Lecture 7

Using wedges to measure intersectoral distortions

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Distortions and wedges

- Wedge decomposition: powerful and popular diagnostic tool for understanding macroeconomic phenomena
- Originally developed by Chari, Kehoe, McGratten (Ecta, 2007) to study business cycles
  - Casey Mulligan has even earlier, unpublished work
- We will use this tools in a specific context: structure transformation of Russia in 1880-1940
  - Cheremukhin, Golosov, Guriev, Tsyvinski "Industrialization and Economic Development of Russia through the lenses of the Neoclassical Growth Model" (ReStud, 2017)

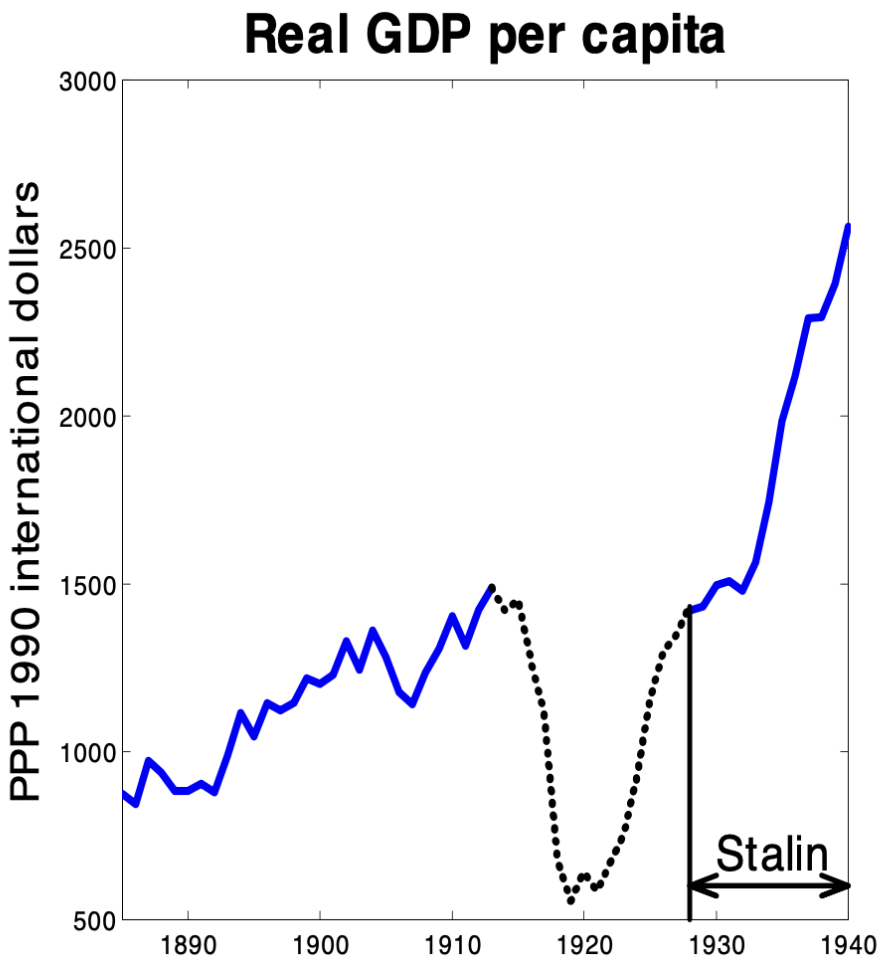
Motivation

- Structural transformation and reallocation of labor force from agriculture to manufacturing and services has been one of the central questions of growth and development
- Even these days most poor countries are heavily agricultural
  - they also appear to be particular unproductive at that activity
- What slows reallocation to other sectors?

This paper

- Study of structural transformation during a particular stark historical episode: industrialization of Russia in 1928-1940
- Russian economy pre-1928:
  - heavily agricultural, over 80% of labor force report agriculture as primary occupation
  - not very good at it: share of agriculture is less than 50%
  - share of labor force is much larger than in other developed countries
- Reforms of 1928-1940
  - 30% of labor force move to manufacturing in just 12 years
  - rapid growth in manufacturing production
  - famine, political repressions

