Capital Services in Global Value Chains

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Abstract

This paper links the supply of investment goods with the use of capital services in the open economy. By lowering prices of imported investment goods, trade liberalization lowers costs for producers that use capital services. Capital incomes rise relative to labor as exports in each country reallocate towards its more capital-intensive mix of industries. These forces are quantitatively important. Welfare gains from trade are twice as high as models where capital is a primary factor in fixed supply, and changes in trade costs between 1997-2007 explain one-quarter of the decline in the global labor share.

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Many traded goods are purchased as investment. These capital expenditures on equipment, machinery, and software provide flows of *capital services* in global value chains. Take, for instance, a semiconductor value chain where production facilities in Taiwan rely on machinery imported from Japan. A reduction in trade costs would eventually reduce the per-period costs of owning (or renting) such machinery. In a competitive market, the price of Taiwanese semiconductors would fall. Because semiconductors are themselves inputs in the production of other goods (including machinery), the initial cost reduction would percolate throughout downstream industries and countries, amplifying the eventual benefits to final consumers.

This paper provides theory and quantification to demonstrate the importance of capital services in global production. The literature on global value chains (see, for example, Antràs and Chor, 2021) has focused thus far on intermediate inputs but not investment and capital. The existing calibration approach in models of production networks (e.g. Acemoglu et al., 2012) treats investment as final-use and capital as a primary factor. When a shock lowers the price of an expensed intermediate input, downstream producers benefit from lower input prices. But when the same shock lowers the price of a capitalized investment good, downstream production costs are unchanged.

My model extends existing multi-industry, multi-country models of trade (e.g. Caliendo and Parro, 2014) in two key dimensions. First, I reconcile the disconnect by treating capital services similarly to intermediate inputs. Capital is simply an intermediate input that doesn't depreciate fully within the accounting period. I embed this insight from Hulten (1979) into a fully disaggregated global production network where input-output linkages reflect the supply and use of not only intermediate inputs but also capital services. Second, final household consumption is financed out of both labor and capital incomes, both of which are endogenous to trade-induced patterns of specialization. As trade lowers the prices of investment goods, more capital-intensive producers benefit from greater cost reductions and gain export market share. Because investment goods are tradable and labor is not, trade reallocates output towards each country's most capital-intensive mix of industries. This reallocation of output can lower the global share of labor income.

Despite the model's conceptual simplicity, existing accounting conventions make it hard to quantify the supply and use of capital services from one industry to another. Most expenditures on equipment, machinery, and software are *capitalized* as investment rather than *expensed*. Unlike intermediate expenses, payments on capital services are usually borne by the producer as implicit user costs with no market value. The use of capital services thus shows up in national accounts as aggregate capital value-added rather than as bilateral payments from the industries using capital services to the industries supplying the initial investment goods.

I lean on the steady state properties of the model to overcome this quantification challenge. In steady-state, investment equals depreciation on existing capital. This property allows me to impute capital service payments from bilateral investment flows across industries reported in the BEA's capital flow tables. I calibrate the model's remaining production and consumption parameters to exactly replicate data in the 1997 World Input-Output Database.

Global value chains in my framework are both wider and deeper than existing static calibrations suggest. I demonstrate the quantitative importance of this result by computing the impact of further trade liberalization. I develop an "exact hat algebra" result similar to Dekle et al. (2008) to solve for the changes in steady state outcomes in response to any change in trade costs. My computational approach requires only observable data on trade, production, and consumption shares in the initial equilibrium, along with standard values for the model's elasticities and depreciation rates. I compare these changes in the steady-state of my model to the predictions of an alternative, static model calibration where investment is final-use and capital is a primary factor in fixed supply.

I provide two new quantitative insights. First, the per-period welfare gains are twice as large as those predicted by static models. A 10 percent uniform reduction in trade costs increases average per-period real consumption by 5.4 percent in my model compared to just 2.7 percent in static models. A fall in trade costs percolates more across my production network due to the supply and use of capital services, amplifying the fall in the final consumption price index. The increased gains from trade also vary across countries according to their relative position in the global value chain. Countries with more capital-intensive producers benefit more from the reduction in investment prices. Their domestic consumption price indices fall by more, and their incomes rise by more as their producers gain market share in the world. The gains from trade in my model relative to that in static calibrations range from 5 times higher in Mexico to 1.3 times higher in South Korea.

Second, trade liberalization is pro-capital. The fall in prices of investment goods reallocates output in each country towards its more capital-intensive industries where comparative advantage has grown. This reallocation can lower the share of labor income in *each country* even when production functions are everywhere Cobb-Douglas. A 10 percent uniform reduction in trade costs lowers the labor share in 32 out of the 41 countries in my analysis, and lowers the global share of labor income by 0.14 percentage points. To put this mechanism in perspective, I apply the methodology in Head and Ries (2001) to extract the "revealed changes" in trade costs between 1997 to 2007, a period of rapid globalization. Holding fixed all other model primitives to their 1997 values, I find that these observed changes in trade costs alone lower the global labor share by 0.74 percentage points, more than one-quarter of its observed decline during this period.

Contributions to the Literature. My first contribution is to show that global value chains are deeper and broader than previously understood. The literature on production networks in both macroeconomics (e.g. Carvalho and Tahbaz-Salehi, 2019) and trade (e.g. Costinot and Rodríguez-Clare, 2014) calibrate input-output linkages using data on flows of intermediate inputs across industries but treat capital as a primary factor in fixed supply. In comparison, I endogenize the supply and use of capital services across industries and countries. Just like intermediate inputs, the price of capital services depends on the cost of upstream suppliers (of investment goods). I develop a quantitative model where inter-industry production coefficients on the use of capital services can be identified from data on investment flows in steady state. Much like existing results in this literature, the augmented input-output coefficients in my model act as sufficient statistics for characterizing the propagation of shocks in steady state. But not only are these coefficients larger and more pervasive compared to what intermediate input use implies, they also alter existing measures of industry centrality and upstream-ness that are critical for the conduct of optimal policy (Blanchard et al., 2021) or contracting (Antràs and Chor, 2013) in global value chains.

My model is an open-economy extension of multi-sector real-business-cycle (RBC) models (Long and Plosser, 1983; Horvath, 2000; Atalay, 2017; vom Lehn and Winberry, 2021). This literature has focused on short-run economic fluctuations in a closed economy rather than long-run changes in the global steady state. Foerster et al. (2021) find that the supply and use of capital across industries amplifies certain sectors' contribution to aggregate US economic growth. I apply a similar framework to study the impact of trade. A parallel literature in trade embeds Ricardian forces in open-economy RBC models, but treat investment and capital as aggregate final goods that are not directly traded (Alvarez, 2017; Eaton et al., 2016; Kehoe et al., 2018), and emphasize the models' dynamic properties such as welfare along the transition path (Baldwin, 1992; Anderson et al., 2020; Ravikumar et al., 2019; Brooks and Pujolas, 2017). Instead, investment goods in my model are tradable, consistent with their observed concentration of production in just a few countries (Eaton and Kortum, 2001). My contribution is to link up the supply of investment with the use of capital services from one industry to another, providing a solution method for steady-state outcomes analogous to disaggregated static models like Caliendo and Parro (2014). I find that disaggregating the supply and use of capital is quantitively important; it amplifies the impact of economic shocks such as trade liberalization.

Moreover, disaggregation in my model provides a new, trade-based explanation for the decline in the global labor share. Recent explanations include superstar firms (Autor et al., 2020), declining competition (De Loecker et al., 2020; Barkai, 2020), tax and accounting rules (Smith et al., 2021; Bridgman, 2018; Koh et al., 2020), and declining investment prices coupled with capital-labor substitutability (Karabarbounis and Neiman, 2013), but have been fairly dismissive of trade. In a Heckscher-Ohlin model, trade would lower the labor share in the capital-abundant country but raise it in the labor-abundant country, and is therefore insufficient for explaining the *global* fall in labor share. Elsby et al. (2013) and Dao et al. (2017) put forward an offshoring hypothesis, but their explanations require non-unitary elasticities of substitution between labor and capital. My model provides a new quantifiable mechanism centered on endogenous comparative advantage. A fall in the price of investment goods causes each country to re-orient its exports towards its own mix of capital-intensive industries. This reallocation of output can decrease the labor share in *each* country even when production functions are everywhere Cobb-Douglas.

