Autonomous Demand and the Investment Share

Daniele Girardi* and Riccardo Pariboni**

* Department of Economics, University of Massachusetts Amherst
** Department of Economics, Roma Tre University.

Introduction

Research Question:
How do (autonomous) demand dynamics affect the investment share of the economy?

Why should we care?

- Influence of demand on investment is a powerful potential mechanism for hysteresis/demand-led growth;
- the effect of autonomous demand on the investment share is a powerful statistic to assess different macroeconomic models (an *'identified moment'* [Nakamura & Steinsson, 2018]).

Theoretical predictions (I)

- *Canonical New-Keynesian 3-equations model* and *'Classical-Marxian' models [Duménil and Lévy 1999]*:
  - Autonomous demand increase would reduce I/Y;
  - Mechanism: demand expansion leads to accelerating inflation, CB reaction causes 'crowding-out'

Theoretical predictions (I)

- *Canonical New-Keynesian 3-equations model* and *'Classical-Marxian' models [Duménil and Lévy 1999]*:
  - Autonomous demand increase would reduce I/Y;
  - Mechanism: demand expansion leads to accelerating inflation, CB reaction causes 'crowding-out'
- *Neo-Kaleckian model*:
  - Baseline version: no autonomous demand, I/Y is supply-determined ($I/Y = s \times \Pi$)
  - Augmented with autonomous demand: negative effect of autonomous demand growth on I/Y.
  - Mechanism: higher demand growth accommodated by permanently higher utilization rate, so investment growth does not catch up.

Theoretical predictions (II)

- *'Supermultiplier' models*
  - Increase in autonomous demand growth increases the investment share
  - Mechanism: after initial over-utilization, I will grow faster than Y for some time, in order to restore $u = u_n$

Theoretical predictions (II)

- *'Supermultiplier' models*
  - Increase in autonomous demand growth increases the investment share
  - Mechanism: after initial over-utilization, I will grow faster than Y for some time, in order to restore $u = u_n$
- *Harrodian models* (á la Peter Skott) :
  - Baseline version: positive *correlation* between demand growth and investment share, but *no causal effect*: both driven by (exogenous) changes in Π.
  - Kaldor-Marshall version (endogenous distribution): positive effect of autonomous demand on the investment share.
  - Mechanism: demand expansion $\rightarrow$ higher Π $\rightarrow$ higher I/Y.

Theoretical predictions: summing up

- New-Keynesian, Classical-Marxian and Neo-Kaleckian models: negative effect of ΔZ on I/Y;
- Supermultiplier model and Harrodian model w/ endogenous distribution: positive effect of ΔZ on I/Y;
- Effect is direct in supermultiplier models; mediated by profit share in Harrod-Kaldor-Marshall model;
- We estimate empirically the effect of ΔZ on I/Y to see which model gets it right.

Dataset

Sample and data

- Quarterly and yearly panel, 20 OECD economies, 1960-2016;
- Outcome variable: private non-housing investment (% of GDP);
- Main explanatory variable: autonomous demand growth
    - Autonomous demand = public consumption and investment + exports + housing investment.
- Control variables: real interest rate and profit share.
- Data sources: OECD Economic Outlook, AMECO, Eurostat.

Identification issues & research design

Identification issues

- Challenge: exports, public spending and housing are partly endogenous (Girardi and Pariboni, 2015 and 2016).
- Reverse causality: business investment may affect autonomous demand directly and through its impact on aggregate income.
- Unobserved shocks to economic activity (supply-side factors, global macroeconomic factors) can affect simultaneously business investment, GDP and autonomous demand.
- We use a combination of panel data techniques and instrumental variables to tackle endogeneity.

