Appendices

Stimulus Effects of Investment Tax Incentives: Production versus Purchases

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Appendix A: Data

A.1. Production and purchases by type.

This appendix provides further details on the investment data used in our empirical analysis. The purchase data come from the BEA Underlying Detail Tables. For structures we equate purchases and production. For equipment, the production data come from the NBER-CES Manufacturing Productivity Database. Both datasets are available online.

The BEA Underlying Detail Tables (available online at http://www.bea.gov/iTable/index_UD.cfm) provide quarterly figures for the nominal value of capital goods purchases by type and type-specific price indecies. Specifically we used data from Tables 5.5.4U (Price Indexes for Private Fixed Investment in Equipment by Type), 5.5.5U (Private Fixed Investment in Equipment by Type), 5.4.4U (Price Indexes for Private Fixed Investment in Structures by Type), and 5.4.5U (Private Fixed Investment in Structures by Type).

NBER-CES Manufacturing Productivity Database provides annual data for production of capital goods and input usage by industry/product. The production data exist at a much more disaggregated level than the data in the BEA detail files. Product types are identified by six-digit NAICS codes. The dataset includes the dollar value of nominal shipments, nominal product prices, employment, payroll, production worker wages and measured total factor productivity (TFP). Unlike the BEA data, the data in the productivity dataset are available only at an annual frequency. Additional information can be found at the NBER public access data archive (http://users.nber.org/data/nberces.html).

To make the production data comparable with the BEA purchases data we aggregate groups of investment goods in the NBER dataset to match the categories in the BEA detail tables. The BEA provided us with a mapping from the underlying census data in the Productivity Database to the more aggregated investment categories in the BEA detail files. Aggregate nominal production for each category is simply the sum of the disaggregated nominal production levels. The aggregate nominal price is a weighted average of type-specific prices with weights given by the share of nominal production for each category. With the aggregated investment types, we then create quarterly production and price series by distributing the annual aggregates using the Chow-Lin (1971) procedure with the BEA quarterly series as the distributor.

This matching procedure yields a quarterly panel of 30 equipment types (see Table 1A) and 20 structures types (see Table 1B). The sample period is 1959:1 to 2009:4. For the reduced-form estimation, we exclude the computer and software types (because their data is dominated by price changes) and the three residential structures types, so the estimation is based on 28 equipment types and 17 structures types. In the solution to the model, we use all types since the all types must be accounted for in general equilibrium.

Tables 1A and 1B show the economic depreciation rates (see below), the average investment share measured as the ratio of nominal investment to total nominal investment from 1990-2009, and the average comprehensive subsidy. We chose to use recent investment shares to have the simulations match recent investment proportions.

A.2. Tax variables.

We take our series for the corporate tax rate (τ_t^π) from the Office of Tax Policy Research at the University of Michigan.

The type-specific investment tax subsidy measures are computed using the following variables: the investment tax credit ($ITC_{m,t}$), the date-t present value of depreciation allowances ($z_{m,t}^J$). Type-specific data on $z_{m,t}^J$ and the $ITC_{m,t}$ were provided by Dale Jorgenson. We make several adjustments to the standard $z_{m,t}^J$ calculation to account for features of the tax code.

Basis adjustment of ITC. The ITC interacts with depreciation allowances because tax law mandates adjustment of the basis for tax depreciation by the amount of the ITC. Define the *ITC basis adjustment* as λ_t^{ITC}, so the basis for depreciation is reduced by $\lambda_t^{ITC} \cdot ITC_{m,t}$. When the ITC was originally enacted in 1962, the basis for depreciation was adjusted by 100% of the ITC ($\lambda_t^{ITC} = 1$). This provision is called the Long Amendment named after Senator Russell B. Long. In 1964, the Long Amendment was repealed, so the ITC did not reduce depreciation allowances ($\lambda_t^{ITC} = 0$).The Tax Equity and Fiscal Responsibility Act of 1982 changed the basis adjustment, so that only half the ITC was excluded ($\lambda_t^{ITC} = 0.5$) where it remained until the ITC was repealed effective in 1986.

Bonus depreciation. In 2002 the Job Creation and Worker Assistance Act introduced a bonus depreciation allowance, which allowed firms to expense a fraction $\lambda_{m,t}^B$ of qualified investment and depreciate the remaining fraction $1-\lambda_{m,t}^B$ according to existing depreciation schedules. Only certain types of investment goods (those with tax recovery periods less than or equal to 20 years) were eligible for bonus depreciation. The initial bonus rate was 30 percent ($\lambda_{m,t}^B = 0.30$). This was increased by subsequent legislation to 50 percent ($\lambda_{m,t}^B = 0.50$) and then expired in 2005 only to be re-introduced in 2008 at a rate of 50 percent.

Adjusted $z_{m,t}$. Combining the ITC basis adjustment and bonus depreciation allowances, we define the adjusted present discounted value of tax depreciation allowances as $z_{m,t}$. For the years with the ITC (but no bonus depreciation) $z_{m,t}$ is

$$z_{m,t} \equiv z_{m,t}^J \left(1 - \lambda_t^{ITC} ITC_{m,t}\right).$$

For the years with bonus depreciation (but no ITC) $z_{m,t}$ is

$$z_{m,t} \equiv z_{m,t}^J \left(1 - \lambda_{m,t}^B\right) + \lambda_{m,t}^B$$

and for all other years (with neither the ITC nor bonus depreciation) $z_{m,t}$ is simply

$$z_{m,t} = z_{m,t}^J.$$

A general expression is

$$\begin{aligned} z_{m,t} &\equiv \left[z_{m,t}^J \left(1 - \lambda_{m,t}^B\right) + \lambda_{m,t}^B\right] \left[1 - \lambda_t^{ITC} ITC_{m,t}\right] \\ &= z_{m,t}^J \left(1 - \lambda_{m,t}^B\right) + \lambda_{m,t}^B - z_{m,t}^J \lambda_t^{ITC} ITC_{m,t} \\ &\quad + \lambda_{m,t}^B \lambda_t^{ITC} ITC_{m,t} \left(1 - z_{m,t}^J\right) \end{aligned}$$

where we have assumed that the ITC basis adjustment would apply equally to bonus depreciation and regular tax depreciation. In practice there has never been a period with both bonus depreciation and the ITC so the last term in the expression above is always zero in the data.

With the adjustments made above, the expression for the comprehensive subsidy (ζ_t^m) is

$$\zeta_t^m = ITC_{m,t} + z_t^m \tau_t^\pi$$

as given by equation (2) in the text.

A.3. Economic depreciation

The economic rates of depreciation for each type of capital are based primarily on Fraumeni (1997), who has estimated depreciation rates using techniques established by Hulten and Wykoff (1981a, 1981b).

Appendix B: Supplemental Results and Comparison with Goolsbee (1998)

This appendix provides additional empirical results as described in the text and also discusses the relationship between our empirical findings and the earlier findings by Goolsbee (1998).

In the text, we reported empirical estimates for the comprehensive investment tax subsidy ζ_t^m. Table B.1 reports results using the alternative measures of investment subsidies—the investment tax credit ITC_t^m and the user cost tax adjustment Φ_t^m. The ITC is a natural measure because it is likely the most salient form of investment subsidy. For the ITC measure, the results are somewhat more pronounced than for the comprehensive subsidy. Depending on the econometric specification, production increases by between 1.02 and 2.66 percent while purchases rise by between 1.69 and 3.31 percent. The differences between production and purchases are statistically significant. As we saw before, the estimates for price responses are quite close to zero.

The lower panel shows estimates for the user cost tax adjustment Φ_t^m. These estimates show similar patterns though it is worth noting that overall, these estimates are less statistically significant.

As we mentioned in the text, the lack of a price response is at odds with Goolsbee's (1998) findings and deserves some additional discussion. To address this difference, we attempted to replicate his findings using his sample period and the vintage data available when he did his original work. The most prominent finding of Goolsbee's paper is that investment subsidies increase equipment prices and benefit not only firms that invest, but also capital suppliers. This result was robust to alternative specifications, and was present in two distinct datasets—investment price deflators from the BEA, and equipment output deflators from the NBER Manufacturing Industry Database. Furthermore, Goolsbee estimated investment supply elasticities, finding evidence in favor of upward sloping supply curves for equipment goods. If the supply of new capital equipment is price inelastic, economic theory predicts that investment tax incentives have little final effect on investment demand, and instead succeed only in driving up equipment prices.

