Can International Sanctions Cause Stagnation? A Macroeconomic Analysis of International Sanctions on Iran's Economy

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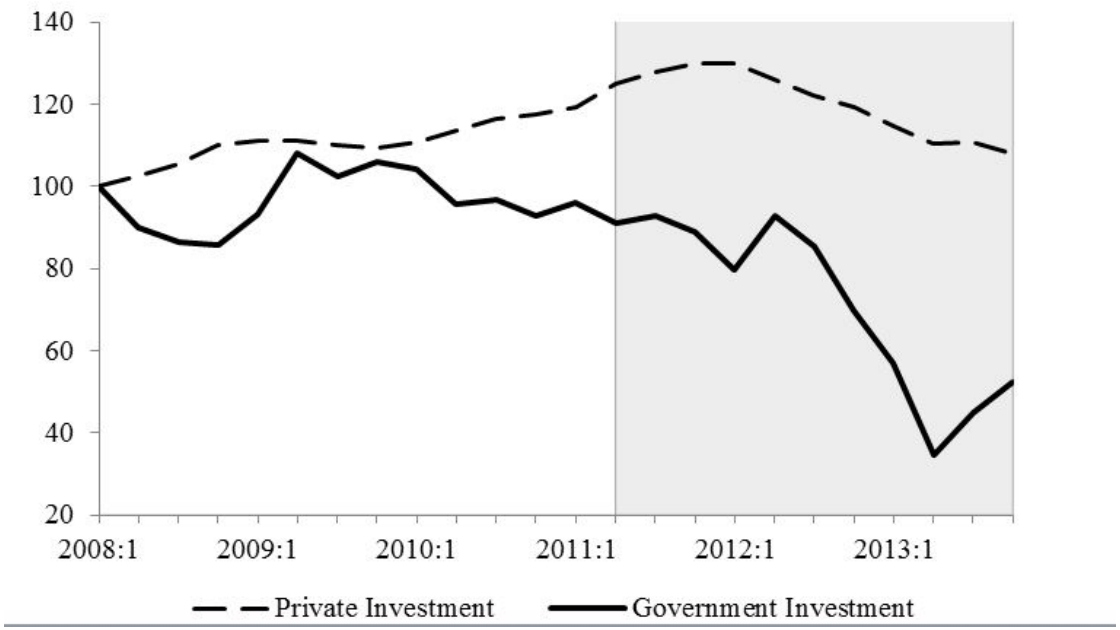
Introduction
Motivation

A deep recession in 2012-13:

- GDP dropped around -%6.8 in 2012 and -%1.9 in 2013
- private investments declined by %17
- government investment plunged %60
- Real trade balance declined %57