The rest of the paper is organized around three sections. In Section 1, I develop the model and describe its analytical properties. Section 2 covers data and calibration, and Section 3 presents new quantitative findings around the gains from trade and the decline in the global labor share.

1 Model of Capital Services in Global Value Chains

My model of global production features a network structure with producers supplying both intermediate inputs and investment goods for use in the production process of other industries in other countries. Goods within each industry are tradable, differentiated by country-of-origin, and produced under perfect competition. Differentiated goods varieties are combined into an industry-level composite using a constant-returns CES function with elasticity of substitution $\theta_j + 1$. I use $n, i = 1, ..., N$ to denote countries, $j, k = 1, ..., J$ to denote industries, and t to denote time.

Industry composite goods are purchased for three types of use: final consumption, intermediate inputs, and investment. Likewise, production requires three types of inputs: labor, intermediate inputs, and capital services. Goods produced in any industry k in any country i can be purchased for investment use and installed in any industry j in any country n to provide a flow of capital services for production.

For simplicity, I assume there is no technological change, no economic uncertainty, and perfect foresight. I focus only on characterizing the model's steady-state and leave transition dynamics to future research.

1.1 Model Primitives

Consumption. The representative household in each consuming country n has standard intertemporal preferences with discount factor $\rho < 1$ and concave utility $u(.)$:

$$U_n = \sum_{t=0}^{\infty} \rho^t u(C_{nt}),$$

where final consumption $C_{nt} \equiv \prod_j C_{njt}^{\alpha_{nj}}$ is a Cobb-Douglas function over industry composite goods C_{njt} with country-specific consumption coefficients $\sum_j \alpha_{nj} = 1$.

Production. Output q_{ijt} in each industry j and country i is a constant-returns Cobb-Douglas function:

$$q_{ijt} = A_{ijt} \cdot l_{ijt}^{\beta_{ij}^L} \prod_{k=1}^{J} m_{ijkt}^{\beta_{ijk}^M} \prod_{k=1}^{J} \kappa_{ijkt}^{\beta_{ijk}^K}, \tag{1}$$

where A_{ijt} is TFP, and $\beta_{ij}^L, \beta_{ijk}^M, \beta_{jk}^K$ are production coefficients representing the elasticity of output with respect to labor, intermediate inputs from industry k, and capital services from industry k. Production coefficients satisfy $\beta_{ij}^L + \sum_{k=1}^J \left(\beta_{ijk}^M + \beta_{ijk}^K\right) = 1$ and vary across countries and industries.

Investment and Capital Accumulation. Households have access to a riskless savings technology in units of the final good. In steady state $C_{nt} = C_{n,t-1}$ and the household Euler condition pins down the interest rate r^f on a one-period bond (in zero net supply):

$$1 + r^f = \frac{1}{\rho}. \tag{2}$$

Households can also invest in goods supplied by any industry k and install them as capital in any industry j to provide capital services.[1] Capital stocks κ_{jkt} are specific to both the supplying and using industries (e.g. computers k in the healthcare industry j), depreciate at rate δ_k and are replenished by new investment I_{ijkt} according to:

$$\kappa_{ijk,t+1} = (1 - \delta_k)\kappa_{ijkt} + I_{ijkt}. \tag{3}$$

A no-arbitrage condition pins down the unit price of capital services (r_{ijkt}) in steady state.[2] The net present asset value of a unit of capital k installed in industry j at the start of a period t, V_{ijkt}, is equal to the price of capital services r_{ijkt} plus its discounted value next period net of depreciation:

$$V_{ijkt} = r_{ijkt} + \frac{1}{1 + r_t^f}(1 - \delta_k)V_{ijk,t+1}.$$

Asset values and prices are constant in steady state, so that $V_{ijk} = V_{ijk,t+1}$. Under no-arbitrage, the return on a one-period bond $(1 + r^f)$ equals the return on investing in any good k (at purchase price P_{ik}), so that

$$1 + r^f = \frac{V_{ijk}}{P_{ik}} = \frac{r_{ijk}}{P_{ik}(1 - \frac{1}{1+r^f}(1 - \delta_k))},$$

which relates the price of capital services (r_{ijk}) with the price of the initial investment good (P_{ik}):

$$r_{ijk} = P_{ik}\left(r^f + \delta_k\right). \tag{4}$$

Equation (4) delivers the key insight in the paper. In steady state, prices of capital services, r_{ijk}, move one-for-one with P_{ik}, the price of the composite investment good supplied by producers in industry k.[3] If any shock (like trade liberalization) reduces the price P_{ik} of investment goods from industry k, downstream industries j that use the services of capital type k benefit from lower production costs since r_{ik} will fall.

[1] Assuming that households make investments and then sell capital services to firms is equivalent to assuming that firms make capital investments by borrowing from households at the required rate of return.

[2] It is also known as the rental price of capital, or Jorgenson (1963)'s user cost of capital.

[3] Here I assume that capital assets of a given type k depreciate at the same rate δ_k regardless of industry j of use. It is trivial to allow depreciation in the model to depend on both k and j, though data requirements would be heftier.

Trade. The usual Armington (1969) setup yields a CES consumption price index for the composite industry good in each country n:

$$P_{nk} = \left(\sum_i (\tau_{nij} c_{ij})^{-\theta_j} \right)^{-\frac{1}{\theta_j}}, \tag{5}$$

where τ_{nij} denotes bilateral iceberg trade frictions between importer n and exporter i, and c_{ij} denotes the unit cost of production in country i in industry j:

$$c_{ij} = A_{ij}^{-1} w_i^{\beta_{ij}^L} \prod_k P_{ik}^{\beta_{ijk}^M + \beta_{ijk}^K} \eta_{ij}, \tag{6}$$

where, using equation (4), industry j's dependence on industry k in production (its use of both intermediate inputs and capital services) can be summarized by the augmented "input-output" coefficients $\beta_{ijk}^M + \beta_{ijk}^K$, reflecting the elasticity of producer j's marginal costs with respect to the consumption price index in industry k. The constant η_{ij} contains production coefficients β, depreciation rates δ, and the interest rate r^f.

Lastly, import shares take on the constant-elasticity form:

$$\pi_{nij} = \frac{(\tau_{nij} c_{ij})^{-\theta_j}}{\sum_{i'} (\tau_{ni'j} c_{i'j})^{-\theta_j}}, \tag{7}$$

and do not vary by type of use, consistent with assumptions made in the WIOD.

1.2 Global Equilibrium in Steady State

I assume that each country operates under financial autarky. All expenditures (including investment) are financed and owned by households from the purchasing country. I model trade deficits (D_n) as exogenous net transfers across countries.

In steady state, capital stocks are constant and investment exactly replenishes depreciation, $I_{ijk} = \delta_k K_{ijk}$. Combined with equation (4), this condition relates purchases of new investment goods $P_{ik} I_{ijk}$ to capital income $r_{ik} \kappa_{ijk}$ (payments for capital services). In turn, using market clearing for capital services ($r_{ik} \kappa_{ijk} = \beta_{ijk}^K X_{ij}$), the same investment flows can be related to gross output X_{ij} in each using industry j:

$$P_{ik} I_{ijk} = \frac{\delta_k}{r^f + \delta_k} r_{ik} \kappa_{ijk} = \frac{\delta_k}{r^f + \delta_k} \beta_{ijk}^K X_{ij}. \tag{8}$$

Equation (8) reveals that only a fraction of capital income is re-invested in steady-state. The remaining fraction $\frac{r^f}{r^f + \delta_k}$ is net capital income and spent on final consumption goods as compensation to households for their investments in the prior period. The more patient are households, the lower the required rate of return $1 + r^f$, and the lower is net capital income.

Using equation (8), Definition 1 expresss the solution to the steady state in terms of labor market and goods market clearing conditions alone. Goods markets clear when gross industry output X_{ij} is exhausted by consumption from each importing country n across the three types of use: (i) as intermediates, (ii) as investment for providing capital services, and (iii) as final consumption. I use bold math notation to denote variables in matrix or vector form.

