Appendix to paper "Do Richer Countries Have Higher Distribution Margins?"

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A Methodology For Price Index Construction

Penn World Table - Summers and Heston (1991) I briefly describe the methodology used to construct a price index for a category, using the information provided by the ICP, consumer prices and expenditures. Let i index items, s index categories, and j index countries. Let p^j_{is} be the local currency price in country j, for the i'th item of category s. The US dollar will be the numeraire. Then the PPP for the i'th item of category s, in country j will be the national currency price for this item over the corresponding US price, defined as $PPP^j_{is} = p^j_{is}/p^{us}_{is}$. Averaging over all items in category s, one can construct the price parities for all detailed categories, denominated in domestic currency relative to the US dollar. Therefore the PPP for category s, in country j, is $PPP^j_s = \frac{p^j_s}{p^{us}_s}$. This exercise provides you with 150 price parities (one for each of the 150 detailed categories), that express the average category national prices relative to the corresponding national prices in the US.

The ICP data also includes final output expenditures in national currency for each category s, in each country j, $E^j_s = p^j_s q^j_s$. Given this information, we can calculate notional quantities, defined as the ratio,

$$Q^j_s = \frac{E^j_s}{PPP^j_s} = \frac{p^j_s q^j_s}{p^j_s/p^{us}_s} = p^{us}_s q^j_s$$

These notional quantities, which are comparable across countries, give the domestic quantities valued at the corresponding US category price. Note, that q^j_s are the hypothetical quantity units of category s, in country j, since they are not observed.

The task now is to calculate an aggregate price of GDP for country j, PPP^j. Let π_s denote the average international price for each category s. Using the notional quantities, calculated above, we can write the aggregate PPP for any country j, as

$$PPP^j = \frac{\sum_s \left(PPP_s^j \times Q_s^j\right)}{\sum_s \left(\pi_s \times Q_s^j\right)} \tag{1}$$

where the numerator measures GDP in domestic prices, and the denominator measures GDP in international prices. Thus PPP^j is measured in local j currency per international dollar. The international price for each category s, is calculated as the weighted average of the category PPPs for all countries,

$$\pi_s = \sum_j \left(\frac{PPP_s^j}{PPP^j} \times \omega_s^j\right) \tag{2}$$

where $\omega_s^j = Q_s^j / \sum_j Q_s^j$. The objects of interest, international prices and aggregate PPPs can be calculated as the fixed point of a system of $[m + (n-1)]$ linear equations described by, (1) and (2), where m is the number of categories and n is the number of countries. This method is known as the Geary - Khamis method.

Finally, note that once the international prices are obtained, one can compute the PPP for any aggregate category (subcategory of GDP) that consists of one or more of the detailed categories s. This is done using an equation similar to (1). For example if one wanted to calculate the PPP for the subcategory 'food', the following would be used,

$$PPP_{food}^j = \frac{\sum_{s \in \{food\}} \left(PPP_s^j \times Q_s^j\right)}{\sum_{s \in \{food\}} \left(\pi_s \times Q_s^j\right)}$$

However such a measure would depend on the international prices. To obtain a measure that is devoid of these prices we can take the ratio relative to the US, e.g., $\frac{PPP_{food}^j}{PPP_{food}^{us}}$.

FAO - Rao (1993) Here I briefly describe how Prasada Rao (1993) calculates PPPs for agricultural production. An important difference with the PWT benchmark data, is that here commodity quantities are observed and thus there is no need for calculating notional quantities.

Let PPP^j denote the purchasing power parity of the currency of country j, which shows the amount of currency j equivalent to one unit of international dollars (numeraire currency). Let p_i^j and q_i^j denote the price and quantity respectively of the i'th agricultural commodity in country j. Let π_i be the international dollar price of the i'th agricultural commodity. Then the purchasing power parity of the currency of country j, is given by,

$$PPP^j = \frac{\sum_i \left(p_i^j \times q_i^j\right)}{\sum_i \left(\pi_i \times q_i^j\right)} \tag{3}$$

where the numerator evaluates the agricultural output of country j, in national currency units, while the denominator in international currency units. The international price π_i, is defined as the international average of prices of the i'th commodity in different countries, and is given by,

$$\pi_i = \sum_j \left(\frac{p_i^j}{PPP^j} \times \omega_i^j \right) \tag{4}$$

where $\omega_i^j = q_i^j / \sum_j q_i^j$. The Geary-Khamis methodology calculates π_i's and PPP^j's as the unique fixed point of the system of simultaneous equations described by (3) and (4). Then PPPs can be used to obtain a measure of agricultural price differences between two countries j and h, as $P^{hj} = \frac{PPP^j}{PPP^h}$.[1]

B Data Sources for U.S. Time Series

Marketing Bill, 1967-2000

Appendix Fig.1 displays three components of the total retail cost of food, production costs, transport costs (which include labor in the transportation sector), and labor costs,[2] for the period 1967-2000. Other components that constitute smaller fractions of the retail cost have not been included in the picture. From the omitted ones, packaging which includes paperboard boxes, containers etc., is the second largest component of the marketing bill.