Figure 1: Private and Public Investment

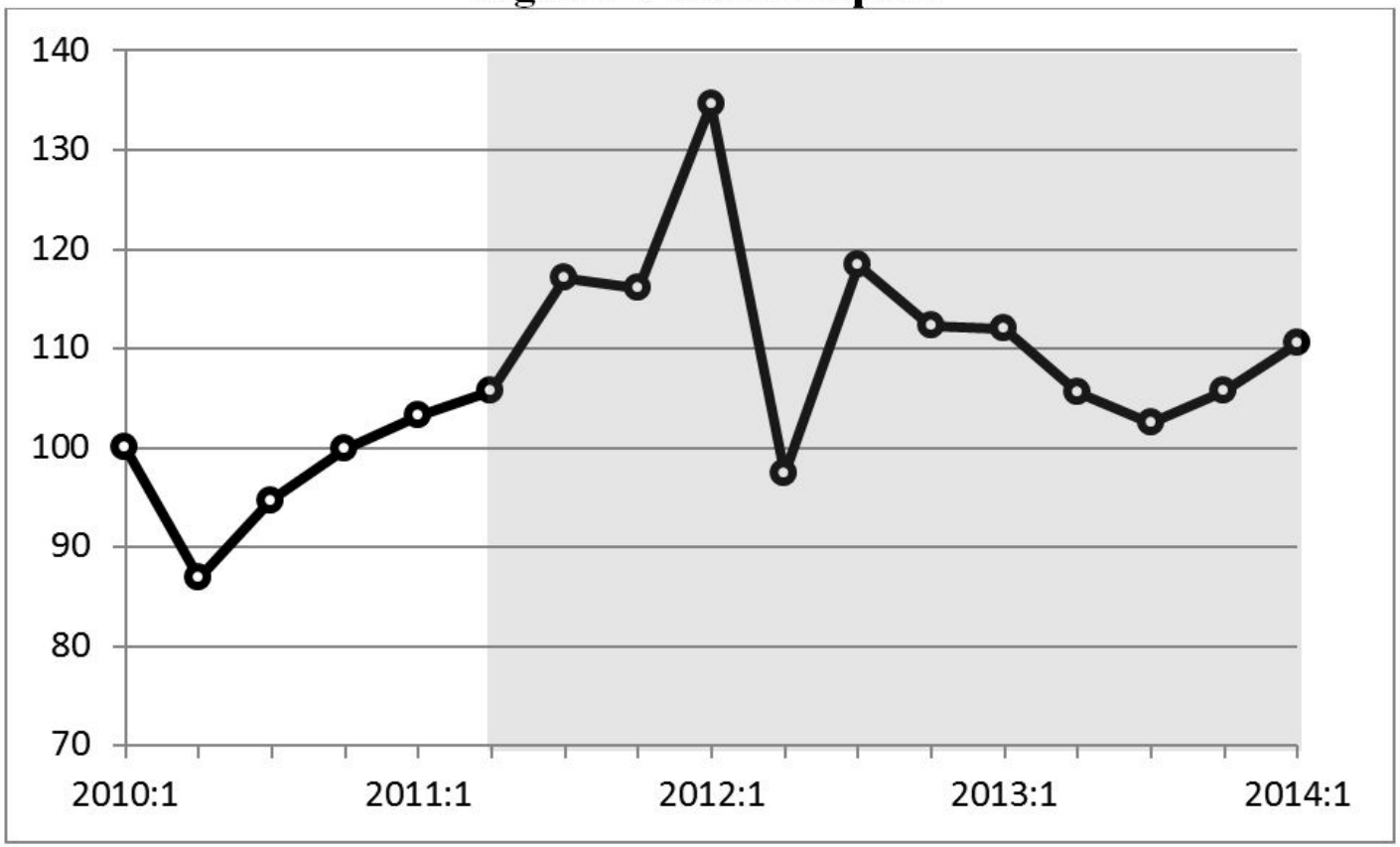


Introduction
Sanctions

international sanction

- restrains imports of intermediates with imposing extra financial costs
- boycotts Iran's exports.

Figure 2: Iran's Export



Outline

- The Detailed Model
- The Benchmark Prototype Economy
- The Mapping— From Frictions to Wedges
- Calibration
- Results
- Robustness Check
- Conclusion

The Detailed Model

Household

- Households maximize their expected utility over per capita consumption (c_t) and per capita labor (l_t)

$$Max \quad \sum_{t=0}^{\infty} \sum_{s^t} \beta^t . \pi_t(s^t) . u(c_t(s^t), l_t(s^t))$$

$$u(c_t, l_t) = \frac{(c_t(1-l_t)^x)^{1-\sigma} - 1}{1-\sigma}$$

- Households are subject to the budget constraint:

$$c_t + (k_{t+1} - k_t(1-\delta)) = w_t . l_t + r_t . k_t + T_t$$

The Detailed Model
Firm

- Aggregate final output q_t combines composite value-added goods z_t and imports m_t according to

$$q_t = z_t^{\alpha} m_t^{1-\alpha}$$

- The representative producer of the final output q_t chooses z_t, m_t to solve this problem,

$$Max\ q_t - \nu_t z_t - e_t m_t - \theta_t r_t e_t m_t$$

- ν_t the price of composite value-added
  e_t the real exchange rate
  θ_t fraction of imports that firms have to pay in advance for input bills
  r_t rental rate on capital
- The financial frictions are θ_t and look like the working capital in *Neumeyer and Perri (2005)*