Identification issues & research design

Research design

1. Estimate dynamic panel models
   - test if past ΔZ predicts subsequent values of I/Y;
2. Use an instrumental-variables strategy to estimate a causal effect
   - we propose 3 instruments for autonomous demand;
3. Figure out which model gets this relation right
   - spoiler: evidence is most consistent with 'supermultiplier' models;

Descriptive evidence

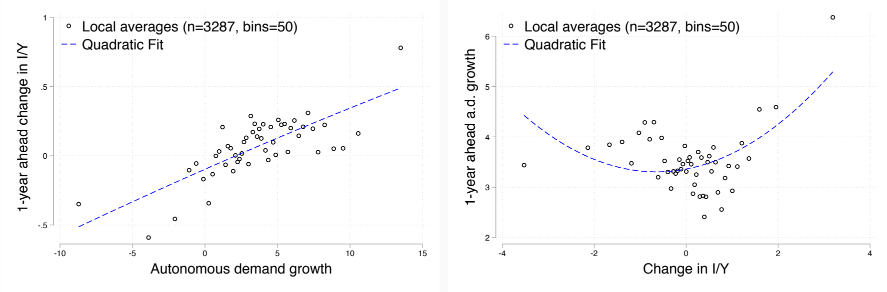


Figure 1: Relation between autonomous demand and business investment share (quarterly panel, 1960-2016)

Granger-causality

Dynamic panel estimation

$$I/Y_{i,t} = \alpha_i + \delta_t + \sum_{j=1}^{p} \beta_j \Delta Z_{i,t-j} + \sum_{j=1}^{p} \gamma_j (I/Y)_{i,t-j} + \epsilon_{i,t}$$

- quarterly data;
- test whether past values of ΔZ predict future values of I/Y;
- control for lags of I/Y and time & country FE;
- robustness analysis also controls for r and Π.

Granger-causality

Dynamic panel estimation – results

- changes in ΔZ predict subsequent changes of the same sign in I/Y;
- estimates imply that in the long-run a permanent 1% increase in autonomous demand growth raises the investment share by more than 1 point of GDP (point estimates between 1.4 and 2.2);
- robust to country & time FEs, interest rate and profit share;
- We assess reverse-causality by testing whether I/Y predicts ΔZ and find some evidence of it (not robust).

Granger-causality

'Disaggregated' dynamic panel tests

- Use same model to test for Granger-causality between each single component of Z and I/Y;
- For each component, we also estimate reverse Granger-causality tests;
- The estimated effect of each autonomous component is positive and of similar magnitude, but imprecisely estimated (larger standard errors);
- Reverse-causality tests reveal interesting patterns:
  - exports negatively related to past values of I/Y.
  - housing and gov't spending positively related to past values of I/Y.

IV Analysis

Instrumental Variables analysis

- Granger-causality tests may be biased by confounding factors;
- instrumental variables to obtain exogenous variation in ΔZ and estimate a causal effect.

IV Analysis

Instrumental Variables analysis

- Granger-causality tests may be biased by confounding factors;
- instrumental variables to obtain exogenous variation in ΔZ and estimate a causal effect.

Three instruments for autonomous demand:

1. jack-knifed US demand for imports, weighted by a country's exposure to trade with the US;
2. an index measuring the weighted-average openness to trade of a country's main export destinations;
3. Military spending

IV Analysis

Jack-knifed US import growth $\times$ exposure to the US

- Overall changes in US import demand affect other country's exports;
- heterogeneous intensity: a given increase in US demand impacts Canada more than Japan; Japan more than the Netherlands;

IV Analysis

Jack-knifed US import growth × exposure to the US

- Overall changes in US import demand affect other country's exports;
- heterogeneous intensity: a given increase in US demand impacts Canada more than Japan; Japan more than the Netherlands;
- for each country *i* and year *t*, take the growth rate of US demand for imports, excluding imports from country i (to avoid endogeneity);
- multiply this variable by the *past* share of the exports of country *i* that are absorbed by the US.
- $\Delta USDemand_{i,t} = [\Delta ln(M_{US} - M_{US-i}) * 100] \times (\bar{X}_{i \to US}/\bar{X}_i)_{past}$

IV Analysis

Jack-knifed US import growth × exposure to the US

- Overall changes in US import demand affect other country's exports;
- heterogeneous intensity: a given increase in US demand impacts Canada more than Japan; Japan more than the Netherlands;
- for each country *i* and year *t*, take the growth rate of US demand for imports, excluding imports from country i (to avoid endogeneity);
- multiply this variable by the *past* share of the exports of country *i* that are absorbed by the US.
- $\Delta USDemand_{i,t} = [\Delta ln(M_{US} - M_{US-i}) * 100] \times (\bar{X}_{i \to US}/\bar{X}_i)_{past}$
- Identification assumptions: *past* exposure to trade with the US exogenous to future I/Y; US aggregate demand not determined by macroeconomic conditions in its trade partner countries.