Historical Transportation Costs

Appendix Fig.2: Freight rates (in cents) on wheat (per bushel) from Chicago to New York by (i) lake and canal, (ii) by rail, over the wholesale price index for all commodities. Source: Freight rates are from George Tunell ("Tables Relating to the Flour and Grain Traffic", Appendix, *Journal of Political Economy*, pp. 413-420, 1897). The Wholesale price index (series F40, F52) is from the Historical Statistics of the United States, Department of Commerce, 1975. *Appendix Fig.3*: Railroad freight revenue per ton mile (in cents), over the wholesale price index. Source: Railroad freight rates (series Q 331-345) and the Wholesale Price index (series F 23) are from the Historical Statistics of the United States, Department of Commerce, 1975. *Appendix Fig.4*: Expenditure per ton mile (cents) over the producer price index for all durables (1982 = 100). Source: Expenditure per ton mile is from the Transportation Statistics, Annual Report 1994 (Table 5.1), Bureau of Transportation Statistics, US Department of Transportation. The producer price index is from the Economic Report of the President (Table B65).

[1] To see why this is so: since we have already expressed agricultural output in terms of common currency units we can obtain a quantity difference index between two countries j and h, as $Q^{hj} = \sum_i \left(\pi_i \times q_i^j\right) / \sum_i \left(\pi_i \times q_i^h\right)$. Then $P^{hj} = (Q^{hj})^{-1} \sum_i \left(p_i^j \times q_i^j\right) / \sum_i \left(p_i^h \times q_i^h\right)$ and the result follows.

[2] This includes labor used by assemblers, wholesalers, retailers.

The fact that these observations are from different series may be thought, to some extent, to account for the pattern of decline in transport costs. For example as reported by Glaeser and Kohlhase (2003), rail freight rates continued to drop after the 1970s. The constancy in the overall transport cost has to do with the shift in the composition of the freight bill, i.e., trucking replaced the railroad as the main means of transporting goods some time in the postwar period. For this reason, the rail freight rates are a good approximation to true transport costs for the earlier period but not for the later, and the overall transport cost is the more appropriate statistic for the period after 1960s.

Historical GDP Shares

The GDP shares for the period 1869-1919 are from the *Martin Series* of the *Historical Statistics*. For the period 1929-1939 they are from the *Commerce Estimates* of the *Historical Statistics* while for the period 1929-2000 they are from the BEA. The Transportation data from the historical series however include Public Utilities and Communications. To calculate estimates for transportation GDP shares for the earlier period I use the same procedure as Glaeser and Kohlhase (2003), namely multiply the reported series by 0.67 - the ratio of transportation in the total measure in 1929. The employment shares for the period 1869-1929 are from the *Kendrick estimates* of the *Historical Statistics*, for the period 1929-1949 from the *Commerce Estimates* of the *Historical Statistics* and for the period 1949-2000 from the BEA. I use the following procedure to extract estimates for Transportation: for the last year of every decade in 1949-1989 I calculate the ratio of employment in pure transportation services over the total measure (that includes Public Utilities and Communications) and then the rate of change of this ratio from decade to decade. The average decline in this ratio has been 3.8%. I use this rate to extrapolate earlier values of the ratio and calculate the transportation series as the product of the resulting ratio and series reported by the *Historical Statistics*.

C Equilibrium of Dynamic Model

Definition

For given non-reproducible factors, initial capital stock, and sectoral TFP sequences, an equilibrium for this economy is

- a sequence of prices, $\{q_{at}, p_{dt}, p_{Tt}, w_t, r_t, Q_{at}, Q_{dt}\}_{t=0}^{\infty}$
- a sequence of allocations for the firms $\{Y_{at}$, Y_{mt}, Y_{dt}, Y_{Tt}, K_{at}, K_{mt}, K_{dt}, K_{Tt}, N_{at}, N_{mt}, N_{dt}, $N_{Tt}\}_{t=0}^{\infty}$
- a sequence of allocations for the household, $\{Z_{at}, Z_{mt}, D_{at}, D_{mt}, T_{at}, T_{mt}, K_{t+1}\}_{t=0}^{\infty}$

such that (1) given prices, $\{Z_{at}, Z_{mt}, D_{at}, D_{mt}, T_{at}, T_{mt}, K_{t+1}\}_{t=0}^{\infty}$ solve the household's problem, (2) factor prices are competitive, (3) markets clear (the market clearing conditions specified above are satisfied).