Definition 1 (Global Steady State) *Given labor $\boldsymbol{L}$, consumption coefficients $\boldsymbol{\alpha}$, production coefficients $\boldsymbol{\beta}$, TFP shifters $\boldsymbol{A}$, interest rate r^f, depreciation rates $\boldsymbol{\delta}$, trade imbalances $\boldsymbol{D}$, iceberg trade costs $\boldsymbol{\tau}$, and trade elasticities $\boldsymbol{\theta}$, the solution to the global steady state can be expressed in terms of output $\boldsymbol{X}$ and relative wages $\boldsymbol{w}$ that satisfy:*

1. *Labor market clearing in each country i:*

$$w_i L_i = \sum_j \beta_{ij}^L X_{ij},$$

2. *Goods market clearing in each industry j in each country i:*

$$X_{ij} = \sum_n \pi_{nij} \left[\sum_k \left(\beta_{nkj}^M + \frac{\delta_j}{r_n^f + \delta_j} \beta_{nkj}^K \right) X_{nk} + \alpha_{nj} \left(w_n L_n + D_n + \sum_j \sum_k \frac{r_n^f}{r_n^f + \delta_j} \beta_{nkj}^K X_{nk} \right) \right],$$

where import shares $\boldsymbol{\pi}$ from equation (7) are a function of $\boldsymbol{w}$ and model primitives using equations (5) and (6).

My model's steady state features two key differences compared to static quantitative trade models. First, there is greater circularity in production. Input-output coefficients reflect the use of not only intermediate inputs (β_{ijk}^M) but also capital services (β_{ijk}^K), amplifying the impact of a cost shock in any investment-supplying industry k on downstream capital-using industries j. Second, both labor and capital incomes are used for final consumption and their relative proportions are endogenous to trade-induced reallocations of output. As trade liberalization lowers the price of capital service inputs relative to labor, each country shifts its output towards its mix of capital-intensive industries where comparative advantage and export demand has risen. This mechanism can raise capital's share of income relative to labor in each country.

1.3 The Impact of Arbitrary Shocks in Steady State

Proposition 1 solves for the exact impact of arbitrary shocks on the global steady state using 'exact-hat' algebra introduced by Dekle et al. (2008). I let $\hat{y} \equiv \frac{y'}{y}$ denote the new value of any variable y' as a ratio of the old value y.

Proposition 1 (Counterfactuals in the Global Steady State) *Let there be unanticipated, exogenous shocks to trade costs* $\{\hat{\tau}_{nij}\}_{n,i,j}$, *population size* $\{\hat{L}_{ij}\}_{i,j}$, *TFP* $\{\hat{A}_{ij}\}_{i,j}$, *and/or imbalances* $\{\hat{D}_n\}_n$. *Using the model parameters* $\boldsymbol{\beta}, \boldsymbol{\alpha}, \boldsymbol{\delta}, r^f, \boldsymbol{\theta}$ *and initial equilibrium data on import shares* $\boldsymbol{\pi}$, *labor income* $\boldsymbol{wL}$, *trade imbalances* $\boldsymbol{D}$ *alone, the solution to the new steady state of the global economy can be expressed in terms of exact changes in wages* $\{\hat{w}_n\}_n$ *such that:*

1. *The labor market clears in each country* i

$$\hat{w}_i \hat{L}_i w_i L_i = \sum_k \beta^L_{ik} X'_{ik},$$

2. *Goods markets clear in each industry* j *in each country* i*:*

$$X'_{ij} = \sum_n \pi'_{nij} \left[\sum_k \left(\beta^M_{nkj} + \frac{\delta_{nj}}{r^f_n + \delta_{nj}} \beta^K_{nkj} \right) X'_{nk} + \dots \right.$$
$$\left. \dots + \alpha_{nj} \left(\hat{w}_n \hat{L}_n w_n L_n + \hat{D}_n D_n + \sum_j \sum_k \frac{r^f_n}{r^f_n + \delta_{nj}} \beta^K_{nkj} X'_{nk} \right) \right],$$

3. *Import shares take the constant-elasticity form:*

$$\pi'_{nij} = \frac{\pi_{nij} (\hat{\tau}_{nij} \hat{c}_{ij})^{-\theta_j}}{\sum_{i'} \pi_{ni'j} (\hat{\tau}_{ni'j} \hat{c}_{i'j})^{-\theta_j}},$$

4. *Changes in unit costs of production in each country* i *in industry* j *are given by:*

$$\hat{c}_{ij} = \hat{A}^{-1}_{ij} \hat{w}_i^{\beta^L_{ij}} \prod_k \hat{P}_{ik}^{\beta^M_{ijk} + \beta^K_{ijk}},$$

5. *Changes in the consumption price index of industry* k *in a given country* n *are given by:*

$$\hat{P}_{nk} = \left(\sum_i \pi_{nik} (\hat{\tau}_{nik} \hat{c}_{ik})^{-\theta_k} \right)^{-\frac{1}{\theta_k}}.$$

I use Proposition 1 to quantify the two key features of the steady state of my model. I show that increased circularity in production generates greater welfare gains from trade, and that trade-induced reallocations of output lower the global share of labor income.

2 Calibration to WIOD and BEA Capital Flows Data

My primary data source is the World Input-Output Database (WIOD) constructed by Timmer et al. (2015). This dataset provides the annual sales of any origin country i and industry k to any destination country n for use as either (i) intermediate inputs in an industry j, (ii) gross fixed capital formation, (iii) final consumption by households. The data cover the years 1995 to 2011 and feature 41 economic regions (including a rest-of-the-world aggregate). I supplement these data with the WIOD's socioeconomic accounts, which contain labor compensation by industry by country, $\boldsymbol{wL}$ in the model.

I calibrate the initial steady state of the model to match the WIOD in 1997, the year with the most complete cross-sectional data available on trade flows, intermediate input flows, and investment flows. Figure 1a illustrates how data in a mock US input-output table maps to the model's consumption and production coefficients. I calibrate final consumption shares α_{nj} as the share of consumption by households and the government in country n on output from industry j. Unlike conventional approaches, I exclude expenditures on investment from calibration of α_{nj} since these do not reflect consumption utility in the model. As usual, production coefficients on labor and intermediate inputs (β^L_{ij} and β^M_{ijk}) are identified from the share of industry j's output expensed on labor and intermediate inputs k.

Production coefficients on capital services (β^K_{ijk}) are harder to calibrate for several reasons. The first is a lack of industry-level data on the supply and use of capital services. Highlighted cells in Figure 1a are missing from the WIOD. Within each column, for a given using industry j, the WIOD only reports *aggregate* payments to capital (computed as gross operating surplus—total value-added less labor compensation wL_{ij}) instead of payments for each type of capital service k (cells highlighted in yellow). Likewise, across each supplying row industry k, the WIOD only records the *aggregate* value of its output purchased as investment instead of purchases by each using industry j (cells highlighted in green).

I overcome the missing data problem by supplementing the WIOD with data from the BEA's capital flow tables in 1997. These tables correspond to the cells highlighted in green in Figure 1a. They contain estimates of the purchases of investment goods from industry k installed as capital in industry j in the US—corresponding to $P_{ik}I_{ijk}$ in the model.

A second challenge is that the model requires the global economy to be in steady state. Outside of the steady state, investment depends on expectations of future economic conditions, so equation (8) may not hold. The model's capital coefficients can be calibrated to either the forward-looking steady state implied by new investment, or the current-year steady state implied by value-added by capital. I choose to calibrate the model to current-year economic conditions, disregarding forward-looking information about the economy contained in investment data (the aggregate investment column in the WIOD).