The Detailed Model
Firm

- The composite value-added goods are produced from capital k_t and labor l_t according to

$$z_t = F(k_t, l_t)$$

- The representative producer of the composite good z_t chooses k_t and l_t to solve this problem

$$Max\ v_t z_t - w_t l_t - r_t k_t$$

- We can describe export and import as

$$x_t = \xi_t \times (e_t)^{\psi}$$
$$x_t = m_t$$

- ψ is the price elasticity demand for domestic final goods
- Boycotts reduce the level of ξ_t

The Benchmark Economy
Household

- The economy has five stochastic exogenous variables

$$s_t = (A_t, (1 - \tau_{l,t}(s^t)), (1 + \tau_{x,t}(s^t)), g_t, \tau_{m,t})$$

- In each period, households and firms maximize their problems by knowing S_t and K_0
- Households maximize the same objective function with this budget constraint:

$$c_t(s^t) + (1 + \tau_{x,t}(s^t)).x_t(s^t) = (1 - \tau_{l,t}(s^t)).w_t(s^t).l_t(s^t) + r_t k_{t-1}(s^t) + T_t(s^t)$$

The Benchmark Economy
Firm

- A firm's production function is

$$y_t(s^t) = A_t(s^t)(k_t(s^t)^{\alpha} l_t(s^t)^{1-\alpha})^{1-\gamma} m_t(s^t)^{\gamma}$$

- Firms maximize their profit in each period:

$$Max \quad y_t(s^t) - w_t(s^t)l_t(s^t) - r_t(s^t)k_t(s^t) - \tau_{m,t}(s^t)m_t(s^t)$$

- The feasibility constraint in this economy is

$$c_t(s^t) + k_t(s^t) + g_t(s^t) = y_t(s^t) + (1-\delta)k_t(s^t) - e_t m_t(s^t)$$

The Mapping
From Frictions to Wedges

- *PROPOSITION 1*: Consider the four-wedge benchmark economy that has constraint (5) and consumer budget constraint (11).which has the efficiency wedge $A_t = \alpha(\frac{1-\alpha}{1+(r_t\theta_t)e_t})^{(\frac{1-\alpha}{\alpha})}$, the labor, and investment wedge given by $(1-\tau_{l,t}) = (1-\tau_{x,t}) = 1$ Then the equilibrium allocations for aggregate variables in the detailed economy and this prototype economy are the same.
- The effects of sanctions are manifest in the efficiency. However, we know from *Chari et al. (2007)* that many other frictions map into the efficiency wedge; thus we cannot isolate the effect of sanctions from other frictions.

The Mapping
From Frictions to Wedges

- *PROPOSITION 2*: Consider a benchmark economy that has resource constraint (5) and consumer budget constraint (11) with the efficiency wedge $A_t = 1$, the labor and investment wedge given by $(1 - \tau_{l,t}) = (1 - \tau_{x,t}) = 1$ and the trade wedge $\tau_{m,t} = (1 + r_t\theta_t)e_t$. Then the equilibrium allocations for aggregate variables in the detailed economy and this prototype economy are the same.
- Therefore international boycotts and financial sanctions manifest themselves *only* in the trade wedge and not the efficiency wedge. This provides a basis for why we will use the benchmark economy with five wedges

Calibration

Parameter	Seasonal Value	Annual Value
α-Capital Share	0.66	0.66
β-Discount Rate	0.985	0.94
δ-Depreciation Rate	0.01046	0.0425
ψ-Leisure Elasticity	2.4	2.4
σ-Consumption Elasticity	1	1
g_n-Population Growth Rate	0.43%	1.75%
g_z-Productivity Growth Rate	0.397%	2.4%
γ-Intermediate Goods Share	0.09	0.09