In contrast, we find that investment tax incentives do not have a clear effect on equipment goods prices, and that investment demand strongly responds to subsidies. Under our preferred specification, a one percent subsidy increases equipment investment by roughly 2 percent, investment production by 1.25 percent, and structures investment by 1.00. The reduced-form analysis in our paper is closely related to Goolsbee's work—we set out to measure many of the same relationships, and our empirical specifications are inspired by those in Goolsbee (1998). Here we attempt to meticulously reconstruct the methodology and data used by Goolsbee at the time when he published his paper. We consider differences in specification, data revisions, and differences in the time period included in each of the two studies. The replication allows us to approximately reproduce Gooslbee's main findings. The main differences are primarily due to differences in sample periods, but also from differences in econometric specification. Tables B.2 and B.3 present the results of our replication / comparison analysis.

Table B.2 presents results for the investment tax credit. Goolsbee's original published estimates are presented in the first column. Goolsbee's specification is run on quasi-differenced data to deal with the first-order serial correlation in the error terms. The next eight columns present results for different specifications, sample periods and data sources. The results are grouped into five different econometric specifications listed as (a) – (e) in the table. For each specification, we report the estimated coefficient on the ITC together with the OLS standard error in parenthesis. The first row in the table presents the pooled estimates (i.e., the results for all types together). Goolsbee's published pooled estimate is 0.390 with an OLS—that is, an increase in the ITC of one percentage point is associated with an increase in the log real price of equipment of 0.390 or roughly 0.4 percentage points.

Specification (a) is closest to Goolsbee's original analysis. This specification uses vintage BEA data on investment prices as well as vintage data for macroeconomic variables included in the regression. The vintage data used were the available data at the time of Goolsbee's earlier paper. The macroeconomic data were published by the U.S. Department of Commerce in *Fixed Reproducible Tangible Wealth in the United States: 1925–1989*. The sample period (1959-1988) and regression specification are both identical to the ones used in Goolsbee's paper. Specifically, the left-hand-side variables include a linear time trend, the growth rate of real GDP, dummy variables for the Nixon price controls, and exchange rates for the German DM and Japanese Yen. For this specification, the OLS regression gives an estimate of 0.551 and a quasi-differenced estimate of 0.177.

Specification (b) is nearly identical to the specification in (a) but we use revised data for equipment prices (i.e., we use the same data values for equipment prices that we used in the text but we continue to restrict the sample period to 1959-1988). Under this specification, the estimates change sharply. The simple OLS regression now gives an estimate of -0.164 and a quasi-differenced estimate of -0.271.

Specification (c) is identical to (b) with the exception that the macroeconomic variables included in the regression uses revised data. Using updated data for the macroeconomic aggregates has only a modest impact on the estmates relative to the results for specification (b). The OLS estimate is -0.143 and the quasi-differenced estimate is -0.133.

Specification (d) uses Goolsbee's sample period (1959-1988) and current data but uses the regression specification used in House, Mocanu and Shapiro (2016). Specifically, the regression includes a piecewise-linear time trend, HP-filtered real GDP, dummy variables for the Nixon price controls, and real oil prices. Changing the regression specification in this way actually shifts the estimates back towards the values in Goolsbee (1998). The OLS estimate is 0.298 (we do not run a quasi-differenced specification due to the piece-wise linear time trend).

Finally, the specification in (e) is the same as (d) with the exeption that the sample period is extended to 1959-2009 (i.e., the specification and sample period used in House, Mocanu and Shapiro 2017). The OLS estimate is 0.038 with a standard error of 0.035 which is neither statistically nor economically significant. The reader will notice that this estimate does not exactly match the corresponding estimate in Table 3. In Table 3, the estimate for the macro covariate specification and for the purchases price measure (the BEA measure) is -0.04 with a standard error of 0.08. The reason for the discrepancy is two-fold. First, the point estimate itself is different. This is due to the fact that the estimates in Table 3 are based on the updated set of equipment categories used by the BEA while the estimates in Table B.2 are based on equipment categories used by the BEA in 1988. Thus, when we use the updated data together with the updated sample period in Table B.2, we continue to aggregate the data to match the investment categories used by Goolsbee. Second, the standatd error is much larger in Table 3. This is because we use a HAC estimator for the standard errors while the results in Table B.2 use untreated standard errors.

Table B.3 presents results for the (negative) user cost tax adjustment (i.e., the term Φ_t^m in equation 4). We state the results as negative values to match the reported values in Goolsbee's paper. Additionally, to be comparable with his specification, we do not implement the basis adjustment for the ITC (see Appendix A), so Φ_t^m is calculated using $z_{m,t}^J$ (the unadjusted present value of tax depreciation allowances provided by Jorgenson) rather than the adjusted $z_{m,t}$ used for the estimates in our paper. The specifications and sample periods (a) – (e) are the same as those in Table B.2. Goolsbee's original pooled estimate is -0.17 with a standard error of 0.028. When we adopt his original regression specification and use vintage data we obtain a pooled OLS estimate of -0.26 (standard error 0.075) and a quasi-differenced estimate of -0.133 (standard error 0.042). Shifting to an updated set of data (columns b and c) reduces the magnitude of the estimates sharply. Adopting the specification used in the text and extending the sample period (columns d and e) partially restore the effects though our final estimate is only half of Goolsbee's original estimate. (Again the discrepancy between the estimate in column e and the value reported in Table 3 is due to slight differences in the equipment categories in the updated data and the original data.)

Tables B.2 and B.3 also report regression results for each equipment type. These estimates are much noisier than the pooled estimates and their match to Goolsbee's original estimates is not as consistent.

Although we have replicated the qualitative results in Goolsbee's paper, our estimates are not numerically identical. We note two factors that likely contribute to this difference. First, we were not able to obtain vintage data for investment subsidies, nor for the German and Japanese price indices we used to calculate real exchange rates. Second, our implementation of the AR(2) quasi-differencing procedure used to address serial correlation may differ from that in Goolsbee's paper. The algorithm relies on numerical convergence, and the choice of stopping criteria can affect estimates.

Finally, it should be noted that, unlike the results for quantities, the price results are not particularly robust across econometric specification. Changes in the sample and regression specification have substantial impacts on the estimates. This is not true for the estimates for investment quantities which are much more stable across specifications.

Appendix C: The Non-Stochastic Steady State

In the steady state, all of the endogenous variables are constant. As a result, we can ignore the adjustment cost terms and imports (which are zero in the steady state). We begin by assuming that we can choose the parameters ϕ and ψ to normalize N and e to 1 in the steady state. We will discuss this normalization after the remainder of the system is solved to ensure that this assumption is correct. With $N = e = 1$, the rest of the steady state is given by the following equations:

$$q^m = \frac{C^{-\frac{1}{\sigma}} (1 - \tau^\pi) \left(1 - \tau^d\right) R^m}{r + \delta^m} \tag{46}$$

$$q^m = C^{-\frac{1}{\sigma}} \left(1 - \tau^d\right) P^m \left[1 - \zeta^m\right] \tag{47}$$

$$Q = A \left[h^Q\right]^\alpha \left[(e)^\theta n^Q\right]^{1-\alpha} \tag{48}$$

$$Q = C + X + G \tag{49}$$

$$R = \alpha \frac{Q}{h^Q} \tag{50}$$

$$(1 - \alpha) \frac{Q}{n^Q} = W \tag{51}$$

$$I^m = B \left\{\mu_x (x^m)^{\frac{\rho-1}{\rho}} + (1 - \mu_x) \left[U^m\right]^{\frac{\rho-1}{\rho}}\right\}^{\frac{\rho}{\rho-1}} \tag{52}$$

$$R = P^m \mu_h (1 - \mu_x) (B)^{\frac{\rho-1}{\rho}} \left[\frac{I^m}{U^m}\right]^{\frac{1}{\rho}} \frac{U^m}{h^m} \tag{53}$$