I use equation (8) to impute payments on capital services (the cells highlighted in yellow) from

BEA data on relative investment flows (cells highlighted in green). Relative capital coefficients for US producers in any industry j equal

$$\frac{\beta^K_{US,jk}}{\beta^K_{US,j}} = \frac{r_{US,k}\kappa_{US,jk}}{\sum_{k'} r_{US,k'}\kappa_{US,jk'}} = \frac{P_{US,k} I_{US,jk} \frac{r^f_{US}+\delta_{US,k}}{\delta_{US,k}}}{\sum_{k'} P_{US,k'} I_{US,jk'} \frac{r^f_{US}+\delta_{US,k'}}{\delta_{US,k'}}}, \tag{9}$$

where the right-hand-side term is a function of data from the capital flow tables, depreciation rates $\boldsymbol{\delta}$, and the risk-free rate r^f. The factor $\frac{r^f_{US}+\delta_{US,j}}{\delta_{US,j}}$ adjusts for the fact that between two capital assets k and k' with the same β^K_{ijk}, the asset with the lower-depreciation rate also requires lower new investments. I set the risk-free rate r^f equal to 0.03 in all countries, and I use the BEA's estimates of depreciation rates by asset type j to calibrate $\boldsymbol{\delta}$.

While the BEA's capital flow tables provide the required data for the US, there is a lack of comparable data for other countries. I overcome this third challenge by using a proportionality assumption to impute capital coefficients in other countries' production functions. I first use observable data from the WIOD to pin down β^K_{ij}, capital service expenditures as a share of gross output in each industry j in country i. Then, using equation (9), I apportion β^K_{ij} into expenditure shares on constituent types of capital services k according to the same proportions observed in industry j in the US economy:

$$\beta^K_{ijk} = \beta^K_{ij} \frac{\beta^K_{US,jk}}{\beta^K_{US,j}} \qquad \forall i = 1, ...N.$$

Figure 1b visualizes the resulting "input-output" matrix of capital coefficients, $\beta^K_{US,jk}$, for the US. Unsurprisingly, construction, machinery and electrical and transportation equipment stand out as the most important capital-service-supplying industries. The corresponding matrix of capital coefficients in other countries will differ insofar as their capital share of value-added in production differs from the US.

I compute import shares $\boldsymbol{\pi}$ directly from WIOD data under the assumption that import shares for a country-pair n, i in each industry j do not differ by type of use. I use the same values for industry-level trade elasticities, $\boldsymbol{\theta}$ as those estimated by Caliendo and Parro (2014). For a few, mostly non-traded, industries that lack pre-existing estimates, I follow Costinot and Rodríguez-Clare (2014) and set $\theta_j = 5$. Lastly, given all the above parameters, I use the system of market-clearing equations behind Definition (1) to solve for the trade imbalances $\boldsymbol{D}$ that exactly rationalize the data in 1997 as a steady state of the global equilibrium.

Tables 1 and 2 provide summary statistics and an overview of calibration assumptions at the industry and country levels respectively.

3 Quantifying the Impact of Capital Services in Global Value Chains

I demonstrate the quantitative importance of embedding capital services in global value chains by assessing the impact of trade liberalization. Having calibrated the model's steady state to 1997 data, I use Proposition 1 to derive outcomes in the counterfactual steady state when bilateral trade costs change. I hold constant all other model primitives to isolate the impact of trade costs. First, I compute the impact of a uniform 10 percent reduction in trade costs ($\hat{\tau}_{nij} = 0.9$) across all country-pairs $n \neq i$ in all industries j.

Next, I conduct a model-based accounting exercise by computing the impact of actual "revealed changes" in bilateral trade costs over the period 1997 to 2007. Following Head and Ries (2001), I use equation (7) to express the change in bilateral trade costs in terms of the ratio of observed changes in import shares between 1997 and 2007:

$$\left(\hat{\tau}_{nij}\hat{\tau}_{inj}\right)^{-\theta_j} = \left(\frac{\hat{\pi}_{nij}\hat{\pi}_{inj}}{\hat{\pi}_{nnj}\hat{\pi}_{iij}}\right), \tag{10}$$

assuming that domestic trade costs remain unchanged in each country ($\hat{\tau}_{nnj} = 1$).[4] In addition, I assume that changes in bilateral frictions are symmetric, so $\hat{\tau}_{nij} = \hat{\tau}_{inj}$, and I winsorize at the 2.5 and 97.5 percentiles of the distribution of $\hat{\tau}_{nij}$. On average, revealed trade costs fell 12 percent during this period.

In both scenarios, I compare the impact under the calibration above to the impact predicted by conventional model calibrations (see e.g. Alvarez and Lucas, 2007; Parro, 2013; Costinot and Rodríguez-Clare, 2014), where all value-added in the WIOD is treated as value-added by equipped labor, a single primary factor of production in fixed supply.

3.1 The Welfare Gains from Trade

To demonstrate the model's increased production circularity, I use Corollary 1 to compute the impact of trade liberalization on per-period welfare (real income for final consumption) in steady state.[5] Equation (11) decomposes this overall welfare change into (i) the change in labor income, (ii) the change in net capital income, and (iii) the change in the consumption price index (the denominator), which affects the purchasing power of both labor and net capital income. The change in real labor income is the traditional "welfare gains from trade" popularized by Arkolakis

[4]This assumption benchmarks changes in international trade frictions *above and beyond* any changes in domestic trade frictions. The imputed $\hat{\boldsymbol{\tau}}$ shocks likely under-represent the true effects of globalization. For example, if transportation costs fell proportionally for both domestic ($i = n$) and international ($i \neq n$) routes, the implied $\hat{\tau}_{ni}$ would equal 1. Indeed, imputed trade costs *rose* (i.e. $\{\hat{\tau}_{nij}\}_{n \neq i,j} > 1$) for 31 percent of the sample, likely instances where domestic frictions fell faster than international frictions.

[5]I include deficits (exogenous transfers D_n) in market clearing conditions but ignore deficits in the interpretation of welfare because it is not clear that deficits are used to fund household expenditures. The Online Appendix provides an alternative derivation for welfare based on final consumption *expenditures* (net of deficit transfers) rather than income. In practice, because deficits are constant across counterfactuals and a small share of total consumption expenditures, the adjustment matters little.

et al. (2012).

But because households also consume out of capital income net of depreciation, any equilibrium change to net capital incomes also affects welfare. With $r^f = 0.03$, on average 20% of consumption expenditures are financed from net capital income in the initial steady state (i.e. s_n^L defined below is on average 0.8).

Corollary 1 (Changes in Real Consumption Income) *The change in per-period real income for final consumption is equal to*

$$\hat{C}_n = \frac{\hat{w}_n \hat{L}_n w_n L_n + \sum_j \sum_k \frac{r_n^f}{r_n^f + \delta_j} \beta_{nkj}^K X'_{nk}}{w_n L_n + \sum_j \sum_k \frac{r_n^f}{r_n^f + \delta_j} \beta_{nkj}^K X_{nk}} \prod_k \hat{P}_{nk}^{-\alpha_{nk}}$$
$$= s_n^L \cdot \underbrace{\frac{\hat{w}_n \hat{L}_n}{\prod_k \hat{P}_{nk}^{\alpha_{nk}}}}_{\Delta \text{real labor income}} + (1 - s_n^L) \cdot \underbrace{\frac{\sum_k \mu_{nk} \hat{X}_{nk}}{\prod_k \hat{P}_{nk}^{\alpha_{nk}}}}_{\Delta \text{real net capital income}}, \qquad (11)$$

where μ_{nk} denotes country n's share of net capital income from industry k:

$$\mu_{nk} \equiv \frac{\sum_j \beta_{nkj}^K \frac{r^f}{r^f + \delta_j} X_{nk}}{\sum_{k'} \sum_j \beta_{nk'j}^K \frac{r^f}{r^f + \delta_j} X_{nk'}},$$

and s_n^L denotes country n's share of total final consumption out of labor income:

$$s_n^L \equiv \frac{w_n L_n}{w_n L_n + \sum_j \sum_k \frac{r_n^f}{r_n^f + \delta_j} \beta_{nkj}^K X_{nk}}.$$

Figure 2a charts each country's change in per-period welfare under both the scenario (i) where capital is in fixed supply (the conventional calibration, in teal) and (ii) where capital is endogenous (my calibration, in red). Table 2 displays the underlying numbers. In the conventional calibration, the gains from a 10 percent trade liberalization average 2.7 percent across countries. In my setting where capital is endogenous, welfare rises by an average of 5.4 percent. This multiplier effect is consistent with increased production circularity. Investment goods from one industry are used to provide capital services for other industries. Trade lowers the prices of investment goods, which lowers production costs in downstream industries supplying intermediate inputs and more investment goods, which further lowers costs for yet more downstream industries, *ad infinitum*. Models that treat investment as final-use and capital as a primary factor would miss these percolations.

