is the sectoral output share of GDP. The estimation contains industry, country and time fixed effects which are not reported here to save space. Lagged share is the lagged dependent variable. Finance, capital, skilled, and unskilled are all expressed in natural logs. Numbers in italics are t -statistics based on autocorrelation and heteroskedasticity robust standard errors that are clustered by country. We use lagged variables from time $t-2$ and earlier as instruments for the factor endowments, finance and their interaction with their intensity of use measures.

Table 4: Arellano-Bond Estimates of Dynamic Panel Models with Endogenous Endowments in an Expanded Sample

ISIC	Lagged Share	Finance	GDPC* Finance	Capital	GDPC* Capital	Skilled	GDPC* Skilled	Unskilled	GDPC* Unskilled	Obs	χ^2	AR1 p val.	AR2 p val.
311	0.412 <i>4.546</i>	0.083 <i>4.760</i>	-0.026 <i>-0.814</i>	-0.394 <i>-1.769</i>	0.038 <i>0.246</i>	0.111 <i>0.570</i>	-0.332 <i>-1.639</i>	0.234 <i>0.605</i>	0.282 <i>0.622</i>	898	521.0	0.000	0.158
313	0.579 <i>9.309</i>	0.000 <i>0.004</i>	-0.037 <i>-0.662</i>	0.135 <i>1.117</i>	0.009 <i>0.103</i>	0.055 <i>0.623</i>	0.107 <i>0.956</i>	-0.101 <i>-0.363</i>	-0.446 <i>-1.113</i>	898	916.5	0.007	0.379
314	0.520 <i>6.275</i>	0.011 <i>1.447</i>	-0.016 <i>-1.555</i>	-0.192 <i>-2.209</i>	0.053 <i>0.667</i>	0.117 <i>1.304</i>	0.080 <i>0.858</i>	0.049 <i>0.358</i>	-0.228 <i>-0.952</i>	898	518.8	0.000	0.228
321	0.606 <i>9.948</i>	0.069 <i>3.240</i>	-0.065 <i>-1.437</i>	-0.286 <i>-3.038</i>	0.222 <i>2.288</i>	0.249 <i>2.367</i>	-0.291 <i>-2.147</i>	0.384 <i>1.480</i>	-0.040 <i>-0.104</i>	898	1010.1	0.042	0.507
322	0.737 <i>14.665</i>	0.019 <i>3.236</i>	-0.004 <i>-0.610</i>	-0.160 <i>-2.264</i>	-0.124 <i>-2.430</i>	-0.035 <i>-0.608</i>	-0.012 <i>-0.221</i>	-0.092 <i>-1.013</i>	0.290 <i>1.719</i>	898	4833.1	0.011	0.284
323	0.571 <i>5.609</i>	0.004 <i>4.132</i>	0.002 <i>1.722</i>	-0.012 <i>-1.201</i>	-0.020 <i>-2.186</i>	-0.003 <i>-0.257</i>	0.018 <i>1.043</i>	0.008 <i>0.364</i>	-0.026 <i>-0.746</i>	898	809.2	0.002	0.625
324	0.577 <i>7.854</i>	0.007 <i>3.857</i>	-0.006 <i>-1.599</i>	-0.007 <i>-0.339</i>	0.015 <i>0.829</i>	0.012 <i>0.417</i>	-0.056 <i>-1.766</i>	-0.029 <i>-0.534</i>	0.043 <i>0.730</i>	898	2779.0	0.001	0.559
331	0.490 <i>10.589</i>	0.006 <i>2.226</i>	-0.008 <i>-2.034</i>	-0.007 <i>-0.239</i>	0.023 <i>0.760</i>	-0.011 <i>-0.294</i>	-0.056 <i>-1.268</i>	0.038 <i>0.477</i>	0.022 <i>0.225</i>	898	1221.6	0.000	0.880
332	0.704 <i>11.871</i>	0.006 <i>2.944</i>	-0.003 <i>-0.739</i>	-0.035 <i>-1.411</i>	-0.019 <i>-1.079</i>	-0.048 <i>-2.820</i>	-0.009 <i>-0.455</i>	0.020 <i>0.403</i>	0.078 <i>1.486</i>	898	2689.8	0.001	0.005
341	0.424 <i>5.751</i>	0.011 <i>2.679</i>	-0.015 <i>-1.632</i>	-0.064 <i>-1.223</i>	-0.045 <i>-1.064</i>	-0.034 <i>-0.805</i>	0.024 <i>0.422</i>	0.049 <i>0.453</i>	-0.025 <i>-0.219</i>	898	536.2	0.000	0.008

Table 4 (cont).