Russian Industrialization in 1928-1940



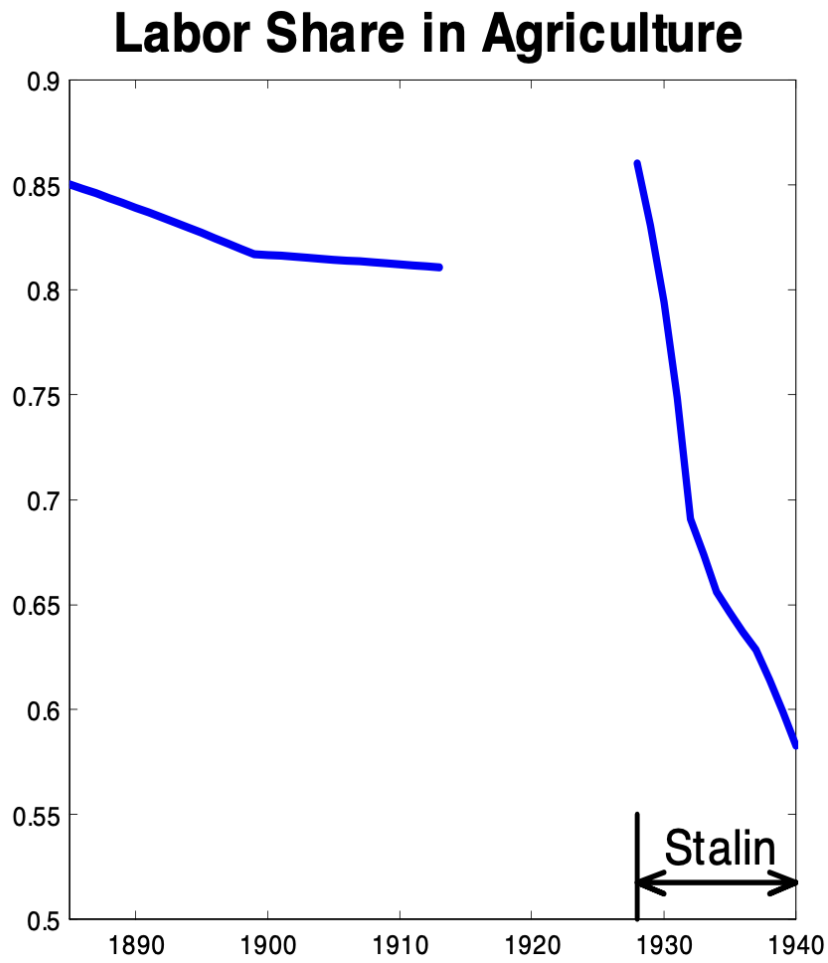


Figure: Real GDP and sectoral labor share in Russia in 1885-1940.

This paper

- This paper: use neoclassical growth model to identify the sets of institutions and reforms that most affected structural transformation *quantitatively*
- We develop a procedure that measures deviations of the predictions of the neoclassical growth model in *quantities* and *prices* ("wedge accounting")
  - any set of policies (in market or command economic system) can be mapped into a system of taxes ("wedges") in a neoclassical growth model
  - different policies map into different wedges
  - consistent procedure to measure importance of different policies across different economic regimes/institutions
  - broader methodological applicability beyond analysis of Russia

Economic policies in Russia pre-1913

- Serfdom abolished in 1861
- Land belongs to communal property
  - land rents shared equally
  - many communes do not allow sale of individual land rights
- Small industrial sector
  - tsar is historically afraid of political challenge from bourgeoisie, keeps large barriers
  - hard to set up companies, run them without state interference
  - prevalence of cartels and monopolies
- Large country with limited transportation network
  - regional markets not well integrated
  - many peasants have little participation in market activity

Economic policies in Russia post-1928

- Industrialization: company managers are encouraged to massively expand industrial production
- Collectivization: collective farms are created in countryside, by 1935 most peasants are employed there
  - results in famines in villages in 1932-33
  - passport system introduced to stem flow of peasants to the cities
- Rationing of consumer goods in 1929-34
  - by 1935 free markets at which farmers sell agricultural goods, buy manufacturing
  - state store prices equalize with those prices by 1937
- Politburo sets general quantities targets and some prices; enterprise-level quantities and prices emerge from decentralized contracting between state ministries and individual enterprises

Two-sector growth model

- Preferences

$$\sum_{t=0}^{\infty} \beta^t \frac{U\left(C_t^A, C_t^M\right)^{1-\rho} - 1}{1-\rho},$$

$$U\left(C^A, C^M\right) = \left[\sum_{i \in \{A,M\}} \eta_i^{1/\sigma} \left(C^i - \gamma_i\right)^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}$$

- Technology

$$C_t^M + I_t = Y_t^M = X_t^M \left(K_t^M\right)^{\alpha_M} \left(N_t^M\right)^{\beta_M},$$

$$C_T^A = Y_t^A = X_t^A \left(K_t^A\right)^{\alpha_A} \left(N_t^A\right)^{\beta_A}.$$