More interestingly, each country's multiplier—the ratio of the welfare change in the two model calibrations—depends on its relative position in the global value chain. Figure 2b shows that the multiplier increases with a country's capital intensity in production. Relative to benchmark models, capital-intensive producers in my model have their marginal costs disproportionately lowered by trade liberalization. Increased comparative advantage in these countries generate terms-of-trade effects that increase labor and capital incomes. Multipliers vary greatly across countries, ranging from 4.3 for Mexico (whose capital income as a share of gross output is 0.37) to only 1.5 for Korea (whose corresponding share is 0.11).

3.2 The Decline of the Global Labor Share

In the calibrated model, capital coefficients within each industry j differ across countries (i.e. $\beta^K_{ijk} \neq \beta^K_{njk}$). All else equal, a shock that lowers the price of investment goods would reallocate world output in each industry towards the country with the most capital-intensive technology. Because investment goods are tradable and labor is not, trade liberalization has the potential to raise the share of capital income in *each* country.[6] In my first quantitative exercise, the 10 percent uniform trade liberalization shock lowers the labor share in 32 out of the 41 countries and lowers the global labor share by 0.14 percentage points.

I demonstrate this second key feature of the model by quantifying the impact of trade-induced reallocations on the share of labor income. Figure 3a visualizes the simultaneous rise in trade and the fall in the global labor share. The colored lines display the exported share of output from all countries in my sample, by each type of use: (i) for investment, (ii) for intermediate inputs, and (iii) for final consumption. The black line displays the share of total income accruing to labor. Several facts are notable. First, investment goods are as traded as intermediate goods (with 13 percent of output exported), whereas final consumption goods are much less traded (with only 6 percent of output exported). Second, the trade share has risen from 1997 to 2007 across all three types of use. Third, during this same period of widespread globalization, the (weighted) global labor share fell by 2.8 percentage points from 60.1 percent to 57.3 percent.

In my second quantitative exercise, I feed in the "revealed changes" in bilateral trade costs from 1997 to 2007 computed using equation (10). While these revealed trade frictions average a reduction of 12 percent, there is substantial heterogeneity across industries and countries, so it remains an empirical question whether trade liberalization can explain the labor share decline during this period. Table 2 reports the model-predicted change in each country's labor share:

$$\Delta LS_i = \frac{\sum_j \beta^L_{ij} X'_{ij}}{\sum_j (\beta^L_{ij} + \beta^K_{ij}) X'_{ij}} - \frac{\sum_j \beta^L_{ij} X_{ij}}{\sum_j (\beta^L_{ij} + \beta^K_{ij}) X_{ij}}. \tag{12}$$

I also compute the global labor share as the GDP-weighted average of ΔLS_i over all countries.

I find that the set of revealed changes in trade costs from 1997 to 2007 reduced the global labor

[6] Technically, this effect can be offset if intermediate inputs are tradable and industries intensive in intermediate input use happen to be also intensive in labor. This correlation, however, is not present in the data.

share by 0.74 percentage points, over one-quarter of the observed decline of 2.8 percentage points. Figure 3b correlates the labor share changes against those observed in the data for each country in the analysis. Besides explaining one-quarter of the overall decline, the model's counterfactual explains 31 percent of the observed variation in labor-share changes across countries. In comparison, in the alternative calibration where capital is a primary factor in fixed supply, the same set of trade shocks also generate production reallocation (because changes in relative costs of intermediate inputs also affect comparative advantage) but predict a virtually unchanged global labor share (in fact, an increase by a trivial 0.05 percentage points).

Figure 3c provides more evidence in support of the mechanism: trade liberalization causes comparative advantage to shift in favor of capital-intensive producers in each industry. I regress each country-industry's model-predicted log change in output ($\log \hat{X}_{ij}$) against its 1997 capital intensity in production, measured as $\beta_{ij}^{K,VA}$, controlling for industry fixed effects so as to measure changes in market *shares* (output relative to other producers in the same industry). The blue line shows a statistically positive and significant regression fit (t-stat = 3.57) from predictions in the model where capital is endogenous. In contrast, the red line shows an insignificant regression fit (t-stat = -1.70) from predictions in the conventional calibration where capital is fixed.

Lastly, the labor share result does not hinge on the assumption of a Cobb-Douglas production function. In the Online Appendix I generalize Proposition 1 to accommodate an arbitrary elasticity of substitution, η, between capital, labor, and intermediate inputs. Unsurprisingly, trade liberalization lowers the global labor share by more whenever η is higher, as producers substitute towards a higher expenditure share on capital services. When $\eta < 1$, capital is complementary with other inputs, so a fall in the price of capital services causes producers to spend more on labor. This competes with the trade-reallocation mechanism, which always causes an expansion of output for the *currently* capital-intensive producers and raises capital's share of income. For mild values of complementarity, e.g. $\eta \in (0.92, 1)$, the trade mechanism quantitatively dominates and the global labor share is still predicted to fall with trade liberalization.

Conclusion

Global value chains are powered by steady flows of investment and capital services. Much of the existing literature has focused exclusively on the role of intermediate inputs. This paper links the supply of investment goods with the use of capital services in a simple, quantitative model of global production. The impact of trade liberalization is dramatically different when capital services are embedded in global value chains. Cost reductions percolate across industries and countries through the supply and use of not only intermediate inputs but also capital services. The welfare impact of trade liberalization is more than twice as high as conventional models predict. These increased gains accrue disproportionately to capital-intensive countries as they benefit from lower production costs and gain comparative advantage in their respective industries.

Most surprisingly, trade liberalization is pro-capital. The most capital-intensive producers in each industry gain market share, and this reallocation in each country towards its own set of capital-intensive industries lowers the global share of labor income. Changes in trade costs between 1997 and 2007 explain more than one-quarter of the decline in the global labor share.

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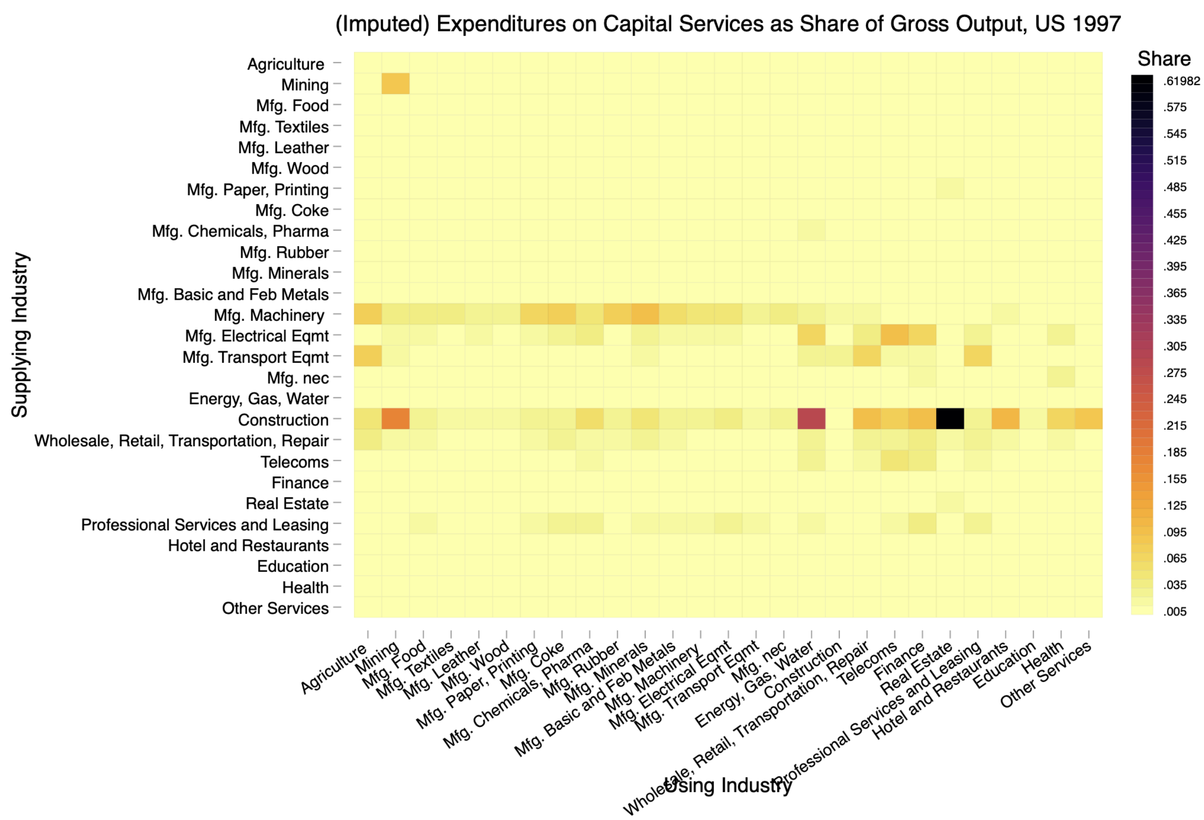
Figure 1: Inter-Industry Supply and Use of Intermediate Inputs, Investment, and Capital Services