342	0.675 <i>14.421</i>	0.005 <i>1.756</i>	-0.008 <i>-1.022</i>	-0.016 <i>-0.462</i>	-0.016 <i>-0.520</i>	-0.001 <i>-0.021</i>	-0.018 <i>-0.376</i>	0.048 <i>0.779</i>	0.145 <i>1.694</i>	898	1792.7	0.000	0.787
351	0.592 <i>9.126</i>	-0.001 <i>-0.056</i>	-0.008 <i>-0.396</i>	-0.081 <i>-0.589</i>	-0.077 <i>-0.773</i>	0.004 <i>0.040</i>	0.008 <i>0.061</i>	0.111 <i>0.556</i>	0.256 <i>1.121</i>	898	974.7	0.000	0.342
352	0.466 <i>7.034</i>	0.035 <i>3.169</i>	-0.019 <i>-1.267</i>	-0.180 <i>-2.040</i>	-0.073 <i>-1.043</i>	-0.212 <i>-2.063</i>	-0.007 <i>-0.084</i>	0.254 <i>1.742</i>	0.148 <i>0.689</i>	898	1057.5	0.000	0.656
353	0.409 <i>4.998</i>	0.028 <i>0.464</i>	-0.110 <i>-1.857</i>	0.178 <i>1.036</i>	0.108 <i>1.174</i>	-0.065 <i>-0.629</i>	-0.206 <i>-1.659</i>	0.017 <i>0.082</i>	-0.052 <i>-0.125</i>	894	461.7	0.000	0.163
354	0.670 <i>5.396</i>	0.000 <i>-0.057</i>	-0.012 <i>-1.121</i>	0.000 <i>-0.011</i>	0.010 <i>0.355</i>	-0.124 <i>-1.758</i>	-0.111 <i>-1.527</i>	-0.123 <i>-1.440</i>	0.116 <i>1.789</i>	891	3873.1	0.094	0.205
355	0.443 <i>5.522</i>	0.017 <i>2.693</i>	-0.012 <i>-1.019</i>	-0.142 <i>-2.022</i>	-0.020 <i>-0.622</i>	-0.003 <i>-0.062</i>	-0.002 <i>-0.062</i>	0.077 <i>1.033</i>	0.143 <i>1.268</i>	898	382.8	0.000	0.856
356	0.493 <i>6.223</i>	0.004 <i>0.526</i>	0.005 <i>0.682</i>	0.102 <i>1.714</i>	-0.001 <i>-0.024</i>	0.007 <i>0.151</i>	-0.051 <i>-0.979</i>	-0.144 <i>-1.352</i>	0.053 <i>0.550</i>	898	689.6	0.000	0.249
361	0.461 <i>8.026</i>	0.006 <i>5.107</i>	0.004 <i>2.695</i>	-0.031 <i>-2.397</i>	-0.029 <i>-2.250</i>	0.016 <i>0.989</i>	0.015 <i>0.984</i>	-0.013 <i>-0.415</i>	0.046 <i>1.447</i>	898	1310.9	0.009	0.305
362	0.594 <i>9.632</i>	0.004 <i>3.110</i>	-0.006 <i>-3.254</i>	-0.004 <i>-0.278</i>	-0.011 <i>-0.981</i>	0.020 <i>1.776</i>	0.001 <i>0.046</i>	-0.009 <i>-0.408</i>	0.053 <i>1.686</i>	898	2628.8	0.000	0.118
369	0.549 <i>9.977</i>	-0.001 <i>-0.212</i>	-0.013 <i>-1.168</i>	0.036 <i>0.799</i>	0.017 <i>0.470</i>	-0.104 <i>-2.476</i>	-0.096 <i>-1.805</i>	0.071 <i>0.629</i>	0.151 <i>1.271</i>	898	597.6	0.000	0.007
371	0.530 <i>7.389</i>	0.023 <i>1.761</i>	-0.027 <i>-1.456</i>	-0.108 <i>-0.895</i>	-0.086 <i>-1.108</i>	-0.040 <i>-0.472</i>	0.020 <i>0.183</i>	0.178 <i>1.219</i>	0.059 <i>0.293</i>	898	1030.6	0.000	0.183

Table 4 (cont).