- Standard feasibility

Key observation

- Any economic policy is equivalent to a set of taxes and transfers in a standard competitive equilibrium
  - the studied economy does not need to be competitive, use market mechanisms for resource allocations, ...
- If you know preferences and technology: can measure total distortions or **wedges (**aka "taxes"**)** in the data
- Powerful diagnostic tool:
  - different economic policies map into different wedges
  - by understanding which wedges are most important quantitatively can narrow the set of key policies/distortions

Optimal allocation

- First welfare theorem: best point in the PPF is an undistorted competitive equilibrium
- CE satisfies

$$1 = \frac{U_{C_M}(t)}{U_{C_A}(t)} \frac{F_N^M(t)}{F_N^A(t)} = \underbrace{\frac{U_{C_M}(t)/p_{M,t}}{U_{C_A}(t)/p_{A,t}}}_{=1} \cdot \underbrace{\frac{p_{M,t}F_N^M(t)/w_{M,t}}{p_{A,t}F_N^A(t)/w_{A,t}}}_{=1} \cdot \underbrace{\frac{w_{M,t}}{w_{A,t}}}_{=1}$$

$$1 = \frac{U_{C_M}(t)}{U_{C_A}(t)} \frac{F_K^M(t)}{F_K^A(t)} = \underbrace{\frac{U_{C_M}(t)/p_{M,t}}{U_{C_A}(t)/p_{A,t}}}_{=1} \cdot \underbrace{\frac{p_{M,t}F_K^M(t)/r_{M,t}}{p_{A,t}F_K^A(t)/r_{A,t}}}_{=1} \cdot \underbrace{\frac{r_{M,t}}{r_{A,t}}}_{=1}$$

$$1 = \frac{\beta U_{C,M}(t+1)}{U_{C,M}(t)} \left(1 + F_K^M(t+1) - \delta\right)$$

Any allocation

- Take any arbitrary collection of allocation and prices
- Define wedges

$$1+\tau_W(t) \equiv \frac{U_{C_M}(t)}{U_{C_A}(t)}\frac{F_N^M(t)}{F_N^A(t)},\ 1+\tau_R(t) \equiv \frac{U_{C_M}(t)}{U_{C_A}(t)}\frac{F_K^M(t)}{F_K^A(t)},$$

$$1+\tau_K(t+1) \equiv \frac{\beta U_{C,M}(t+1)}{U_{C,M}(t)}\left(1+F_K^M(t+1)-\delta\right)$$

$$1+\tau_W(t) = \underbrace{\frac{U_{C_M}(t)/p_{M,t}}{U_{C_A}(t)/p_{A,t}}}_{\equiv\text{consumption component}} \cdot \underbrace{\frac{p_{M,t}F_N^M(t)/w_{M,t}}{p_{A,t}F_N^A(t)/w_{A,t}}}_{\equiv\text{production component}} \cdot \underbrace{\frac{w_{M,t}}{w_{A,t}}}_{\equiv\text{mobility compone}}$$

$$1+\tau_r(t) = \ldots$$

- Note: this arbitrary collection of allocation and prices can be supported as a CE with taxes, where taxes are set to wedges and their components
  - any collection of policies/distortions is equivalent to some combination of taxes

Using wedges for analysis

- Key observation: different policies will map into different combination of wedges
  - measure wedges and their quantitative importance $\Longrightarrow$ see which policies matter and how much
- Several policies can map into the same wedge
  - cannot pin down specific policy, but can distinguish between broad classes of explanations
- This approach does **not** require us to assume that our assumption on preferences and technologies are correct
  - if preferences/technologies are different $\Longrightarrow$ shows up as wedges in this analysis
  - different theories about preferences/technologies have different implications about such wedges

Mapping of tsarist frictions to wedges

- *Obschina*: land pre 1910 is in a communal property of a village. If peasant leave a village, he loses land rent

$$\text{mobility component} > 1$$

- *Limited competition*: large prevalence of monopolies and cartels in manufacturing, barriers to setting corporations

$$\text{production component} > 1$$

- *Limited market participation*: a lot of peasants poorly integrated in market economy, mostly produce for own consumption

$$\text{consumption component} > 1$$

- *Costly human capital acquisition*:

$$\text{mobility component} > 1$$

Mapping of Soviet policies to wedges

- *Rationing/non-market clearing prices*:

$$\text{consumption component} \downarrow, \uparrow$$

- *Big push*: a common story of success of industrialization (e.g. Murphy-Shleifer-Vishny)

$$\text{TFP in manufacturing} \uparrow$$
$$\text{production component} \uparrow$$