(a) Example Augmented Input-Output Table in Autarky with Two Industries

Type of Use (columns):	Intermediates		Investment			Consmp.	Output
Source of Supply (rows):	by j	by k	Total	(by j)	(by k)		
Intermediate inputs:				Capital Flows:			
from j	$\beta^M_{jj} X_j$	$\beta^M_{kj} X_k$	$\frac{\delta_j\left(\beta^K_{jj}X_j+\beta^K_{kj}X_k\right)}{r^f+\delta_j}$	$\frac{\delta_j}{r^f+\delta_j}\beta^K_{jj}X_j$	$\frac{\delta_j}{r^f+\delta_j}\beta^K_{kj}X_k$	$\alpha_j S$	X_j
from k	$\beta^M_{jk} X_j$	$\beta^M_{kk} X_k$	$\frac{\delta_k\left(\beta^K_{jk}X_j+\beta^K_{kk}X_k\right)}{r^f+\delta_k}$	$\frac{\delta_k}{r^f+\delta_k}\beta^K_{jk}X_j$	$\frac{\delta_k}{r^f+\delta_k}\beta^K_{kk}X_k$	$\alpha_k S$	X_k
Capital value-added:	$\beta^K_j X_j$	$\beta^K_k X_k$					
(= sum of capital services)							
from capital supplied by j	$\beta^K_{jj} X_j$	$\beta^K_{kj} X_k$					
from capital supplied by k	$\beta^K_{jk} X_j$	$\beta^K_{kk} X_k$					
Labor value-added	$\beta^L_j X_j$	$\beta^L X_k$					
Output	X_j	X_k					

Notes: Consmp. stands for final household consumption (S). Highlighted cells are 'missing' from basic input-output tables. Cells highlighted in green are provided by the BEA's capital flow tables. I use these cells to infer the value of cells highlighted in yellow, which can be directly used to calibrate production coefficients.

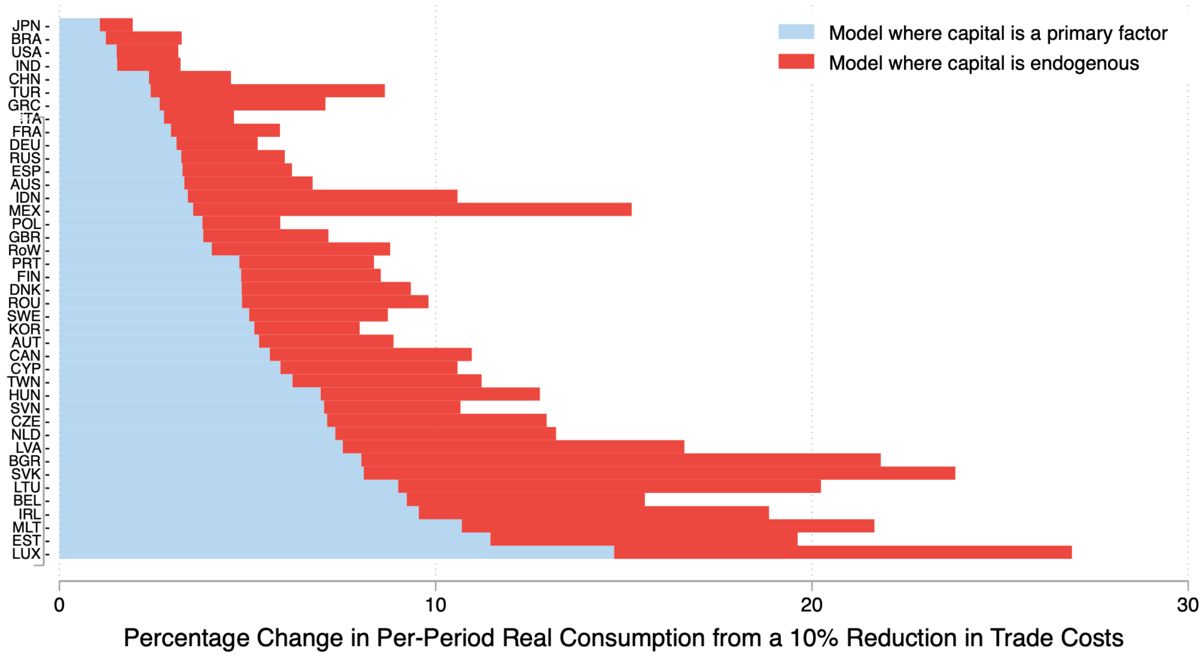
(b) US Capital Services Input-Output Matrix, coefficients $\beta^K_{US,jk}$



Notes: This figure visualizes the US capital services input-output matrix. Each cell corresponds to β^K_{jk} highlighted in yellow in the 2x2 example from Figure 1a: the expenditures $r_{jk}\kappa_{jk}$ by the using industry j on capital services from capitalized investment goods supplied by industry k as a share of the using industry's gross output X_j. *Source:* US BEA, WIOD, and author's calculations.

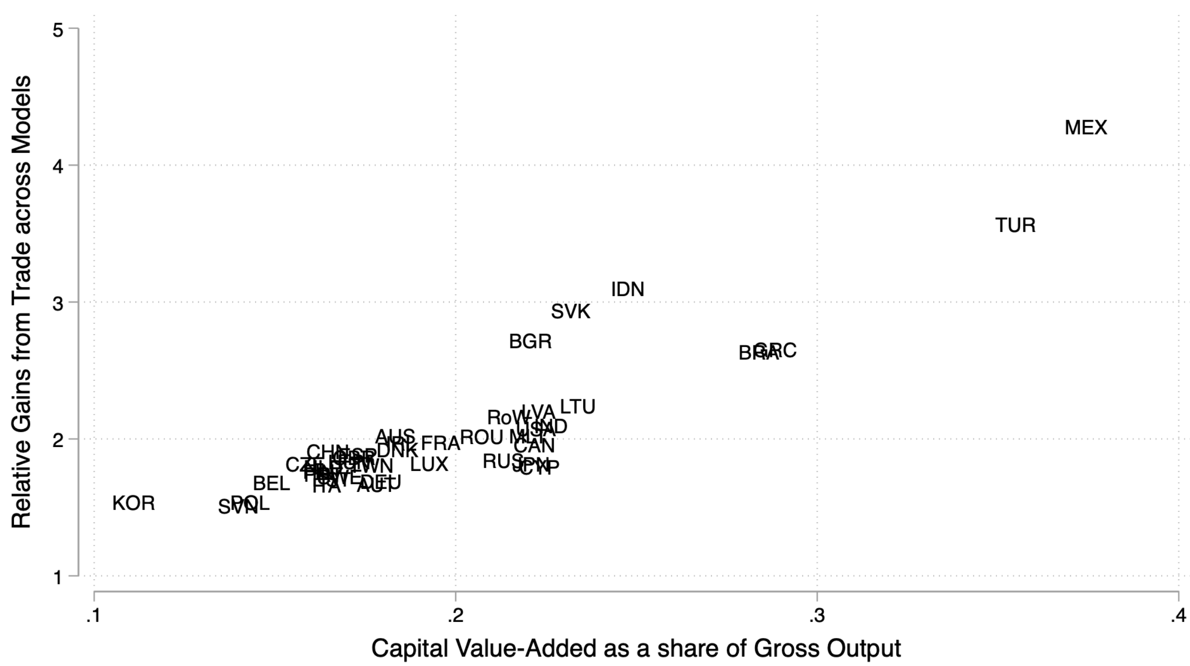
Figure 2: Welfare Impacts of Trade Liberalization with Capital Services in GVCs

(a) Comparison of Welfare Gains across Models



Notes: This figure plots the change in per-period steady state real income for consumption ($100(\hat{C}_n - 1)$) by country from a 10 percent reduction in trade costs across all country pairs $n \neq i$ in all industries, across two different model calibrations (shown in teal and red).