$$1 = P^m \mu_x (B)^{\frac{\rho-1}{\rho}} \left[\frac{I^m}{x^m}\right]^{\frac{1}{\rho}} \tag{54}$$

$$W = P^m (1 - \mu_h) (1 - \mu_x) (B)^{\frac{\rho-1}{\rho}} \left[\frac{I^m}{U^m}\right]^{\frac{1}{\rho}} \frac{U^m}{n^m} \tag{55}$$

$$U^m = (H^m)^{\mu_h} (e^m)^{\theta(1-\mu_h)} (n^m)^{(1-\mu_h)} \tag{56}$$

$$\delta^m K^m = I^m \tag{57}$$

$$N = n^Q + \sum_{m=1}^{M} n^m \tag{58}$$

$$X = \sum_{m=1}^{M} x^m \tag{59}$$

$$H = \left(\prod_{m=1}^{M} \left(\frac{1}{\gamma}\right)^\gamma\right) \left(\prod_{m=1}^{M} (K^m)^\gamma\right) \tag{60}$$

$$H = h^Q + \sum_{m=1}^{M} h^m \tag{61}$$

$$R\gamma \frac{H}{K^m} = R^m \tag{62}$$

This system has 17 equations (or blocks of equations) in the variables $W, C, Q, X, R, H, H^Q, n^Q, q^m, R^m, P^m, I^m, X^m, H^m, n^m, U^m, K^m$. Eliminating the shadow values q^m with equations (46) and (47) gives

$$\frac{R^m}{P^m} = \left[\frac{1-\zeta^m}{1-\tau^\pi}\right](r+\delta^m)$$

We now eliminate the "duplicate variables" for the separate m-sectors by writing each of the m-variables in terms of the corresponding variable for sector 1. Using the type-specific capital demand equations (62) from the capital aggregating firms we have

$$\frac{R^m}{R^1} = \frac{\gamma_m}{\gamma_1}\frac{K^1}{K^m} = \frac{\gamma_m \delta_m}{\gamma_1 \delta_1}\frac{I^1}{I^m}$$

and so,

$$\frac{R^m}{P^m}\frac{P^1}{R^1} = \frac{\gamma_m \delta_m}{\gamma_1 \delta_1}\frac{P^1 I^1}{P^m I^m}.$$

Using this with our expression for the real rental price $\frac{R^m}{P^m}$ we can write

$$\frac{\frac{R^m}{P^m}}{\frac{R^1}{P^1}} = \frac{\left[\frac{1-\zeta^m}{1-\tau^\pi}\right](r+\delta^m)}{\left[\frac{1-\zeta^1}{1-\tau^\pi}\right](r+\delta^1)} = \frac{\gamma_m \delta_m}{\gamma_1 \delta_1}\frac{P^1 I^1}{P^m I^m}$$

and as a result,

$$\frac{P^m I^m}{P^1 I^1} = \frac{\gamma_m \delta_m}{\gamma_1 \delta_1}\frac{\left[1-\zeta^1\right](r+\delta^1)}{\left[1-\zeta^m\right](r+\delta^m)} = \Psi_m \tag{63}$$

(equation 39 in the text). Since we have data on the shares $s_m \equiv \frac{P^m I^m}{P^1 I^1}$, depreciation rates δ^m and baseline subsidies ζ^m for all types m, we can construct the implied parameters γ_m as follows. Notice that each γ_m can be expressed in terms of γ_1 as

$$\gamma_m = \Gamma_m \gamma_1$$

where

$$\Gamma_m \equiv s_m \frac{\delta_1}{\delta_m}\frac{\left[1-\zeta^m\right]}{\left[1-\zeta^1\right]}\frac{(r+\delta^m)}{(r+\delta^1)}.$$

Then, since $\sum_m \gamma_m = 1$ (constant returns to scale) we must have

$$\gamma_1 = \left[\sum_{m=1}^{M}\Gamma_m\right]^{-1}$$

This gives the set of share parameters $\{\gamma_m\}_{m=1}^{M}$ necessary to match the observed investment shares, depreciation rates, and tax subsidies in the data.

Because the production functions for the type-specific investment goods have constant returns to scale, the input ratios are common to all sectors m. In particular, dividing the capital first order condition for sector m (53) by the labor first order condition for sector m (55) gives the ratio of labor to capital as

$$\frac{R}{W} = \frac{\mu_h}{1-\mu_h}\frac{n^m}{h^m} \Rightarrow \frac{n^m}{h^m} = \frac{1-\mu_h}{\mu_h}\frac{R}{W}.$$

Similarly the ratio of U^m to h^m is constant across the m-sectors:

$$\frac{U^m}{h^m} = (h^m)^{\mu_h - 1}(n^m)^{(1-\mu_h)} = \left(\frac{n^m}{h^m}\right)^{1-\mu_h} \Rightarrow \frac{U^m}{h^m} = \left(\frac{1-\mu_h}{\mu_h}\right)^{1-\mu_h}\left(\frac{R}{W}\right)^{1-\mu_h}.$$

Dividing the capital first order condition by the materials first order condition (54) gives

$$\frac{U^m}{x^m} = \left(\frac{1-\mu_x}{\mu_x}\right)^{\rho}(\mu_h)^{\rho}\left(\frac{U^m}{h^m}\right)^{\rho}\left(\frac{1}{R}\right)^{\rho} \tag{64}$$

Since the ratio U^m/h^m is the same for all m, the ratio x^m/U^m is also constant for all m sectors. We now use the expressions for U^m/h^m and U^m/x^m together with the production function for type m captial (52) to write the ratio of investment to materials I^m/x^m as

$$\frac{I^m}{x^m} = B^m \mathbb{U}(W, R)$$

where the term $\mathbb{U}(W, R)$ is

$$\mathbb{U}(W, R) \equiv \left\{ \mu_x + \mu_x^{1-\rho} (1-\mu_x)^\rho \left[(1-\mu_h)^{1-\mu_h} (\mu_h)^{\mu_h} \left(\frac{1}{W}\right)^{1-\mu_h} \left(\frac{1}{R}\right)^{\mu_h} \right]^{\rho-1} \right\}^{\frac{\rho}{\rho-1}} \tag{65}$$

Given a real wage W and a real rental price for aggregate capital services R, the implied real relative pre-tax price of type m capital (P^m) can be recovered from any of the first order conditions. In particular, using the materials first order condition (54) gives us

$$P^m = \frac{1}{\mu_x} \frac{1}{B^m} \mathbb{U}(W, R)^{-\frac{1}{\rho}} \tag{66}$$

Notice that if the productivity terms B^m are common across the m sectors, then all of the types will have the same price $P^m = P$. We will use the B^m terms to normalize the steady state prices to $P^m = 1$. With this normalization, and $P^m I^m = \Psi_m P^1 I^1$ from (63), we have

$$\begin{aligned} I^m &= \Psi_m I^1 \\ n^m &= \Psi_m n^1 \\ x^m &= \Psi_m x^1 \\ U^m &= \Psi_m U^1 \\ h^m &= \Psi_m h^1 \end{aligned}$$

Using (65), (66) and the definition for MC^U provided in the text gives the expression for μ_x (equation 41).

We can also find expressions for aggregate material usage, aggregate employment in the investment industries and aggregate capital usage by the investment industries as $X \equiv \sum_{m=1}^M x^m = \sum_{m=1}^M \Psi_m x^1 = \mathbb{B} x^1$ where $\mathbb{B} = \sum_{m=1}^M \Psi_m$. Similarly, $\mathbb{B} n^1$ is total employment in the investment industries and total capital usage is $\mathbb{B} h^1$.

We can express the capital stocks similarly as

$$K^m = \Psi_m^k K^1$$

where $\Psi_m^k \equiv \Psi_m \frac{\delta_1}{\delta^m}$. Aggregate capital is then

$$H = K^1 \mathbb{A} \left(\prod_{m=1}^M \left(\frac{1}{\gamma_m}\right)^{\gamma_m} \right)$$

with $\mathbb{A} = \prod_{m=1}^M \left(\Psi_m^k\right)^{\gamma_m}$.