Firm and Household Problems

The problem for a firm in the agricultural sector is

$$\max_{K_{at},N_{at},L_a} \{q_{at}Y_{at} - w_t N_{at} - r_t K_{at} - Q_{at}L_a\}$$

s.t. $Y_{at} = A_{at}\left(K_{at}^{\mu}L_a^{1-\mu}\right)^{\alpha} N_{at}^{1-\alpha}$. The problem of a firm in the non-agricultural sector is,

$$\max_{K_{mt},N_{mt}} \{Y_{mt} - w_t N_{mt} - r_t K_{mt}\}$$

s.t. $Y_{mt} = A_{mt}K_{mt}^{\theta}N_{mt}^{1-\theta}$.

The wholesaling-retailing firm and the transportation firm solve the following profit maximization problems,

$$\max_{K_{dt},N_{dt},L_d} \{p_{dt}Y_{dt} - w_t N_{dt} - r_t K_{dt} - Q_{dt}L_d\}$$

s.t. $Y_{dt} = A_{dt}\left(K_{dt}^{\lambda}L_d^{1-\lambda}\right)^{\psi} N_{dt}^{1-\psi}$,

$$\max_{K_{Tt},N_{Tt}} \{p_{Tt}Y_{Tt} - w_t N_{Tt} - r_t K_{Tt}\}$$

s.t. $Y_{Tt} = A_{Tt}K_{Tt}^{\xi}N_{Tt}^{1-\xi}$,
where p_{dt} and p_{Tt} are the prices of wholesaling-retailing and transportation relative to the producer price in the non-agricultural sector.

Perfect mobility of capital and labor across sectors ensures that the capital labor ratios are proportional to each other in equilibrium

$$\frac{K_{mt}}{N_{mt}} = \frac{1}{\varphi_a}\frac{K_{at}}{N_{at}} = \frac{1}{\varphi_d}\frac{K_{dt}}{N_{dt}} = \frac{1}{\varphi_T}\frac{K_{Tt}}{N_{Tt}} \tag{5}$$

where $\varphi_a \equiv \frac{(1-\theta)\alpha\mu}{\theta(1-\alpha)}$, $\varphi_d \equiv \frac{(1-\theta)\lambda\psi}{\theta(1-\psi)}$, $\varphi_T \equiv \frac{(1-\theta)\xi}{\theta(1-\xi)}$.

The first order conditions from the household's problem imply

$$\frac{Z_{at}}{D_{at}+\overline{d}_a} = \frac{(1-\phi_a-\tau_a)}{\phi_a}\frac{p_{dt}}{q_{at}}$$

$$\frac{Z_{at}}{T_{at}-\overline{T}_a} = \frac{(1-\phi_a-\tau_a)}{\tau_a}\frac{p_{Tt}}{q_{at}}$$

$$\frac{Z_{mt}}{D_{mt}+\overline{d}_m} = \frac{(1-\phi_m-\tau_m)\,\phi_a}{(1-\phi_a-\tau_a)\,\phi_m}\frac{Z_{at}}{D_{at}+\overline{d}_a}q_{at}$$

$$\frac{Z_{mt}}{T_{mt}-\overline{T}_m} = \frac{(1-\phi_m-\tau_m)\,\tau_a}{(1-\phi_a-\tau_a)\,\tau_m}\frac{Z_{at}}{T_{at}-\overline{T}_a}q_{at}$$

$$\rho C_{mt} = (1-\rho)\frac{p_{at}}{p_{mt}}(C_{at}-\overline{a})$$

$$\frac{1}{p_{mt}}\left(\frac{C_t}{N_t}\right)^{-\sigma}\left(\frac{C_{at}-\overline{a}}{C_{mt}}\right)^{\rho} = \frac{\beta}{p_{mt+1}}\left(\frac{C_{t+1}}{N_{t+1}}\right)^{-\sigma}\left(\frac{C_{at+1}-\overline{a}}{C_{mt+1}}\right)^{\rho}[r_{t+1}+(1-\delta)]$$

where the retail price indices of the two composite goods are weighted averages of the prices of the goods that comprise them:

$$p_{at} = B_a p_{dt}^{\phi_a} p_{Tt}^{\tau_a} q_{at}^{1-\phi_a-\tau_a}$$

$$p_{mt} = B_m p_{dt}^{\phi_m} p_{Tt}^{\tau_m}$$

with $B_a \equiv \left[(1-\phi_a-\tau_a)^{1-\phi_a-\tau_a}\, \phi_a^{\phi_a} \tau_a^{\tau_a}\right]^{-1}$ and $B_m \equiv \left[(1-\phi_m-\tau_m)^{1-\phi_m-\tau_m}\, \phi_m^{\phi_m} \tau_m^{\tau_m}\right]^{-1}$.