Accounting procedure

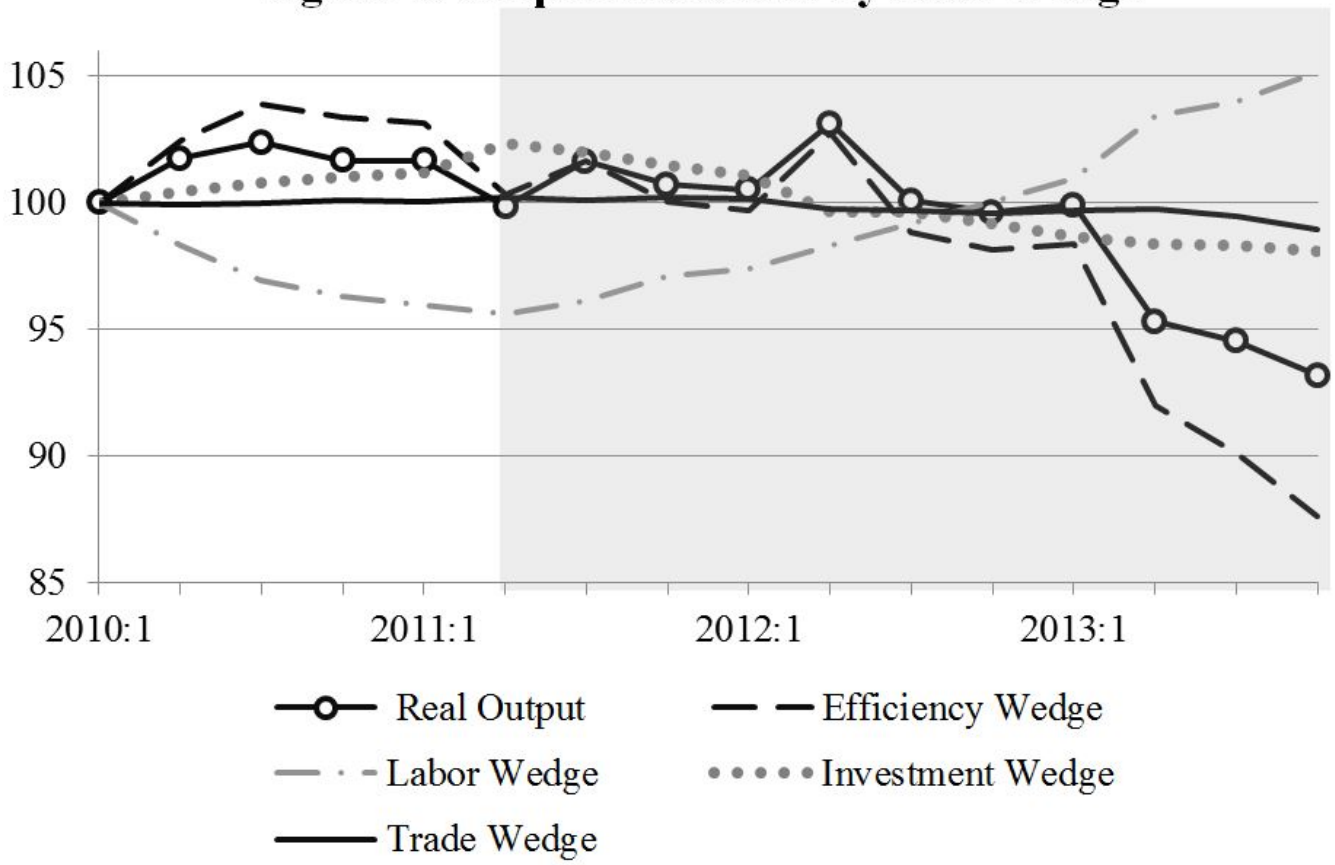
- First step: estimating the parameters of the Markov Process

$$s_t = P_0 + P s_{t-1} + \epsilon_t \qquad \epsilon_t \sim N(0, \Sigma)$$

- Second step: Measuring the realized wedges
- Third step: Isolate the marginal effects of the wedges