Since we have normalized $P^m = 1$, we now know the type specific rental prices R^m for each of the m sectors.

$$R^m = \left[\frac{1-\zeta^m}{1-\tau^\pi}\right] (r + \delta^m).$$

The rental price for the aggregate capital good can be recovered from any of the demand conditions for type m captial (62). For $m = 1$ we have

$$\begin{aligned} R &= R^1 \frac{K^1}{H} \frac{1}{\gamma_1} \\ &= R^1 \frac{\prod_{m=1}^M (\gamma_m)^{\gamma_m}}{\mathbb{A}\gamma_1} \end{aligned}$$

Notice that since we know R, we know the capital-to-labor ratio in the numeraire sector $\frac{h^Q}{n^Q}$. Using (50) and (48) we have

$$\frac{h^Q}{n^Q} = \left(\frac{\alpha A}{R}\right)^{\frac{1}{1-\alpha}}$$

which implies that, from (51), we know the steady state wage W

$$W = (1-\alpha)\frac{Q}{n^Q} = (1-\alpha) A \left[\frac{n^Q}{h^Q}\right]^{-\alpha}$$

Since we now know R and W, we can solve for the input ratios in the m sector (we previously knew only that were constant across the sectors). In particular, $\frac{n^m}{h^m} = \frac{1-\mu_h}{\mu_h}\frac{R}{W}$ and $\frac{U^m}{n^m} = \left(\frac{h^m}{n^m}\right)^{\mu_h}$. Also, our earlier expression (64) gives us the ratio U^m/x^m. Thus, we now know all of the ratios of the inputs h^m, n^m and x^m (and U^m) for the capital producing sectors.

To find the constant B required to ensure a real relative price of investment goods equal to 1, recall that $\frac{I^m}{x^m} = B \cdot \mathbb{U}(W, R)$ (where we have used the fact that $B^m = B$). From the materials first order condition (54) with $P^m = P = 1$ we need

$$1 = \mu_x (B)^{\frac{\rho-1}{\rho}} \left[\frac{I^m}{x^m}\right]^{\frac{1}{\rho}} = \mu_x (B)^{\frac{\rho-1}{\rho}} \left[B \cdot \mathbb{U}(W, R)\right]^{\frac{1}{\rho}}$$

so we require

$$B = \frac{1}{\mu_x}\mathbb{U}(W, R)^{-\frac{1}{\rho}}$$

We now have all of the input ratios for the m sectors as well as the ratio of n^Q/h^Q in the numeraire sector. We also know the constant B, the rental prices R^m and R and W.

Notice that the production function for type 1 investment is

$$\begin{aligned}
\delta^1 K^1 &= Bx^1 \left\{\mu_x + (1-\mu_x)\left[\frac{U^m}{x^m}\right]^{\frac{\rho-1}{\rho}}\right\}^{\frac{\rho}{\rho-1}} \\
&= Bn^1 \left(\frac{x^m}{n^m}\right)\left\{\mu_x + (1-\mu_x)\left[\frac{U^m}{x^m}\right]^{\frac{\rho-1}{\rho}}\right\}^{\frac{\rho}{\rho-1}} \\
&= n^1 \mathbb{C}
\end{aligned}$$

where $\mathbb{C} = \left(\frac{x^m}{n^m}\right)\left\{\mu_x + (1-\mu_x)\left[\frac{U^m}{x^m}\right]^{\frac{\rho-1}{\rho}}\right\}^{\frac{\rho}{\rho-1}}$ is a known constant. Using the fact that total capital usage in the investment sectors is $\mathbb{B}h^1$ together with the capital market clearing condition (61) we have

$$\begin{aligned}
\mathbb{A}\left(\prod_{m=1}^{M}\left(\frac{1}{\gamma_m}\right)^{\gamma_m}\right) K^1 &= h^Q + \mathbb{B}h^1 \\
\mathbb{A}\left(\prod_{m=1}^{M}\left(\frac{1}{\gamma_m}\right)^{\gamma_m}\right) \delta^1 K^1 &= \delta^1 n^Q \left(\frac{h^Q}{n^Q}\right) + \delta^1 \mathbb{B} n^1 \left(\frac{h^1}{n^1}\right)
\end{aligned}$$

where we have used $h^Q = n^Q\left(\frac{h^Q}{n^Q}\right)$ and $h^1 = n^1\left(\frac{h^1}{n^1}\right)$ (recall the ratios $\frac{h^Q}{n^Q}$ and $\frac{h^1}{n^1}$ are known). Using $\delta^1 K^1 = n^1\mathbb{C}$ we have

$$n^1 = n^Q \frac{\delta^1 \cdot \left(\frac{h^Q}{n^Q}\right)}{\left(\prod_{m=1}^{M}\left(\frac{1}{\gamma_m}\right)^{\gamma_m}\right)\mathbb{A}\mathbb{C} - \delta^1 \mathbb{B} \cdot \left(\frac{h^1}{n^1}\right)}.$$

Using the fact that total labor used in the investment sectors is $\mathbb{B}n^1$ and total labor has been normalized to 1, the labor market clearing condition is

$$1 = n^Q + \mathbb{B}n^1,$$

which implies that employment in the numeraire sector is

$$n^Q = \frac{\left(\prod_{m=1}^{M}\left(\frac{1}{\gamma_m}\right)^{\gamma_m}\right)\mathbb{AC}-\delta^1\mathbb{B}\cdot\left(\frac{h^1}{n^1}\right)}{\left(\prod_{m=1}^{M}\left(\frac{1}{\gamma_m}\right)^{\gamma_m}\right)\mathbb{AC}-\delta^1\mathbb{B}\cdot\left(\frac{h^1}{n^1}\right)+\delta^1\mathbb{B}\cdot\left(\frac{h^Q}{n^Q}\right)}$$

and $n^1 = \frac{1-n^Q}{\mathbb{B}}$. With n^1 and n^Q, we can compute h^1, x^1, U^1, and h^Q. We now also have n^m,h^m, x^m,U^m, I^m and K^m. With the set $\{K^m\}_{m=1}^{M}$ we have the aggregate capital stock H. Total production of the numeraire good is $Q = An^Q\left[\frac{n^Q}{h^Q}\right]^{-\alpha}$ and the resource constraint for the numeraire good requires

$$Q = C + \mathbb{B}x^1 + G.$$

Given a level of government purchases G we can compute C as the residual. Our procedure is to calibrate the ratio $g = \frac{G}{C}$ and then solve for consumption as

$$C = \frac{Q - \mathbb{B}x^1}{1+g}$$

Finally, steady state real GDP in the model is (by definition)

$$GDP = C + \sum_{m=1}^{M} I^m + G$$

To make sure that the initial normalization $N = e = 1$ is consistent with our proposed steady state solution we must satisfy the labor supply condition

$$W = \frac{C^{\frac{1}{\sigma}}}{1-\tau^N}\frac{\phi}{1-\theta}[1]$$

which will require the parameter ϕ to be

$$\phi = W\frac{\left(1-\tau^N\right)(1-\theta)}{C^{\frac{1}{\sigma}}}.$$

Similarly, to ensure $e = 1$ we will require the steady state effort supply condition to be

$$e = \frac{\theta}{1-\theta}\frac{\phi}{\psi}[1] = 1$$

which requires

$$\psi = \frac{\theta}{1-\theta}\phi$$

Appendix D: Non-targeted Moments

In this appendix, we report simulated moments that were not targeted by the indirect inference procedure. The indirect inference estimator of the supply elasticity χ was chosen to match the empirical moments in Table 6—equipment production, equipment investment, hours worked at equipment firms, material inputs used at equipment firms, and measured TFP at equipment firms. The model also produces moments that we did not target but for which we have reduced-form estimates. Table D.1 reports non-targeted moments for each of the model specifications considered in Table 6. Specifically, the table reports the model implied moments for structures production, wage payments at equipment firms, equipment prices and structures prices. The left-hand side column displays the reduced-form estimates of these parameters from the data. The columns to the right report the model-implied moments.

Perhaps surprisingly, the model does a fairly good job of replicating the price estimates. The equipment price coefficients are all close to zero while the structures price estimates are roughly 0.2—again close to their empirical counterparts. The moments where the model fit is worst is with wage changes and structures investment. The structural model was constructed to match data on equipment production and purchases. Structures seem to react substantially more strongly to investment subsidies and are likely described by a different supply specification. Thus, it is perhaps not surprising that the structures production moments fail to match.