The first two equations say that the optimal mix, in the consumer's basket, of the generic agricultural good and distribution services depends on their relative prices. The perfect substitutability in the use of wholesaling-retailing and transportation services between the two final goods implies that the ratios of generic goods to each one of these services must be proportional across the two goods, as suggested by the third and fourth equation. From the subsequent two equations, the first says that the marginal rate of substitution between the food and the non-food good must be equal to their retail price ratio. The second, is the counterpart to the well-known Euler equation, and suggests that the marginal cost in terms of utility, from sacrificing one unit of consumption today should be equal to the present discounted utility benefit of extra consumption tomorrow.

Balanced Growth Path Equilibrium

A balanced growth path equilibrium with a constant real interest rate, is an equilibrium as defined above with the property that aggregate variables grow at constant rates (possibly different). In particular $\{K_{t+1},\ K_{at},\ K_{mt},\ K_{dt},\ K_{Tt},\ Z_{mt},\ Y_{mt}\}$ grow at rate $\gamma - 1$; $\{Y_{at},\ Z_{at}\}$ grow at rate $\gamma_{q_a}^{-1}\gamma - 1$; $\{Y_{dt},\ D_{at},\ D_{mt}\}$ grow at rate $\gamma_{p_d}^{-1}\gamma - 1$; $\{Y_{Tt},\ T_{at},\ T_{mt}\}$ grow at rate $\gamma_{p_T}^{-1}\gamma - 1$; labor variables $\{N_t, N_{at}, N_{mt}, N_{dt}, N_{Tt}\}$ grow at rate $\eta - 1$; C_{at} grows at rate $\gamma_{p_a}^{-1}\gamma - 1$; C_{mt} grows at rate $\gamma_{p_m}^{-1}\gamma - 1$; the relative producer price of agriculture, q_a, grows at rate $\gamma_{q_a} - 1$; the relative price of wholesaling-retailing p_d grows at rate $\gamma_{p_d} - 1$; the relative cost of transportation p_T grows at rate $\gamma_{p_T} - 1$; the relative retail price of food p_a grows at rate $\gamma_{p_a} - 1$; the relative retail price of non-food p_m grows at rate $\gamma_{p_m} - 1$; the wage rate w_t is growing at rate $\gamma_m^{\frac{1}{1-\theta}} - 1$; the rural land rents Q_{at} and urban land rents Q_{dt} are growing at a rate $\gamma - 1$; while the real interest rate r_t is constant. Definitions of the these growth rates and their corresponding TFP factors are provided in the following table.

Growth Rates and Growth Factors

TFP Factor	TFP Growth Rate
$A_t \equiv A_{mt}^{\frac{1}{1-\theta}} N_t$	$\gamma_t \equiv \gamma_{mt}^{\frac{1}{1-\theta}} \eta_t$
$A_{q_{at}} \equiv \frac{A_{mt}^{\frac{1-\alpha\mu}{1-\theta}} N_t^{\alpha(1-\mu)}}{A_{at}}$	$\gamma_{q_{at}} \equiv \frac{\gamma_{mt}^{\frac{1-\alpha\mu}{1-\theta}} \eta_t^{\alpha(1-\mu)}}{\gamma_{at}}$
$A_{p_{dt}} \equiv \frac{A_{mt}^{\frac{1-\psi\lambda}{1-\theta}} N_t^{\psi(1-\lambda)}}{A_{dt}}$	$\gamma_{p_{dt}} \equiv \frac{\gamma_{mt}^{\frac{1-\psi\lambda}{1-\theta}} \eta_t^{\psi(1-\lambda)}}{\gamma_{dt}}$
$A_{p_{Tt}} \equiv \frac{A_{mt}^{\frac{1-\xi}{1-\theta}}}{A_{Tt}}$	$\gamma_{p_{Tt}} \equiv \frac{\gamma_{mt}^{\frac{1-\xi}{1-\theta}}}{\gamma_{Tt}}$
$A_{p_{at}} \equiv A_{p_{dt}}^{\phi_a} A_{p_{Tt}}^{\tau_a} A_{q_{at}}^{1-\phi_a-\tau_a}$	$\gamma_{p_{at}} \equiv \gamma_{p_{dt}}^{\phi_a} \gamma_{p_{Tt}}^{\tau_a} \gamma_{q_{at}}^{1-\phi_a-\tau_a}$
$A_{p_{mt}} \equiv A_{p_{dt}}^{\phi_m} A_{p_{Tt}}^{\tau_m}$	$\gamma_{p_{mt}} \equiv \gamma_{p_{dt}}^{\phi_m} \gamma_{p_{Tt}}^{\tau_m}$