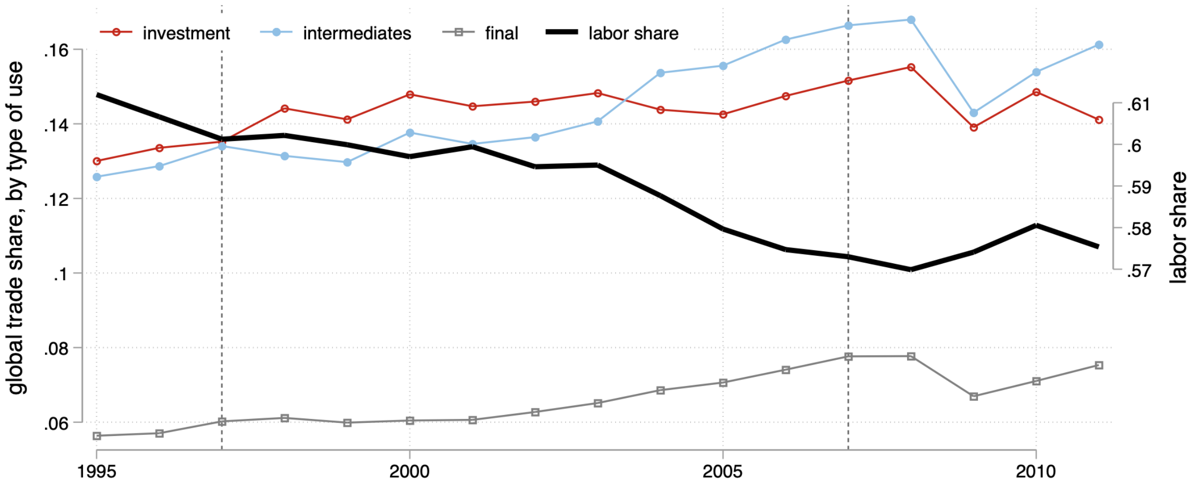
(b) Capital Intensity in Production Explains the Magnified Gains from Trade



Notes: This figure plots the ratio in the predicted welfare gains from trade in the two different model calibrations in Figure 2a (red divided by teal bar) against each country's overall capital intensity in production.

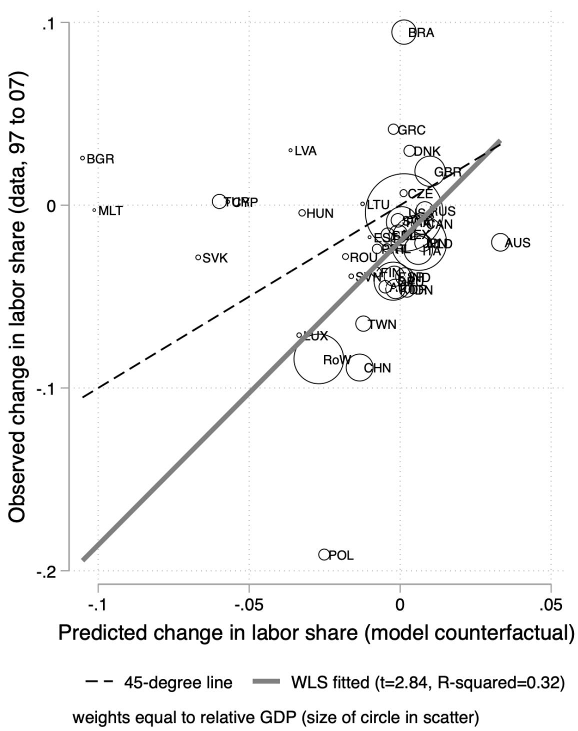
Figure 3: Trade Liberalization explains the Decline of the Global Labor Share

(a) Data on Global Trade by Type of Use and the Labor Share, 1995-2011

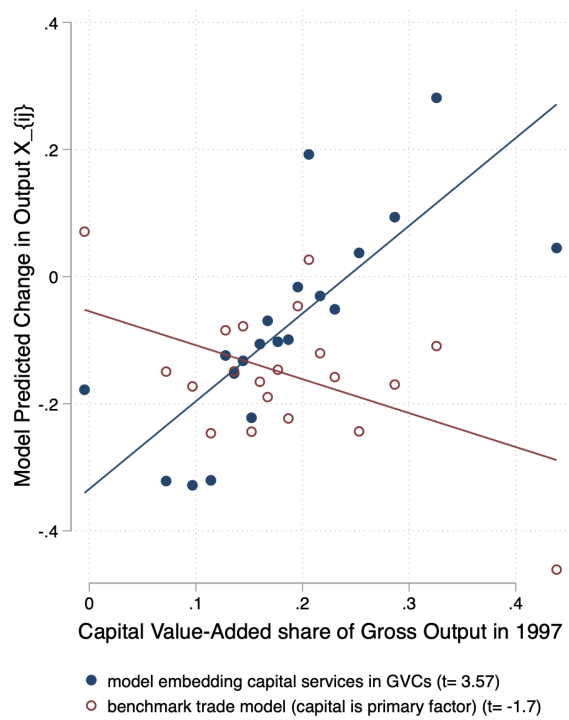


Notes: This figure plots, on the left axis, the exported share of output in all 41 countries in the sample (excluding Rest-of-World), by three types of use. The right-axis plots the labor share of income over the same set of countries. Dashed vertical lines indicate 1997 and 2007, the start and end periods of my quantitative analysis. *Source:* WIOD.

(b) Change in Labor Share, 1997-2007: Data Observations versus Model Predictions



(c) Model Mechanism: Capital-intensive Producers Gain Market Share



Notes: Panel (b) plots, by country, the change in the labor share in the data (97-07) against the change in the labor share in the model's counterfactual. The 45 degree line is given by red dashes. The bold grey line is the best-fit line from a weighted-least squares regression. Panel (c) plots binscatter regressions of the model's predicted change in output, log $\hat{X}_{ij}$, against the industry's capital intensity in production, β_{ij}^K, absorbing industry fixed effects, for two model calibrations: in blue: the model where capital is endogenous, and in red, the model where capital is a primary factor.