IV Analysis

Weighted average openness to trade of export destinations

- for a country *i*, a lifting of trade restrictions in its main export destinations can give an (exogenous) boost to exports
- conversely, the erection of trade barriers in key trade partners can depress exports;

IV Analysis

Weighted average openness to trade of export destinations

- for a country *i*, a lifting of trade restrictions in its main export destinations can give an (exogenous) boost to exports
- conversely, the erection of trade barriers in key trade partners can depress exports;
- for each country, we calculate the weighted-average openness to trade of its five main export destinations (weights = economy size);
- measure of openness: 'trade restrictions' [Dreher et al. (2008)].

IV Analysis

Weighted average openness to trade of export destinations

- for a country *i*, a lifting of trade restrictions in its main export destinations can give an (exogenous) boost to exports
- conversely, the erection of trade barriers in key trade partners can depress exports;
- for each country, we calculate the weighted-average openness to trade of its five main export destinations (weights = economy size);
- measure of openness: 'trade restrictions' [Dreher et al. (2008)].
- Identification assumption: trade policy of other countries is exogenous to country *i*'s macroeconomic conditions;

IV Analysis

Military spending

- A sizable component of public spending that tends to be largely independent of the business cycle;
- a large literature uses it as instrument for government spending;

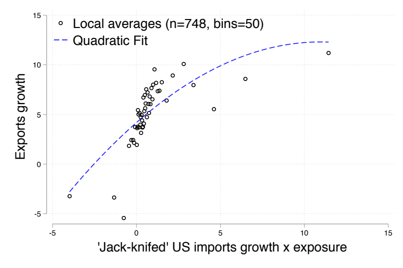
IV Analysis

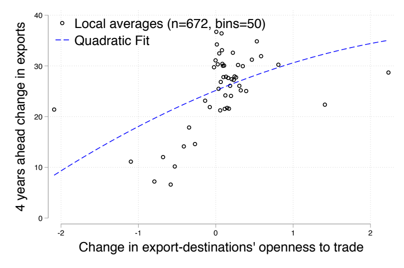
Military spending

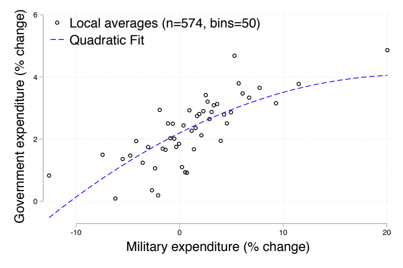
- A sizable component of public spending that tends to be largely independent of the business cycle;
- a large literature uses it as instrument for government spending;
- Identification assumptions:
  - changes in military spending exogenous to domestic macroeconomic conditions;
  - they affect the domestic economy only through their multiplier effect.

IV Analysis

Instruments Relevance (yearly panel, 1970-2015)







IV Analysis

2SLS estimation

$$I/Y_{i,t} = \alpha_i + \delta_t + \sum_{j=0}^{p} \beta_j \Delta Z_{i,t-j} + \sum_{j=0}^{p} \gamma_j (I/Y)_{i,t-j} + \epsilon_{i,t} \tag{1}$$

IV Analysis

2SLS estimation

$$I/Y_{i,t} = \alpha_i + \delta_t + \sum_{j=0}^{p} \beta_j \Delta Z_{i,t-j} + \sum_{j=0}^{p} \gamma_j (I/Y)_{i,t-j} + \epsilon_{i,t} \qquad (1)$$

$$\Delta Z_{i,t} = \rho_i + \theta_t + \sum_{j=0}^{q} \phi_j \Delta USDemand_{i,t-j} + \sum_{j=0}^{q} \pi_j \Delta TP\_openness_{i,t-j} +$$
$$+ \sum_{j=0}^{q} \sigma_j \Delta Milex_{i,t-j} + \sum_{j=0}^{p} \omega_j \Delta (I/Y)_{i,t-j} + v_{i,t}$$

IV Analysis

2SLS estimation

$$I/Y_{i,t} = \alpha_i + \delta_t + \sum_{j=0}^{p} \beta_j \Delta Z_{i,t-j} + \sum_{j=0}^{p} \gamma_j (I/Y)_{i,t-j} + \epsilon_{i,t} \tag{1}$$