Proposition 1. *A balanced growth path with a constant real interest rate r and a declining relative producer price of agriculture q_a, a constant relative cost of transportation p_T, and a rising relative price of wholesaling-retailing p_d requires that*

$$\gamma_a > \gamma_m^{\frac{1-\alpha\mu}{1-\theta}} \eta^{\alpha(1-\mu)}$$

$$\gamma_d < \gamma_m^{\frac{1-\psi\lambda}{1-\theta}} \eta^{\psi(1-\lambda)}$$

$$\gamma_T = \gamma_m^{\frac{1-\xi}{1-\theta}}$$

These are the conditions that the calibration will impose on the TFP growth rates (based on data), which I discuss in detail in the quantitative section of the paper.

Asymptotically the economy will converge to this balanced growth path. It is useful to transform all growing variables by dividing them with their growth factors along the balanced growth path. Denote the transformed quantity variables by lower case letters, for example K_t is transformed to $k_t = K_t/A_t$. For lack of better notation the transformed transportation services variables will be denoted by hats, for example $\widehat{T}_{at}$. Denote the transformed price variables by hats, for example $\widehat{q}_{at} = q_{at}/A_{q_{at}}$. The labor share N_{it} is transformed to $n_{it} = \frac{N_{it}}{N_t}$, for $i \in \{a, m, d, T\}$.

From the Euler equation along a balanced growth path, the rental price of capital is $r = \beta^{-1}\gamma_m^{\frac{\sigma}{1-\theta}} \gamma_{p_a}^{\rho(1-\sigma)} \gamma_{p_m}^{(1-\rho)(1-\sigma)} - (1-\delta)$. This along with the first order condition with respect to capital in the non-agricultural sector implies that the capital-labor ratio in that sector is

$$\frac{k_m}{n_m} = \left[\theta\beta / \left(\gamma_m^{\frac{\sigma}{1-\theta}} \gamma_{p_a}^{\rho(1-\sigma)} \gamma_{p_m}^{(1-\rho)(1-\sigma)} - \beta(1-\delta)\right)\right]^{\frac{1}{1-\theta}}$$

and from (5) we can obtain the capital labor ratios in the other sectors. In order to solve for the other variables along the balanced growth path it is necessary to solve for the fraction of labor allocated to the agricultural and distribution technologies. Due to the many feedback relationships between the different sectors in the economy, solving for analytical expressions for these variables becomes infeasible. The system of equations corresponding to the dynamical system of this model (presented in the next section) can be solved numerically, exploiting the steady state properties of the transformed variables along the balanced growth path.

Transitional Dynamics

The following set of equations fully describes the dynamics of the transformed economy. These relationships will hold at all points in time, including the balanced growth path.

The first order conditions to the household's problem in terms of the transformed variables can be written as,

$$\rho c_{mt} = (1-\rho) \frac{\widehat{p}_{at}}{\widehat{p}_{mt}} \left(c_{at} - \frac{\overline{a}}{A_t A_{p_{at}}^{-1}} \right)$$

$$\frac{\gamma_{mt}^{\frac{\sigma}{1-\theta}}}{\widehat{p}_{mt}} \frac{c_t^{1-\sigma}}{c_{mt}} = \frac{\beta}{\widehat{p}_{mt+1}} \frac{c_{t+1}^{1-\sigma}}{c_{mt+1}} \gamma_{p_{at}}^{-\rho(1-\sigma)} \gamma_{p_{mt}}^{-(1-\rho)(1-\sigma)} \left[r_{t+1} + 1 - \delta \right]$$

where c_t is,

$$c_t = \left(c_{at} - \frac{\overline{a}}{A_t A_{p_{at}}^{-1}} \right)^{\rho} c_{mt}^{1-\rho}$$

and the consumption index for final good $i \in \{a, m\}$ is

$$c_{it} = \left(\frac{d_{it} + \overline{d}_i A_t^{-1} A_{p_{dt}}}{z_{it}} \right)^{\phi_i} \left(\frac{\widehat{T}_{it} - \overline{T}_i A_t^{-1} A_{p_{Tt}}}{z_{it}} \right)^{\tau_i} z_{it}$$

The retail prices for food and non-food in terms of the transformed variables are,

$$\widehat{p}_{at} = B_a \widehat{p}_{dt}^{\phi_a} \widehat{p}_{Tt}^{\tau_a} \widehat{q}_{at}^{1-\phi_a-\tau_a} \tag{6}$$

$$\widehat{p}_{mt} = B_m \widehat{p}_{dt}^{\phi_m} \widehat{p}_{Tt}^{\tau_m} \tag{7}$$