The wage response in the data is quite muted (0.12 in our preferred econometric specification) while it is more pronounced in the model. This discrepancy could reflect several possibilities. First, the model assumes that wages are allocative while in the real world there is evidence that wage payments are not purely allocative. Second, the baseline calibration for the model features an intermediate value for the long-run substitutability of labor across sectors (determined by the parameter ψ_n). It is possible that the relatively low estimate of the wage reaction to investment subsidies is indicative of greater substitutability than we have in the baseline specification (e.g., see the last column of Table D.1). Finally, the reader will note that the wage estimates themselves are not consistent from one reduced-form specification to another (see Table 4 in the text).

Appendix E: Allowing for International Borrowing and Lending

In this appendix, we consider the consequences of modifying the model to allow for international borrowing and lending of the numeraire good in addition to allowing trade in equipment goods.

To allow for international borrowing and lending we introduce another "country" which we simply refer to as the "Rest of the World" or the ROW. This country seeks to maximize

$$\sum_{t=0}^{\infty} \beta^t \frac{\left(C_t^{\text{row}}\right)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

subject to

$$Q^{\text{row}} + S_{t-1}^{\text{row}}\left(1+r_{t-1}\right) = C_t^{\text{row}} + S_t^{\text{row}}.$$

Where Q^{row} is a constant real endowment of the numeraire good. S^{row} is real savings and C^{row} is real consumption of the numeraire good by the ROW. The solution to this optimization problem requires

$$\left(C_t^{\text{row}}\right)^{-\frac{1}{\sigma}} = \left(1+r_t\right)\beta E_t\left[\left(C_{t+1}^{\text{row}}\right)^{-\frac{1}{\sigma}}\right].$$

We now require a bond market clearing condition $S_t^{\text{row}} + S_t = 0$. We modify the domestic economy's resource constraint to include savings so

$$Q_t + S_{t-1}\left(1+r_{t-1}\right) = C_t + X_t + \sum_{m=1}^{M} P_t^m IMP_t^m + G_t + S_t.$$

We also modify the domestic definition of real GDP (Y_t) to allow for non-zero net exports

$$Y_t = C_t + \sum_{m=1}^{M} P^m \cdot \left[I_t^m + IMP_t^m\right] + G_t + \left\{S_t - S_{t-1}\left(1+r_{t-1}\right)\right\}$$

Note that if we let $\tilde{S}_t^{\text{row}} \equiv \frac{dS_t^{\text{row}}}{Q^{\text{row}}}$ and $\tilde{S}_t \equiv \frac{dS_t}{Q}$ then the linearized version of the bond market clearing condition $S_t^{\text{row}} + S_t = 0$ is

$$\left(\frac{Q^{\text{row}}}{Q^{\text{row}}+Q}\right)\tilde{S}_t^{\text{row}} + \left(1 - \frac{Q^{\text{row}}}{Q^{\text{row}}+Q}\right)\tilde{S}_t = 0$$

where $\omega \equiv \left(\frac{Q^{\text{row}}}{Q^{\text{row}}+Q}\right)$ is the ratio of the "size" of the ROW relative to the total market for the numeraire good. If $\omega = 0$ then the ROW is so small that it has no influence on the domestic equilibrium. This corresponds with the case of period by period balanced trade with the foreign suppliers of tradeable equipment. If $\omega = 1$ then the ROW is so much larger than the domestic economy that the domestic market effectively faces a fixed real interest rate for the numeraire good. This corresponds to a case of a small open economy. Intermediate cases are associated with an upward sloping supply of savings.

Tables E.1 and E.2 show the consequences of allowing for an elastic supply of lendable funds. Table E.1 reproduces the estimates in Table 6 in the text under the assumption that $\omega = 1/2$. This implies that the "size" of the ROW is equal to the size of the domestic economy (the U.S.). Comparing the estimates of χ in Table E.1 to the estimates in Table 6 we see that the estimated supply of foreign equipment rises modestly across all specifications. Table E.2 considers the case in which $\omega = 3/4$ which implies that the ROW is three times as large as the U.S. Again, the estimates increase modestly for all of the specifications. The results in these tables suggest that the estimates of χ are, for the most part, robust to whether the U.S. borrows to finance purchases of foreign equipment.

Figure E.1 shows the aggregate consequences of allowing for international borrowing and lending of the numeraire. In the figure, we report aggregate investment purchases, aggregate investment production, aggregate GDP and aggregate imports. Each line corresponds to a different value for ω. The dark thin lines are for lower values of ω while the light thick lines are for high values of ω (approaching 1.00). The baseline model considered in the text corresponds to $\omega = 0$.

The reader will notice that variations in ω have relatively little impact on aggregate investment purchases, production or imports. On the other hand, as we change ω aggregate GDP does change noticeably. In particular, for $\omega = 0$, GDP rises moderately with the onset of the subsidy. The reason for this is two-fold: first the subsidy encourages domestic production of investment goods; Second the subsidy encourages purchases of investment goods from foreign suppliers. Given our baseline assumption of balanced trade, the import of foreign investment goods necessitates the contemporaneous production and export of the numeraire good. Both forces work to increase GDP in the short run. For $\omega = 1$, there is no immediate increase in GDP. Instead, while domestic production of investment goods increases, importing investment goods from abroad can be financed over time. Thus, while the overall stimulus to GDP is roughly the same, it is spread out over time when we allow for borrowing and lending from abroad.

TABLE A.1. ROMER AND ROMER (2009) CLASSIFICATION OF CHANGES IN TAX LAWS

Law Name	Public Law No.	Romer and Romer (2009) Classification	Motivation
Internal Revenue Code of 1954	83-591	Exogenous	Long-run
Small Business Tax Revision Act of 1958	85-699	Exogenous	Long-run
Revenue Act of 1962	87-834	Exogenous	Long-run
Tax Rate Extension Act of 1962	87-507	Exogenous	Long-run
Revenue Act of 1964	88-272	Exogenous	Long-run
Suspension of Investment Tax Credit of 1966	89-800	Endogenous	Countercyclical
Restoration of Investment Tax Credit	90-26	Exogenous	Long-run
Tax Reform Act of 1969	91-172	Exogenous Endogenous	Long-run Countercyclical
Reform of Depreciation Rules of 1971	n.a.	Exogenous	Long-run
Revenue Act of 1971	92-178	Exogenous	Long-run
Tax Reduction Act of 1975	94-12	Endogenous	Countercyclical
Tax Reform Act of 1976	94-455	Exogenous	Long-run
Revenue Act of 1978	95-600	Exogenous	Long-run
Economic Recovery Tax Act of 1981	97-34	Exogenous	Long-run
Tax Equity and Fiscal Responsibility Act of 1982	97-248	Exogenous	Deficit-driven

Law Name	Public Law No.	Romer and Romer (2009) Classification	Motivation
Deficit Reduction Act of 1984	98-369	Exogenous	Deficit-driven
Tax Reform Act of 1986	99-514	Exogenous	Long-run
Tax Relief Act of 1997	105-34	Exogenous	Deficit-driven
Job Creation and Worker Assistance Act of 2002	107-147	Endogenous	Countercyclical
Jobs and Growth Tax Relief Reconciliation Act of 2003	108–27	Endogenous	Countercyclical
The Economic Stimulus Act of 2008	110–185	Endogenous	Countercyclical
American Recovery and Reinvestment Act of 2009	111-5	Endogenous	Countercyclical
Small Business Jobs Act of 2010	111-240	Endogenous	Countercyclical
Tax Relief, Unemployment Insurance Reauthorization, Job Creation Act of 2010	111-312	Endogenous	Countercyclical
The American Taxpayer Relief Act of 2012	112–240	Endogenous	Countercyclical
The Tax Increase Prevention Act of 2014	113-295	Endogenous	Countercyclical

TABLE B.1: EFFECTS OF INVESTMENT SUBSIDIES ON EQUIPMENT PRODUCTION, PURCHASES AND PRICES USING ALTERNATIVE MEASURES OF INVESTMENT SUBSIDIES