372	0.353 <i>5.319</i>	-0.005 <i>-0.623</i>	0.009 <i>0.608</i>	0.021 <i>0.282</i>	-0.034 <i>-0.878</i>	0.012 <i>0.247</i>	-0.052 <i>-0.904</i>	-0.143 <i>-1.409</i>	0.080 <i>0.667</i>	898	464.9	0.005	0.029
381	0.527 <i>7.649</i>	0.025 <i>3.327</i>	0.001 <i>0.091</i>	-0.042 <i>-0.574</i>	-0.054 <i>-0.973</i>	-0.108 <i>-1.750</i>	-0.064 <i>-0.893</i>	0.018 <i>0.155</i>	0.373 <i>3.076</i>	898	1089.5	0.000	0.067
382	0.696 <i>12.260</i>	0.002 <i>0.273</i>	-0.015 <i>-1.244</i>	0.217 <i>2.618</i>	0.054 <i>0.774</i>	0.080 <i>0.779</i>	-0.136 <i>-1.052</i>	-0.051 <i>-0.251</i>	0.544 <i>1.668</i>	898	2267.7	0.000	0.936
383	0.745 <i>14.353</i>	0.020 <i>1.486</i>	-0.023 <i>-1.421</i>	-0.089 <i>-0.391</i>	-0.179 <i>-1.788</i>	-0.112 <i>-0.620</i>	0.052 <i>0.337</i>	-0.158 <i>-0.600</i>	0.166 <i>0.701</i>	898	2428.6	0.000	0.532
384	0.562 <i>7.642</i>	0.010 <i>0.656</i>	-0.008 <i>-0.326</i>	-0.031 <i>-0.225</i>	-0.118 <i>-1.202</i>	0.071 <i>0.724</i>	-0.070 <i>-0.462</i>	-0.300 <i>-1.197</i>	0.402 <i>1.221</i>	898	540.9	0.000	0.642
385	0.665 <i>18.557</i>	0.002 <i>1.233</i>	-0.004 <i>-1.609</i>	-0.015 <i>-0.597</i>	0.009 <i>0.528</i>	-0.005 <i>-0.277</i>	0.007 <i>0.263</i>	0.030 <i>1.108</i>	0.008 <i>0.136</i>	898	2808.6	0.000	0.321
390	0.507 <i>6.473</i>	0.003 <i>1.455</i>	-0.010 <i>-3.617</i>	-0.021 <i>-0.811</i>	-0.018 <i>-1.344</i>	-0.037 <i>-1.448</i>	0.000 <i>0.014</i>	0.025 <i>0.579</i>	-0.019 <i>-0.479</i>	898	726.6	0.006	0.418

Each row reports a dynamic unbalanced panel estimation of equation (17) in the text. The dependent variable is the sectoral output share of GDP. Each estimation contains country and time fixed effects which are not reported here to save space. Lagged share is the lagged dependent variable. Finance, capital, skilled, and unskilled are all expressed in natural logs. GDPC represents the logarithm of GDP per capita relative to the sample average. Numbers in italics are t -statistics based on autocorrelation and heteroskedasticity robust standard errors that are clustered by country. We use lagged variables from time $t-2$ and earlier as instruments for the factor endowments, finance and their interaction with the log of GDP per capita.

Table 5: A Rajan-Zingales Style Dynamic Panel Model with Endogenous Endowments in an Expanded Sample

Lagged Share	External Finance Dependence*Finance	Skilled Labor Share*Skilled	Unskilled Labor Share*Unskilled	Capital-labor Ratio*Capital	Obs	χ^2	AR1 p val.	AR2 p val.
0.634	-0.012	-0.067	0.175	-0.014	20095	341.1	0	0.200
<i>13.59</i>	<i>-0.91</i>	<i>-0.68</i>	<i>1.58</i>	<i>-0.16</i>				

This table reports a dynamic unbalanced panel estimation of equation (18) in the text. The observations are on industry i in country c and time t . The dependent variable is the sectoral output share of GDP. The estimation contains industry, country and time fixed effects which are not reported here to save space. Lagged share is the lagged dependent variable. Finance, capital, skilled, and unskilled are all expressed in natural logs. Numbers in italics are t -statistics based on autocorrelation and heteroskedasticity robust standard errors that are clustered by country. We use lagged variables from time $t-2$ and earlier as instruments for the factor endowments, finance and their interaction with their intensity of use measures.