Table 1: Industry-level parameters and economic characteristics in 1997

Industry	δ_k	θ_k	π_k	share of output consumed for: investment	share of output consumed for: final use	share of expenditures on: capital $\left(\bar{\beta}^K_{\cdot j}\right)$	share of expenditures on: labor $\left(\bar{\beta}^L_{\cdot j}\right)$
Agriculture	0.02	8.11	0.08	0.02	0.37	0.20	0.38
Mining	0.04	15.72	0.26	0.06	0.03	0.42	0.18
Mfg. Food	0.16	2.55	0.11	0.00	0.64	0.15	0.13
Mfg. Textiles	0.16	5.56	0.32	0.01	0.50	0.12	0.22
Mfg. Leather	0.16	5.56	0.37	0.00	0.58	0.09	0.19
Mfg. Wood	0.16	10.83	0.15	0.06	0.07	0.11	0.22
Mfg. Paper, Printing	0.16	9.07	0.13	0.03	0.18	0.15	0.24
Mfg. Coke	0.16	51.08	0.16	0.00	0.30	0.22	0.05
Mfg. Chemicals, Pharma	0.16	4.75	0.29	0.01	0.23	0.18	0.15
Mfg. Rubber	0.16	1.66	0.18	0.02	0.13	0.13	0.22
Mfg. Minerals	0.16	2.76	0.12	0.01	0.09	0.18	0.23
Mfg. Basic and Feb Metals	0.09	7.99	0.19	0.07	0.04	0.13	0.21
Mfg. Machinery	0.13	1.52	0.33	0.44	0.12	0.11	0.25
Mfg. Electrical Eqmt	0.17	10.60	0.40	0.29	0.13	0.13	0.20
Mfg. Transport Eqmt	0.11	0.37	0.32	0.26	0.28	0.09	0.18
Mfg. nec	0.13	5.00	0.26	0.18	0.46	0.11	0.27
Energy, Gas, Water	0.02	5.00	0.01	0.01	0.34	0.37	0.16
Construction	0.03	5.00	0.00	0.82	0.01	0.09	0.33
Wholesale, Retail, Trnspt., Repair	0.10	5.00	0.07	0.06	0.42	0.21	0.40
Telecoms	0.02	5.00	0.03	0.01	0.35	0.32	0.31
Finance	0.16	5.00	0.04	0.00	0.36	0.29	0.31
Real Estate	0.03	5.00	0.00	0.03	0.70	0.73	0.06
Professional Services and Leasing	0.33	5.00	0.06	0.09	0.12	0.19	0.43
Hotel and Restaurants	0.16	5.00	0.02	0.00	0.74	0.13	0.36
Education	0.16	5.00	0.01	0.00	0.94	0.07	0.70
Health	0.16	5.00	0.00	0.00	0.95	0.13	0.49
Other Services	0.16	5.00	0.01	0.01	0.83	0.13	0.50

Notes: This table summarizes parameters and characteristics of the 27 industries in the quantitative model. Industries come from a slight aggregation of the WIOD nomenclature to be concordable with BEA capital flow tables. Depreciation rates δ_k are taken from the BEA and from Corrado et al. (2009). Trade Elasticities are taken from Caliendo and Parro (2014). Remaining data come directly from the WIOD, and data shown are weighted averages over all countries in the sample (see Table 2). Trade shares π_k are the share of industry output that is traded. The last four columns contain estimates of (i) the share of output consumed by type of use: investment and final (with intermediate inputs making up the remainder), and (ii) the production expenditures on capital and labor as a share of industry gross output (with intermediate inputs making up the remainder).
Source: US BEA, WIOD, and existing literature.

Table 2: Country-level economic characteristics in 1997 and model counterfactual outcomes

Country:		Data from 1997: β_i^K	$\frac{\beta_i^L}{\beta_i^L+\beta_i^K}$	π_i	$100(\hat{C}_i - 1)$ from $\hat{\tau} = 0.9$: model (i)	model (ii)	Δ 100x Labor share from revealed $\hat{\tau}$: data (97-07)	model (i)	model (ii)
AUS	Australia	0.18	0.62	0.06	3.32	6.73	-2.03	0.68	3.32
AUT	Austria	0.18	0.67	0.13	5.30	8.88	-4.46	-0.17	-0.49
BEL	Belgium	0.15	0.67	0.20	9.23	15.56	-1.62	-1.26	-0.41
BGR	Bulgaria	0.22	0.48	0.18	8.02	21.83	2.58	0.83	-10.52
BRA	Brazil	0.28	0.50	0.03	1.23	3.25	9.47	-0.06	0.13
CAN	Canada	0.22	0.58	0.11	5.59	10.96	-1.00	-0.10	0.72
CHN	China	0.16	0.57	0.05	2.38	4.56	-8.88	-0.53	-1.34
CYP	Cyprus	0.22	0.64	0.16	5.87	10.58	0.19	-0.52	-5.71
CZE	Czech Republic	0.16	0.59	0.15	7.11	12.95	0.66	0.18	0.11
DEU	Germany	0.18	0.67	0.08	3.11	5.27	-4.16	-0.03	-0.23
DNK	Denmark	0.18	0.66	0.11	4.84	9.34	2.97	0.03	0.31
ESP	Spain	0.17	0.65	0.08	3.27	6.18	-3.89	-0.02	-0.19
EST	Estonia	0.17	0.61	0.21	11.45	19.62	-1.75	-0.28	-1.01
FIN	Finland	0.16	0.66	0.11	4.83	8.54	-3.66	-0.34	-0.79
FRA	France	0.20	0.63	0.07	2.96	5.86	-0.93	0.08	0.06
GBR	United Kingdom	0.17	0.66	0.08	3.82	7.15	1.86	0.16	0.99
GRC	Greece	0.29	0.50	0.08	2.66	7.07	4.16	-0.15	-0.22
HUN	Hungary	0.17	0.61	0.18	6.94	12.77	-0.42	-0.81	-3.25
IDN	Indonesia	0.25	0.50	0.08	3.41	10.58	-4.62	-0.01	0.23
IND	India	0.23	0.55	0.05	1.53	3.22	-3.91	0.09	0.15
IRL	Ireland	0.18	0.59	0.21	9.55	18.86	-2.33	0.36	-0.44
ITA	Italy	0.16	0.67	0.07	2.78	4.64	-2.46	0.18	0.60
JPN	Japan	0.22	0.58	0.03	1.07	1.95	-2.05	0.07	0.62
KOR	Korea, Republic of	0.11	0.75	0.11	5.18	7.98	-4.58	-0.43	-0.15
LTU	Lithuania	0.23	0.54	0.19	9.00	20.24	0.07	-0.53	-1.24
LUX	Luxembourg	0.19	0.57	0.33	14.74	26.91	-7.11	-0.16	-3.35
LVA	Latvia	0.22	0.55	0.15	7.53	16.61	3.00	0.57	-3.63
MEX	Mexico	0.37	0.34	0.11	3.55	15.21	-1.58	0.07	-0.06
MLT	Malta	0.22	0.57	0.25	10.69	21.66	-0.27	0.46	-10.13
NLD	Netherlands	0.16	0.67	0.17	7.33	13.20	-2.07	0.26	0.76
POL	Poland	0.14	0.70	0.08	3.80	5.87	-19.11	-0.25	-2.51
PRT	Portugal	0.16	0.66	0.11	4.78	8.36	-2.39	-0.10	-0.76
ROU	Romania	0.21	0.53	0.11	4.85	9.81	-2.81	0.02	-1.81
RUS	Russia	0.21	0.59	0.04	3.24	5.99	-0.29	0.11	0.82
RoW	Rest of the World	0.21	0.58	0.11	4.05	8.79	-8.41	0.33	-2.69
SVK	Slovak Republic	0.23	0.41	0.16	8.09	23.81	-2.85	-3.48	-6.69
SVN	Slovenia	0.14	0.70	0.16	7.03	10.66	-3.89	-0.26	-1.62
SWE	Sweden	0.17	0.66	0.12	5.04	8.73	-0.83	-0.06	-0.07
TUR	Turkey	0.35	0.37	0.08	2.42	8.65	0.21	0.45	-5.99
TWN	Taiwan	0.18	0.63	0.14	6.19	11.22	-6.48	-0.33	-1.21
USA	United States	0.22	0.60	0.03	1.52	3.16	-0.40	-0.08	0.13
World (weighted)		0.21	0.60	0.07	2.71	5.44	-2.82	0.05	-0.74

Note: This table summarizes characteristics and model-based counterfactual outcomes in steady state by country. Capital intensity β_i^K denotes capital value-added as a share of gross output. The labor share $\beta_i^L/(\beta_i^L + \beta_i^K)$ is the ratio of labor value-added over total value-added. Import shares π_i denote imports as a share of total consumption. The change in real income for consumption $100(\hat{C}_i - 1)$ measures the percentage change in welfare and is computed from equation (11) and Proposition 1 under a uniform 10 percent decline in trade costs, over two model calibrations that each match the WIOD in 1997. Model (i) is the conventional calibration treating capital as a primary factor and investment as final use. Model (ii) is this paper's calibration embedding capital services in global value chains. The last three columns denote each country's change in labor share, first in the data between 1997 and 2007, and then in each of model (i) and model (ii)'s counterfactuals when using revealed trade cost changes computed from equation (10). Finally, the last row in the table gives corresponding values for the world economy, weighting countries by their share of gross output or GDP where appropriate. *Source:* US BEA, WIOD and author's calculations.