	Specification			
Dependent Variable	Constant and linear trend	Macro covariates excluding oil	Macro covariates	Leads and lags of subsidy
	A. Investment Tax Credit			
Production	2.09	2.12	2.66	2.91
	(0.50)	(0.45)	(0.52)	(0.53)
Purchases	2.94	2.97	3.02	3.31
	(0.64)	(0.56)	(0.65)	(0.63)
Diff.: Prod. – Purch	0.85	0.85	0.37	0.39
	(0.20)	(0.18)	(0.21)	(0.22)
Production Prices	0.02	-0.11	0.14	0.18
	(0.13)	(0.09)	(0.13)	(0.15)
Purchases Prices	-0.20	-0.24	-0.08	-0.08
	(0.14)	(0.09)	(0.14)	(0.15)
	B. User Cost Tax Adjustment			
Production	1.28	1.28	1.28	1.41
	(0.33)	(0.31)	(0.36)	(0.38)
Purchases	1.73	1.73	1.44	1.60
	(0.44)	(0.41)	(0.47)	(0.49)
Diff.: Prod. – Purch	0.45	0.44	0.16	-0.19
	(0.14)	(0.14)	(0.15)	(0.16)
Production Prices	0.00	-0.08	-0.01	0.02
	(0.07)	(0.06)	(0.07)	(0.07)
Purchases Prices	-0.09	-0.09	-0.01	0.01
	(0.08)	(0.06)	(0.08)	(0.09)

Notes. The dependent variable is the natural logarithm of equipment production or equipment purchases as indicated. The independent variable is either the investment tax credit, ITC^m (Panel A) or the user cost tax adjustment, Φ^m (Panel B). The coefficients are semi-elasticities of production or purchases with respect to the subsidy (b_1 in equation 5). The columns report specifications with alternative control variables or lags. The specification in the last column reports the sum of the coefficients on the current and two leads and lags of the subsidy. This last specification also includes the macro covariates. Driscoll-Kraay standard errors are shown in parentheses. As described in Section III in the text, the sample is a quarterly panel of 28 types of equipment from 1959:1 to 2009:4.

Table B.2: Investment Tax Credit (ITC)

Investment Type	Goolsbee (1998)	Specification / Sample Period: (a) 1959-1988 Vintage Data		(b) (a) + revised eqp price data		(c) (b) + revised macro data		(d) 1959-1988 Current data /specification	(e) 1959-2009 Current data /specification
	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	OLS
Pooled	0.390	0.551	0.177	-0.164	-0.271	-0.143	-0.133	0.298	0.038
	(0.036)	(0.129)	(0.074)	(0.090)	(0.062)	(0.089)	(0.057)	(0.075)	(0.035)
Furniture	0.024	-0.098	-0.051	-0.496	-0.270	-0.483	-0.302	0.105	-0.300
	(0.137)	(0.159)	(0.159)	(0.119)	(0.132)	(0.121)	(0.128)	(0.175)	(0.066)
Fabricated metals	0.745	1.159	0.223	0.548	0.449	0.706	0.443	0.449	-0.264
	(0.170)	(0.321)	(0.288)	(0.299)	(0.278)	(0.270)	(0.281)	(0.262)	(0.149)
Engines	0.664	0.853	-0.020	0.650	0.205	0.774	0.145	0.689	-0.299
	(0.248)	(0.320)	(0.284)	(0.378)	(0.370)	(0.355)	(0.372)	(0.529)	(0.186)
Tractors	0.710	0.331	0.378	-0.013	-0.181	0.058	0.215	0.401	-0.004
	(0.133)	(0.175)	(0.173)	(0.196)	(0.265)	(0.187)	(0.129)	(0.193)	(0.110)
Agricutural machinery	0.976	0.660	0.513	0.097	-0.149	0.178	0.312	0.635	0.065
	(0.195)	(0.263)	(0.326)	(0.169)	(0.224)	(0.161)	(0.131)	(0.159)	(0.101)
Construction machinery	0.481	0.435	-0.035	0.324	0.168	0.329	0.275	-0.055	0.156
	(0.145)	(0.474)	(0.649)	(0.234)	(0.285)	(0.228)	(0.210)	(0.384)	(0.131)
Mining machinery	1.674	1.221	0.104	0.885	0.021	1.079	0.078	0.476	0.032
	(0.243)	(0.406)	(0.307)	(0.397)	(0.385)	(0.379)	(0.386)	(0.369)	(0.163)
Metalworking machinery	0.432	0.283	0.069	-0.237	-0.141	-0.157	-0.158	0.192	-0.301
	(0.183)	(0.172)	(0.198)	(0.221)	(0.269)	(0.222)	(0.268)	(0.235)	(0.104)
Special ind. machinery	0.150	0.057	0.023	-0.268	-0.199	-0.214	-0.246	-0.015	-0.294
	(0.139)	(0.125)	(0.147)	(0.174)	(0.217)	(0.173)	(0.153)	(0.222)	(0.089)
General industrial	0.206	0.307	0.305	-0.229	-0.272	-0.221	-0.278	-0.020	-0.191
	(0.162)	(0.158)	(0.146)	(0.174)	(0.171)	(0.184)	(0.172)	(0.265)	(0.085)
Office/computers	-0.761	2.958	-0.378	-1.608	-0.415	-2.272	-0.015	0.210	1.458
	(0.492)	(2.176)	(0.881)	(1.393)	(0.932)	(1.350)	(0.936)	(1.001)	(0.424)
Service ind. machinery	0.125	0.001	0.015	-0.477	-0.433	-0.434	-0.431	0.211	0.162
	(0.112)	(0.092)	(0.109)	(0.142)	(0.110)	(0.142)	(0.103)	(0.149)	(0.067)

Table B.2 (cont.): Investment Tax Credit (ITC)

Investment Type	Goolsbee (1998)	Specification / Sample Period: (a) 1959-1988 Vintage Data		(b) (a) + revised eqp price data		(c) (b) + revised macro data		(d) 1959-1988 Current data /specification	(e) 1959-2009 Current data /specification
	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	OLS
Electrical distribution	0.260	-0.035	0.140	-0.313	-0.249	-0.246	-0.264	0.843	0.355
	(0.183)	(0.206)	(0.210)	(0.210)	(0.194)	(0.205)	(0.161)	(0.315)	(0.124)
Communication equip.	-0.603	-0.424	-0.186	-0.452	-0.259	-0.552	-0.265	-0.055	0.734
	(0.210)	(0.221)	(0.136)	(0.251)	(0.204)	(0.249)	(0.200)	(0.239)	(0.121)
Electrical equipment	0.894	0.471	0.197	-0.530	-0.534	-0.513	-0.532	0.175	-0.373
	(0.181)	(0.306)	(0.192)	(0.134)	(0.091)	(0.138)	(0.119)	(0.205)	(0.085)
Trucks and buses	0.787	0.176	-0.081	-0.249	-0.505	-0.087	-0.525	0.363	-0.118
	(0.230)	(0.408)	(0.290)	(0.423)	(0.428)	(0.375)	(0.426)	(0.334)	(0.245)
Autos	-0.583	1.971	1.698	-2.393	-1.652	-2.371	-1.684	-1.867	-1.552
	(0.194)	(1.130)	(1.234)	(0.397)	(0.363)	(0.393)	(0.351)	(0.426)	(0.209)
Aircraft	1.010	0.380	0.445	-0.244	-0.456	-0.189	-0.389	0.713	0.538
	(0.184)	(0.390)	(0.408)	(0.192)	(0.208)	(0.189)	(0.193)	(0.220)	(0.094)
Ships and boats	0.591	0.470	-0.282	-0.346	-0.275	-0.276	-0.275	0.384	-0.262
	(0.120)	(0.310)	(0.202)	(0.156)	(0.180)	(0.152)	(0.176)	(0.135)	(0.084)
Railroad equipment	1.091	1.159	1.031	0.838	0.335	0.982	0.257	0.908	0.089
	(0.170)	(0.367)	(0.275)	(0.359)	(0.376)	(0.346)	(0.378)	(0.399)	(0.152)
Instruments	-0.349	-0.049	-0.079	-0.524	-0.537	-0.585	-0.520	0.560	0.081
	(0.172)	(0.111)	(0.101)	(0.178)	(0.163)	(0.190)	(0.169)	(0.181)	(0.057)

Notes: The table reports the estimated coefficient on the type specific investment tax credit. The left hand side variable is the log of real equipment prices as described in Appendix B. Columns (a) – (e) indicate different econometric specifications. Specification (a) limits the sample to 1959-1988 and uses vintage data as described in Appendix B. Regressors include linear time trend, growth rate of real GDP, Nixon price controls, and exchange rates for the German DM and Japanese Yen. Specification (b) is the same as (a) but uses revised (current) data for equipment prices; (c) is the same as (b) but uses revised data for macroeconomic covariates; (d) is the same as (c) but changes the regression specification to include a piecewise-linear time trend, HP-filtered real GDP, Nixon price controls, and real oil prices; (e) is the same as (d) but extends the sample period to 1959-2009.