Since distribution services of both types can be used for either of the two final goods, in equilibrium

$$\frac{z_{mt}}{d_{mt} + \overline{d}_m A_t^{-1} A_{p_{dt}}} = \frac{(1-\phi_m-\tau_m)\,\phi_a}{(1-\phi_a-\tau_a)\,\phi_m} \frac{z_{at}}{d_{at} + \overline{d}_a A_t^{-1} A_{p_{dt}}} \widehat{q}_{at}$$

$$\frac{z_{mt}}{\widehat{T}_{mt} - \overline{T}_m A_t^{-1} A_{p_{Tt}}} = \frac{(1-\phi_m-\tau_m)\,\tau_a}{(1-\phi_a-\tau_a)\,\tau_m} \frac{z_{at}}{\widehat{T}_{at} - \overline{T}_a A_t^{-1} A_{p_{Tt}}} \widehat{q}_{at}$$

The rental price of capital and the normalized wage rate (divided by its growth factor) can be solved for from the first order conditions of the non-agricultural firm,

$$r_t = \theta \left(\frac{k_{mt}}{n_{mt}} \right)^{\theta-1}$$

$$\widehat{w}_t = (1-\theta) \left(\frac{k_{mt}}{n_{mt}} \right)^{\theta}$$

Market clearing for the agricultural good implies

$$z_{at} = L_a^{\alpha(1-\mu)} \left(\frac{k_{mt}}{n_{mt}} \right)^{\alpha\mu} \varphi_a^{\alpha\mu} n_{at}^{\alpha(\mu-1)+1}$$

Market clearing for the non-agricultural good and labor market clearing produce

$$\left(\frac{k_{mt}}{n_{mt}} \right)^{\theta} (1 - n_{at} - n_{dt} - n_{Tt}) = \gamma_{mt}^{\frac{1}{1-\theta}} \eta_t k_{t+1} - (1-\delta)\, k_t + z_{mt}$$

The requirement that wholesale-retail output and transport output be used to distribute food and non-food to the market, is reflected in the following two equations

$$L_d^{(1-\lambda)\psi} \varphi_d^{\psi\lambda} \left(\frac{k_{mt}}{n_{mt}} \right)^{\psi\lambda} n_{dt}^{\psi(\lambda-1)+1} = d_{at} + d_{mt}$$

$$\varphi_T^{\xi} \left(\frac{k_{mt}}{n_{mt}} \right)^{\xi} n_{Tt} = \widehat{T}_{at} + \widehat{T}_{mt}$$

Wage equalization between sectors m and a allow to solve for the relative producer price of agriculture, which varies with the economy's capital labor ratio, and the share of labor in agriculture,

$$\widehat{q}_{at} = \left(\frac{1}{L_a^{\alpha(1-\mu)}}\right)\left(\frac{1}{\varphi_a^{\alpha\mu}}\right)\left(\frac{1-\theta}{1-\alpha}\right)\left(\frac{k_{mt}}{n_{mt}}\right)^{\theta-\alpha\mu} n_{at}^{\alpha(1-\mu)}$$

Wage equalization between non-agriculture and wholesaling-retailing, and transporting respectively, can be exploited to solve for the marginal costs of providing these services. The cost of transportation and the costs of wholesaling-retailing are respectively

$$\widehat{p}_{Tt} = \left(\frac{1-\theta}{1-\xi}\right)\left(\frac{1}{\varphi_T^{\xi}}\right)\left(\frac{k_{mt}}{n_{mt}}\right)^{\theta-\xi} \tag{8}$$

$$\widehat{p}_{dt} = \left(\frac{1-\theta}{1-\psi}\right)\left(\frac{1}{L_d^{\psi(1-\lambda)}}\right)\left(\frac{1}{\varphi_d^{\lambda\psi}}\right)\left(\frac{k_{mt}}{n_{mt}}\right)^{\theta-\psi\lambda} n_{dt}^{\psi(1-\lambda)} \tag{9}$$

Finally capital and labor market clearing along with (5) produces the final equation required to solve the system.

$$k_t = \frac{k_{mt}}{n_{mt}}\left[1-(1-\varphi_a)\,n_{at}-(1-\varphi_d)\,n_{dt}-(1-\varphi_T)\,n_{Tt}\right]$$

The complexity in the environment due to the introduction of the distribution sector (which makes all quantity variables and prices interdependent) does not permit to solve for the transitional dynamics analytically. I solve for transitions to the balanced growth path numerically.

D Static Version of the Model

In this section I present the static version of the model used for the cross-sectional experiments. The production functions in agriculture, non-agriculture, wholesaling-retailing, and transportation are those given in Section 5.1.