Results
2012-2013 recession

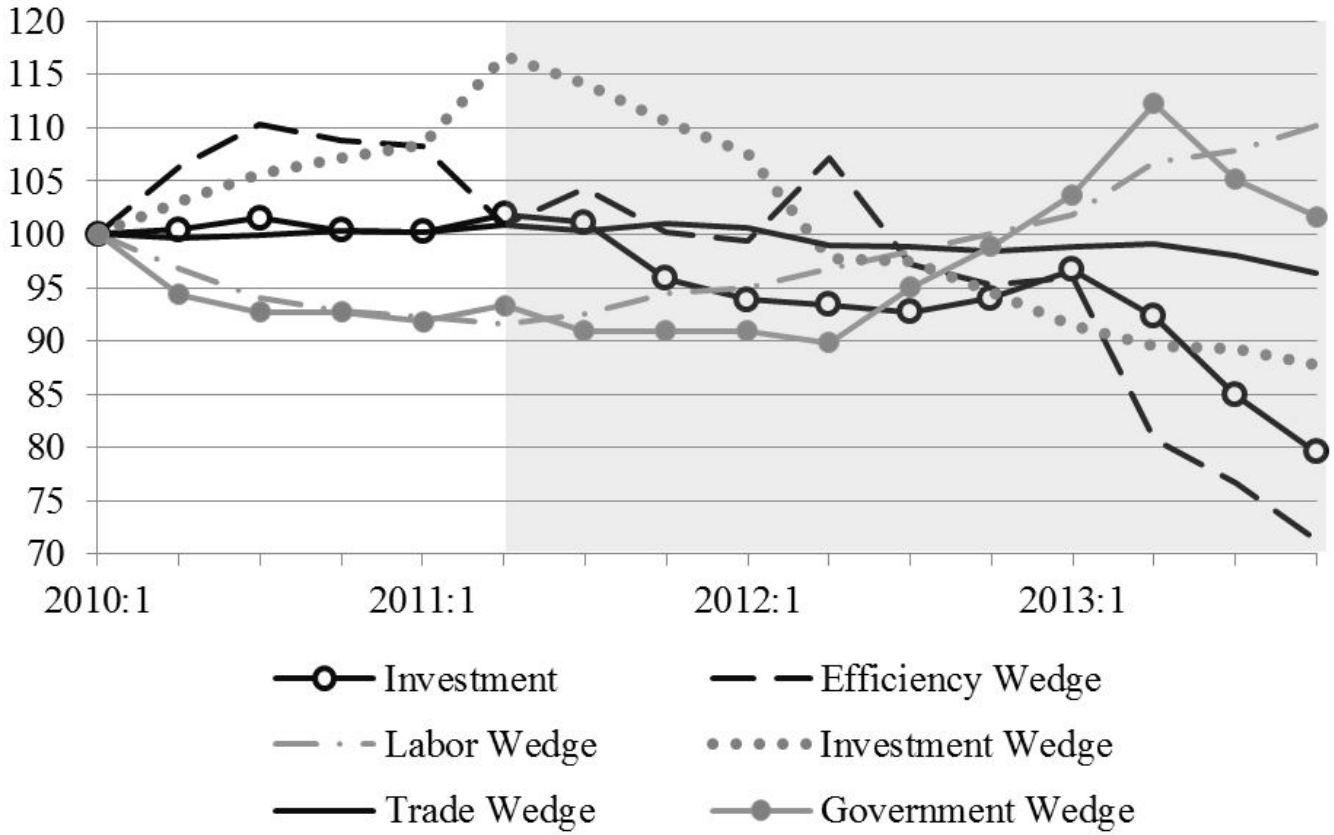
Figure 4: Output Generated by Each Wedge



- The efficiency wedge plays a pivotal role in output fluctuations
- The investment wedge explains recession to some extent
- when we fed back the trade wedge into the model, the output decreases 1.1% while real output declines 10%
- The government wedge causes almost no fluctuations in output