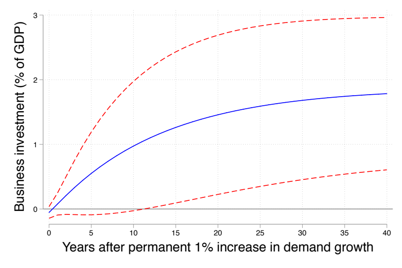
$$\Delta Z_{i,t} = \rho_i + \theta_t + \sum_{j=0}^{q} \phi_j \Delta USDemand_{i,t-j} + \sum_{j=0}^{q} \pi_j \Delta TP\_openness_{i,t-j} + \\ + \sum_{j=0}^{q} \sigma_j \Delta Milex_{i,t-j} + \sum_{j=0}^{p} \omega_j \Delta (I/Y)_{i,t-j} + v_{i,t}$$

- yearly dataset (1970-2015);
- treat autonomous demand as endogenous, and instrument it using our three instruments;
- control for lags of I/Y and country and year fixed effects.
- robustness: control also for r and Π;

IV Analysis

2SLS Estimation - Results

- A (significant and relevant) positive effect of ΔZ on I/Y across all specifications;
- Baseline preferred IV specification implies that a permanent 1% increase in ΔZ increases the equilibrium (I/Y) by around 1.9 percentage points of GDP.
- Impulse response function (IRF) from the preferred IV specification:



IV Analysis

Semi-parametric estimates (Local Projections)

- IRF from IV dynamic panel (previous slide):
  - gives the dynamic effect of a *permanent* increase in ΔZ;
  - based on extrapolating from estimated coefficients;
  - relies heavily on parametric specification of the autoregressive process followed by I/Y;
- IRF from local-projections (LPs) [Jordá , 2005]:
  - does not assume a parametric model for the dynamics of the outcome;
  - gives the dynamic effect of a *temporary* increase in ΔZ;

IV Analysis

Semi-parametric estimates (Local Projections)

- For each time-horizon h, estimate the LP regression:

$$I/Y_{i,t+h} = \alpha_i^h + \delta_t^h + \beta^h \Delta Z_{i,t} + \sum_{j=0}^{q} \gamma_j^h (I/Y)_{i,t-j} + \epsilon_{i,t+h} \quad \text{for } h = 1, ..., n \tag{2}$$

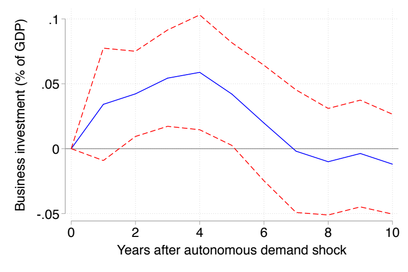
IV Analysis

Semi-parametric estimates (Local Projections)

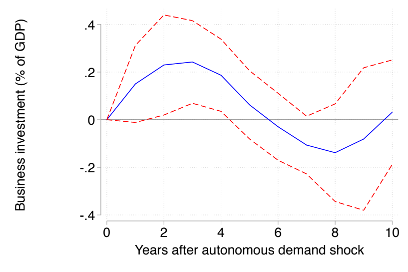
- For each time-horizon h, estimate the LP regression:

$$I/Y_{i,t+h} = \alpha_i^h + \delta_t^h + \beta^h \Delta Z_{i,t} + \sum_{j=0}^{q} \gamma_j^h (I/Y)_{i,t-j} + \epsilon_{i,t+h} \quad \text{for } h = 1, ..., n \tag{2}$$

- Resulting IRF (Dynamic effect of a temporary 1% increase in ΔZ):



(c) OLS estimation



(d) IV estimation

Discussion

Demand shocks (increases in rate of growth of autonomous demand) tend to cause the business investment share to increase significantly

- effect of demand dynamics on capital accumulation can be a major source of hysteresis/demand-led growth;
- Not consistent with:
  - macro models in which potential output is exogenous to aggregate demand (NK 3-equations models; ‘Classical-Marxian’ models);
  - Neo-Kaleckian model with flexible desired utilization;
- Consistent with:
  - models in which productive capacity adjusts to demand in the long-run (‘Supermultiplier’ models);
  - Skott (2010) Harrod-Marshall-Kaldor model – which however would predict the effect to disappear when controlling for Π.