Table B.3: User Cost Tax Adjustment (negative)

Investment Type	Goolsbee (1998)	Specification / Sample Period (a) 1959-1988 Vintage Data		(b) (a) + revised eqp price data		(c) (b) + revised macro data		(d) 1959-1988 Current data /specification	(e) 1959-2009 Current data /specification
	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	OLS
Pooled	-0.170	-0.263	-0.133	0.030	0.010	0.007	-0.017	-0.180	-0.088
	(0.028)	(0.075)	(0.042)	(0.052)	(0.039)	(0.051)	(0.033)	(0.033)	(0.018)
Furniture	-0.024	0.069	0.024	0.276	0.043	0.259	0.052	-0.060	0.146
	(0.077)	(0.093)	(0.088)	(0.073)	(0.083)	(0.074)	(0.083)	(0.075)	(0.036)
Fabricated metals	-0.413	-0.678	-0.096	-0.381	-0.320	-0.443	-0.322	-0.143	-0.573
	(0.073)	(0.176)	(0.155)	(0.162)	(0.138)	(0.142)	(0.140)	(0.109)	(0.081)
Engines	-0.345	-0.397	-0.167	-0.301	-0.187	-0.373	-0.164	-0.385	0.136
	(0.145)	(0.192)	(0.161)	(0.220)	(0.210)	(0.209)	(0.213)	(0.219)	(0.089)
Tractors	-0.498	-0.136	-0.183	-0.034	-0.001	-0.097	-0.170	-0.198	0.014
	(0.112)	(0.108)	(0.113)	(0.115)	(0.151)	(0.110)	(0.071)	(0.088)	(0.057)
Agricutural machinery	-0.485	-0.386	-0.371	-0.112	-0.067	-0.164	-0.233	-0.245	-0.055
	(0.112)	(0.145)	(0.167)	(0.092)	(0.116)	(0.085)	(0.059)	(0.074)	(0.051)
Construction machinery	-0.288	-0.293	-0.163	-0.168	-0.138	-0.227	-0.188	-0.457	-0.017
	(0.078)	(0.324)	(0.399)	(0.162)	(0.192)	(0.163)	(0.154)	(0.264)	(0.077)
Mining machinery	-0.882	-0.767	-0.122	-0.591	-0.158	-0.681	-0.181	-0.232	-0.134
	(0.127)	(0.234)	(0.170)	(0.228)	(0.214)	(0.215)	(0.215)	(0.171)	(0.089)
Metalworking machinery	-0.169	-0.226	-0.067	-0.029	-0.018	-0.063	-0.012	-0.069	-0.028
	(0.095)	(0.094)	(0.103)	(0.131)	(0.139)	(0.125)	(0.140)	(0.098)	(0.057)
Special ind. machinery	-0.085	-0.091	-0.086	0.057	-0.008	0.028	0.060	-0.150	0.039
	(0.066)	(0.067)	(0.078)	(0.101)	(0.125)	(0.097)	(0.082)	(0.100)	(0.047)
General industrial	-0.130	-0.193	-0.202	0.069	0.115	0.064	0.129	-0.162	0.031
	(0.083)	(0.088)	(0.086)	(0.101)	(0.101)	(0.104)	(0.100)	(0.134)	(0.046)
Office/computers	0.483	-0.468	0.072	0.799	-0.182	1.036	-0.449	-0.203	-0.655
	(0.266)	(1.400)	(0.467)	(0.873)	(0.527)	(0.839)	(0.522)	(0.429)	(0.254)
Service ind. machinery	-0.071	-0.052	-0.065	0.167	0.028	0.136	0.192	-0.072	-0.079
	(0.060)	(0.055)	(0.061)	(0.100)	(0.124)	(0.097)	(0.075)	(0.071)	(0.034)

Table B.3 (cont.): User Cost Tax Adjustment (negative)

Investment Type	Goolsbee (1998)	Specification / Sample Period							
		(a) 1959-1988 Vintage Data		(b) (a) + revised eqp price data		(c) (b) + revised macro data		(d) 1959-1988 Current data /specification	(e) 1959-2009 Current data /specification
	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	Quasi Diff	OLS	OLS
Electrical distribution	-0.130	-0.037	-0.157	0.131	0.023	0.095	0.150	-0.401	-0.242
	(0.073)	(0.121)	(0.114)	(0.126)	(0.135)	(0.121)	(0.090)	(0.138)	(0.062)
Communication equip.	0.183	0.251	0.047	0.314	0.191	0.361	0.200	0.079	-0.145
	(0.092)	(0.129)	(0.085)	(0.143)	(0.120)	(0.140)	(0.119)	(0.102)	(0.068)
Electrical equipment	-0.429	-0.424	-0.174	0.214	0.060	0.202	0.108	-0.149	0.078
	(0.092)	(0.168)	(0.094)	(0.093)	(0.104)	(0.091)	(0.097)	(0.087)	(0.048)
Trucks and buses	-0.419	-0.025	0.004	0.221	0.109	0.048	0.123	-0.101	0.414
	(0.174)	(0.265)	(0.159)	(0.272)	(0.246)	(0.249)	(0.246)	(0.184)	(0.134)
Autos	0.341	-0.512	-0.643	1.093	0.935	1.103	0.933	0.352	0.632
	(0.129)	(0.598)	(0.693)	(0.227)	(0.203)	(0.244)	(0.203)	(0.307)	(0.107)
Aircraft	-0.539	-0.254	-0.291	0.099	0.258	0.045	0.213	-0.351	-0.235
	(0.134)	(0.235)	(0.253)	(0.119)	(0.129)	(0.119)	(0.124)	(0.118)	(0.053)
Shipts and boats	-0.206	-0.237	0.166	0.031	-0.004	0.010	-0.012	-0.190	-0.290
	(0.055)	(0.149)	(0.093)	(0.083)	(0.094)	(0.075)	(0.094)	(0.043)	(0.037)
Railroad equipment	-0.486	-0.546	-0.502	-0.420	-0.202	-0.469	-0.175	-0.322	-0.129
	(0.081)	(0.199)	(0.152)	(0.189)	(0.190)	(0.180)	(0.192)	(0.148)	(0.072)
Instruments	0.164	0.005	0.041	0.233	0.239	0.247	0.229	-0.210	-0.068
	(0.090)	(0.071)	(0.063)	(0.123)	(0.112)	(0.131)	(0.114)	(0.084)	(0.032)

Notes: The table reports the estimated coefficient on the type specific user cost tax adjustment (see equation 4 in the text). The left hand side variable is the log of real equipment prices as described in Appendix B. Columns (a) – (e) indicate different econometric specifications. Specification (a) limits the sample to 1959-1988 and uses vintage data as described in Appendix B. Regressors include linear time trend, growth rate of real GDP, Nixon price controls, and exchange rates for the German DM and Japanese Yen. Specification (b) is the same as (a) but uses revised (current) data for equipment prices; (c) is the same as (b) but uses revised data for macroeconomic covariates; (d) is the same as (c) but changes the regression specification to include a piecewise-linear time trend, HP-filtered real GDP, Nixon price controls, and real oil prices; (e) is the same as (d) but extends the sample period to 1959-2009.