Profit maximization by firms and perfect mobility of labor across all sectors imply the following relative prices for this economy,

$$q_a = \left(\frac{1}{\pi_a}\right)\left(\frac{1}{1-\alpha}\right)\left(\frac{N_a/N}{L_a/N}\right)^{\alpha}$$

$$p_d = \left(\frac{1}{\pi_d}\right)\left(\frac{1}{1-\psi}\right)\left(\frac{N_d/N}{L_d/N}\right)^{\psi}$$

$$p_T = \frac{1}{\pi_T}$$

The problem of the household is to choose how much of the generic goods (agricultural and non-agricultural) to consume and how much distribution services (wholesaling-retailing and transportation) they want attached to the generic goods.

$$\max_{\{z_i,d_i,T_t\}_{i=a,m}} \left\{ (c_a - \overline{a})^{\rho} \, c_m^{1-\rho} \right\}$$

s.t. for $i \in \{a, m\}$

$$c_i = \left(d_i + \overline{d}_i\right)^{\phi_i} \left(T_i - \overline{T}_i\right)^{\tau_i} z_i^{1-\phi_i-\tau_i}$$

$$q_a z_a + z_m + p_T (T_a + T_m) + p_d (d_a + d_m) = w + Q_a L_a + Q_d L_d$$

The first order conditions to this problem imply that for $i \in \{a, m\}$ (with $q_i = 1$ for $i = m$)

$$\frac{z_i}{d_i + \overline{d}_i} = \frac{1 - \phi_i - \tau_i}{\phi_i} \frac{p_d}{q_i}$$

$$\frac{z_i}{T_i + \overline{T}_i} = \frac{1 - \phi_i - \tau_i}{\tau_i} \frac{p_T}{q_i}$$

$$\frac{\rho}{1-\rho} c_m = \frac{p_a}{p_m} (c_a - \overline{a})$$

where the price indices of the composite consumption goods (food and non-food) are given by, $p_a = B_a p_d^{\phi_a} p_T^{\tau_a} q_a^{1-\phi_a-\tau_a}$ and $p_m = B_m p_d^{\phi_m} p_T^{\tau_m}$, with B_a and B_m defined as before. Market clearing requires that, $Y_a = z_a$, $Y_m = z_m$, $Y_d = d_a + d_m$, $Y_T = T_a + T_m$, $N = N_a + N_m + N_d + N_T$.