Results
2012-2013 recession

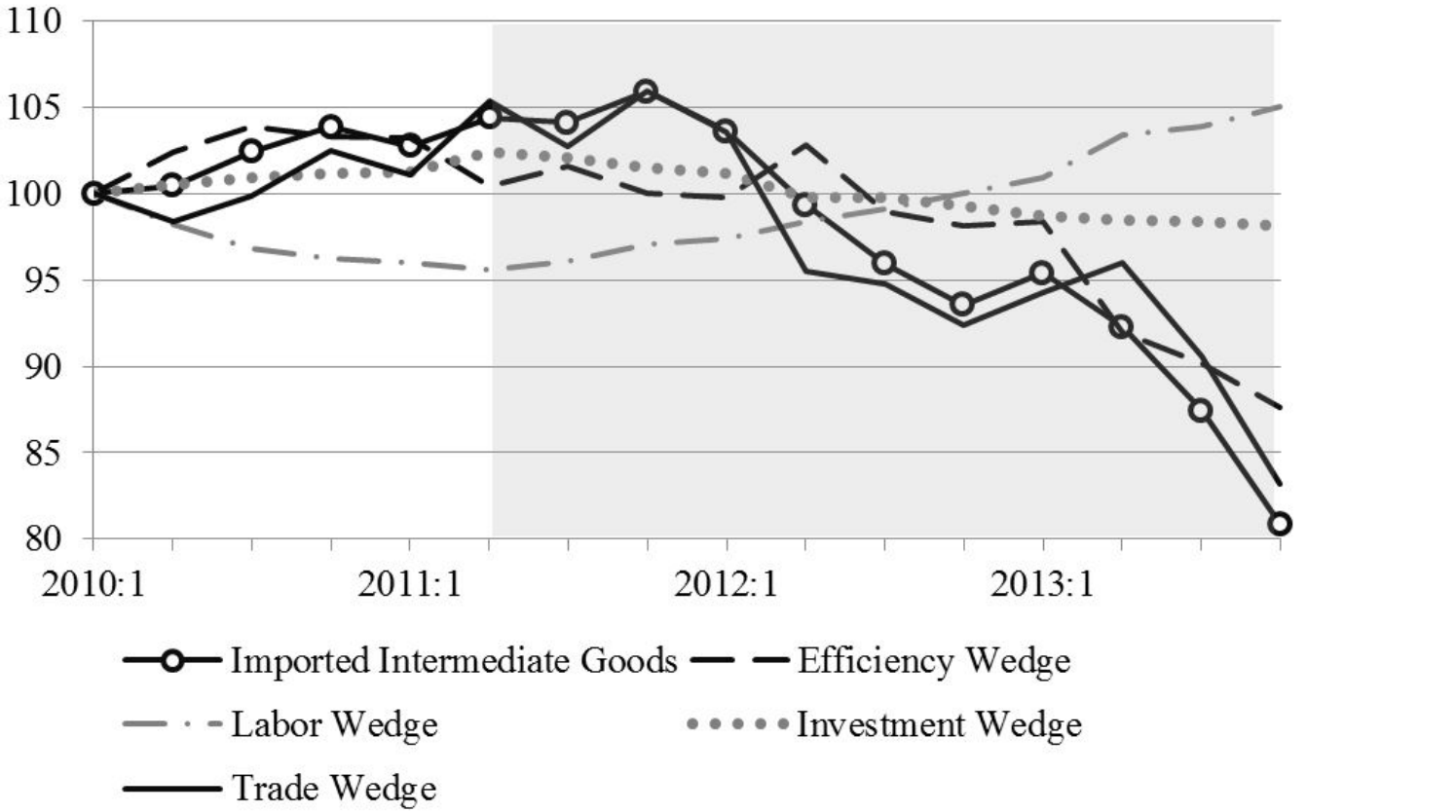
Figure 5: Investment Generated by Each Wedge



- The investment wedge can explain almost all the decline in investment
- The government wedge and the trade wedge cause a minor decline in the investment in 2013

Results
2012-2013 recession

Figure 6: Imported intermediate goods predicted by just one wedge



- the imported intermediate goods reach their peak in winter of 2011, then drop 25% during 8 seasons. The trade wedge explains almost all fluctuations in imported intermediate goods

Robustness Check

- Capital goods import is also added to intermediate goods import by a calibrated value of 0.12 for γ
- Capital goods and final goods import is also added to intermediate goods import by a calibrated value of 0.137 for γ
- Use a CES productions function in which elasticity of substitution between imported intermediate goods and GDP is 0.4(two production factors are complementary)

The explanatory power of the trade wedge improved *slightly*

Conclusion

- We have also defined a new wedge called "Trade Wedge" in accordance to Iran's economy in order to measure the effect of trade barriers, such as exchange rate jumps and sanctions on importing intermediate goods by firms, which has decreased drastically during recession
- The trade wedge predicts only 1.1% decline in output in the 2013 recession, so sanctions that represent themselves by trade wedge have no explanatory power in accounting movements of output

Conclusion

- The efficiency wedge explains a great proportion of the fluctuations in output during the recession
- The investment wedge, which accounts for investment movements very well, plays a secondary role
- Other wedges cannot explain them at all
- We do not reject the hypothesis that strict, economic sanctions have no effect; we state that trade barriers such as sanctions cannot affect output through imports and boycotts