TABLE D.1. INDIRECT INFERENCE ESTIMATES: NON-TARGETED MOMENTS

Model Specification	Data	Baseline	Low λ	High λ	Low θ	High θ	Low adj. costs	High adj. costs	Low ψ_n	High ψ_n
Estimated Import Supply Elasticity (χ)		6.53	7.22	5.17	3.06	24.14	13.99	3.13	5.02	16.31
		(1.56)	(1.61)	(1.36)	(0.84)	(11.68)	(2.43)	(0.95)	(1.12)	(5.41)
Reduced-form coefficients		Reduced-Form Coefficients Implied by Model								
Structures Investment	0.46	1.78	1.81	1.70	1.53	2.11	2.02	1.55	1.73	1.90
	(0.31)									
Wage Bill	0.12	0.60	0.61	0.59	0.61	0.62	0.56	0.64	0.77	0.26
	(0.96)									
Equipment Prices	0.07	0.09	0.10	0.09	0.14	0.03	0.05	0.14	0.10	0.05
	(0.08)									
Structures Prices	0.22	0.27	0.29	0.25	0.33	0.22	0.20	0.33	0.29	0.24
	(0.09)									

Notes: The first row reports indirect inference estimates of the import supply elasticity under baseline and alternative values of the calibrated parameters. The inferences are based on targeting the reduced-form regression coefficients shown in the first column. The model-implied estimates of these parameters are given in the balance of the table.

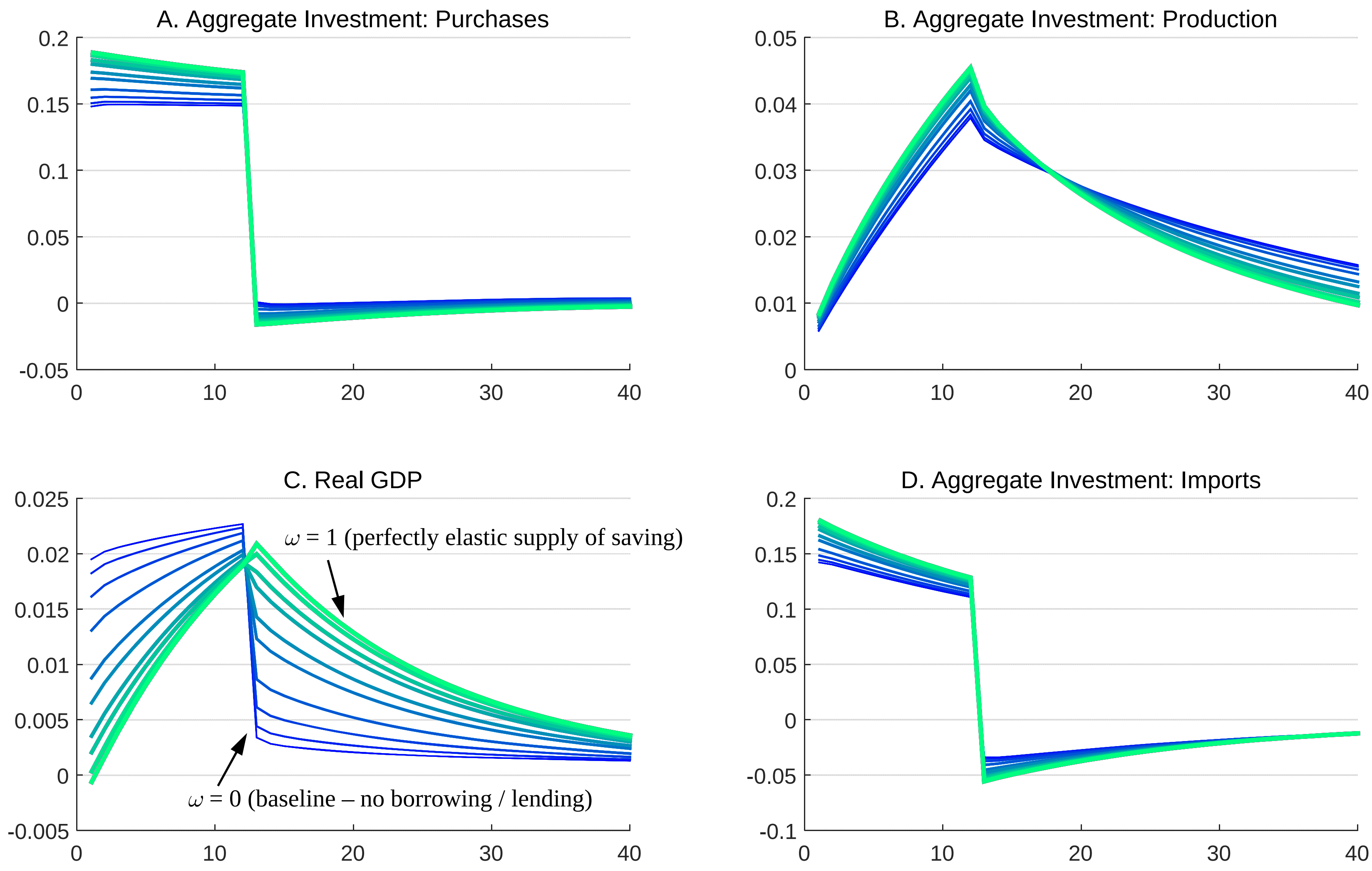
TABLE E.1. INDIRECT INFERENCE ESTIMATES AND INTERNATIONAL BORROWING ($\omega = 1/2$, ROW IS SAME SIZE AS U.S.)

Model Specification	Data	Baseline	Low λ	High λ	Low θ	High θ	Low adj. costs	High adj. costs	Low ψ_n	High ψ_n
Estimated Import Supply Elasticity (χ)		7.47 (1.78)	8.17 (1.82)	5.94 (1.55)	3.59 (0.93)	24.57 (12.81)	17.06 (2.04)	3.72 (0.00)	5.65 (1.24)	21.61 (8.05)
Targeted Reduced-form coefficients		Reduced-Form Coefficients Implied by Model								
Equipment Production	1.08 (0.40)	1.02	1.04	1.01	1.00	1.17	1.04	0.98	1.03	0.99
Equipment Investment	1.76 (0.43)	1.63	1.78	1.49	1.47	1.90	1.77	1.47	1.58	1.80
Hours	0.65 (0.54)	0.57	0.58	0.57	0.62	0.59	0.55	0.59	0.44	0.80
Material Inputs	0.81 (0.51)	1.02	1.04	1.01	1.00	1.17	1.04	0.98	1.03	0.99
Productivity (TFP)	0.28 (0.15)	0.04	0.04	0.04	0.00	0.09	0.04	0.04	0.05	0.02

TABLE E.2. INDIRECT INFERENCE ESTIMATES AND INTERNATIONAL BORROWING ($\omega = 3/4$, ROW IS 3X SIZE U.S.)

Model Specification	Data	Baseline	Low λ	High λ	Low θ	High θ	Low adj. costs	High adj. costs	Low ψ_n	High ψ_n
Estimated Import Supply Elasticity (χ)		9.13 (2.2)	9.81 (2.21)	7.29 (1.89)	4.24 (1.06)	23.77 (13.41)	24.01 (4.65)	3.92 (1.13)	6.69 (1.46)	30.00 (13.68)
Targeted Reduced-form coefficients		Reduced-Form Coefficients Implied by Model								
Equipment Production	1.08 (0.40)	1.03	1.05	1.02	1.01	1.25	1.04	1.00	1.04	1.04
Equipment Investment	1.76 (0.43)	1.68	1.84	1.54	1.53	1.91	1.85	1.50	1.63	1.88
Hours	0.65 (0.54)	0.56	0.57	0.55	0.59	0.63	0.54	0.59	0.42	0.82
Material Inputs	0.81 (0.51)	1.03	1.05	1.02	1.01	1.25	1.04	1.00	1.04	1.04
Productivity (TFP)	0.28 (0.15)	0.04	0.04	0.04	0.00	0.09	0.04	0.04	0.05	0.02

FIGURE E.1. TEMPORARY INVESTMENT SUBSIDY FOR EQUIPMENT WITH INTERNATIONAL BORROWING



Notes: The figure reports the simulated impulse response functions for the selected variables. The investment subsidy is a 10 percent subsidy for equipment (structures are not eligible) and has an expected horizon of 3 years as described in the text. The figure plots a sample realization in which the policy sunsets in exactly 3 years. Each line corresponds to a different value of the parameter ω as described in Appendix E.