E Appendix Figures

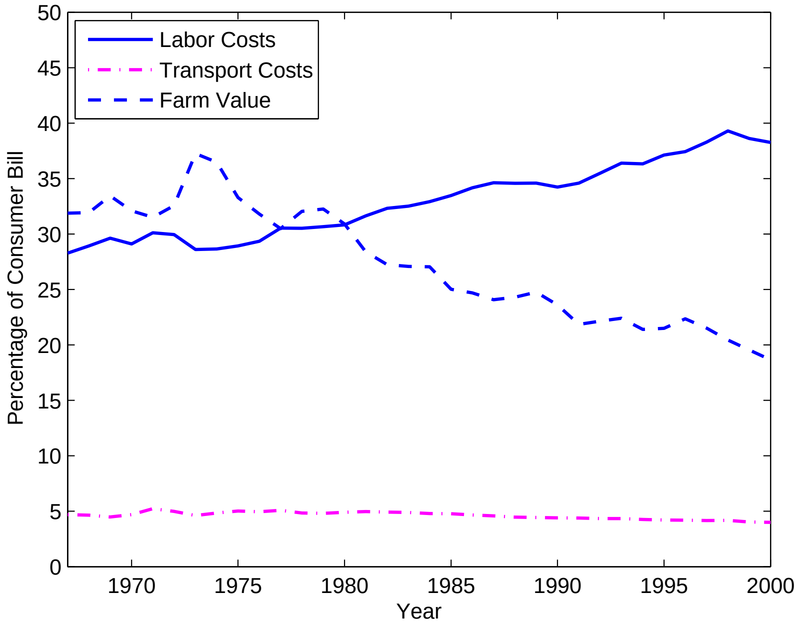

Figure 1: Main Components of the Marketing Bill, 1967-2000

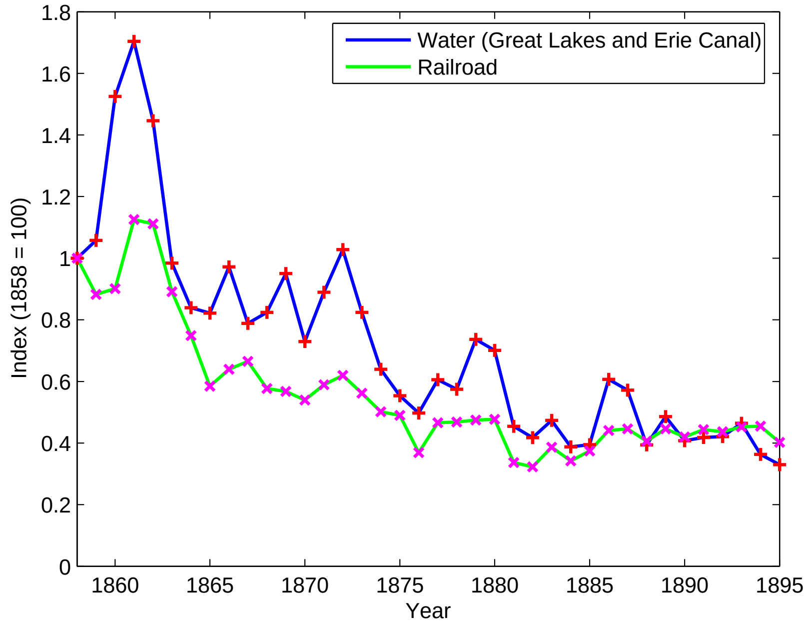

Figure 2: Real Transportation Costs, United States, 1858-1895

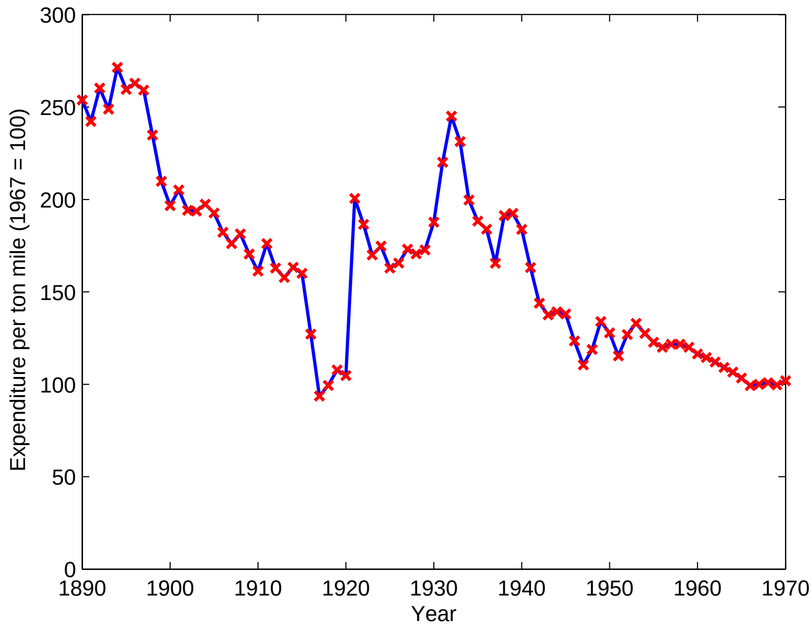

Figure 3: Relative Railroad Freight Costs: United States, 1890-1970

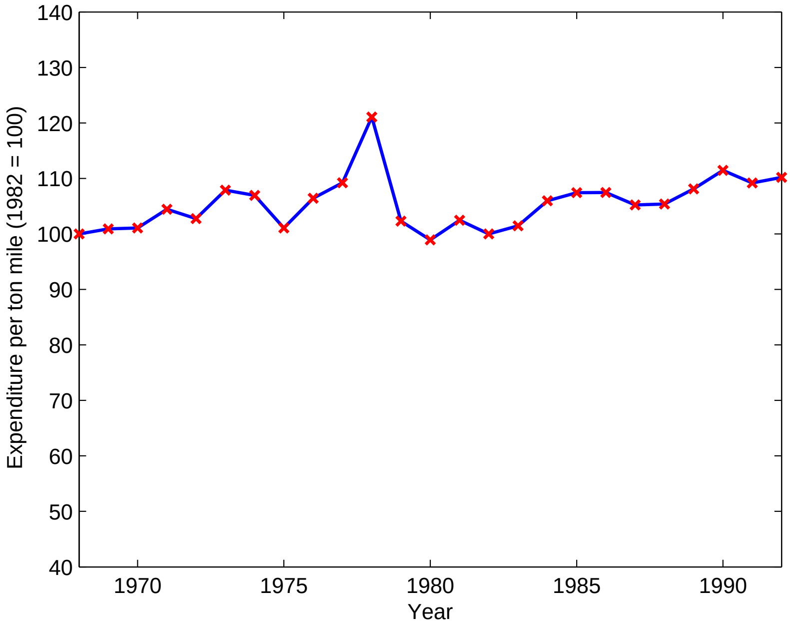

Figure 4: Relative Price of Transportation, United States, 1968-1992