- *Expansion of industry/creating of collective farms (monopsonist on ag labor market)*:

$$\text{production component} \downarrow$$

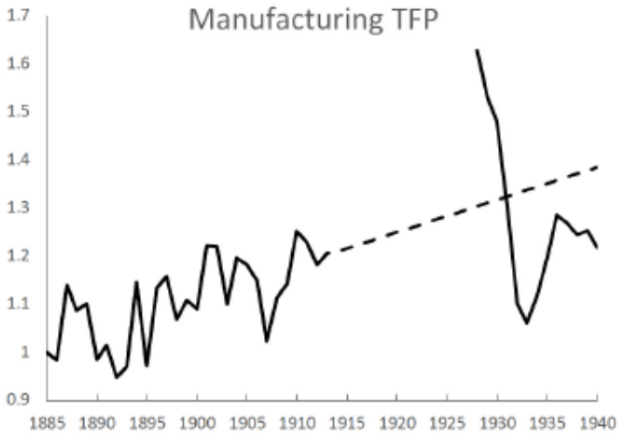
Strategy

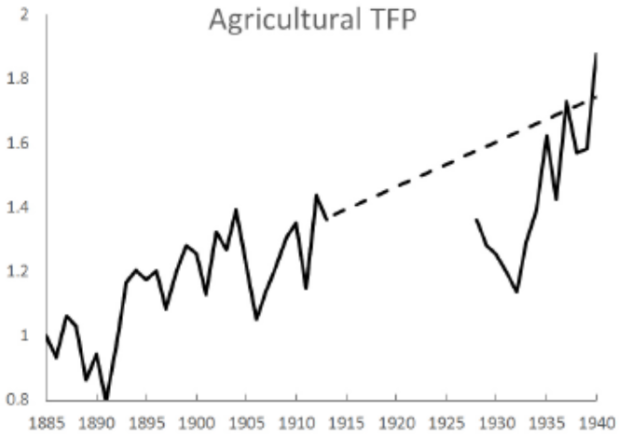
- Take data from historical sources
- Use standard model parameters for labor shares and preferences
  - Caselli-Coleman, Hayashi-Prescott, Buera-Kaboski, Herrendorf-Rogerson-Valentinyi
- Compute

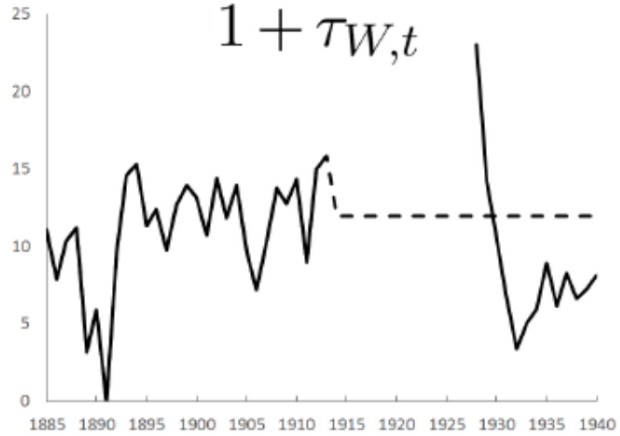
$$\left\{ X^M(t), X^A(t), \tau^W(t), \tau^R(t), \tau^K(t), components(t) \right\}_t$$

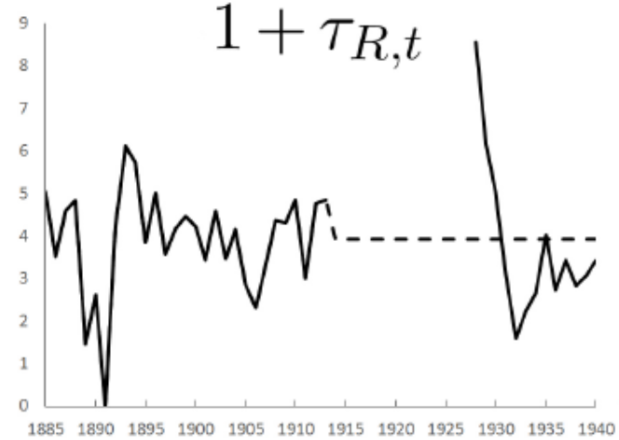
Aggregate economic indicators in Russia in 1885-1940

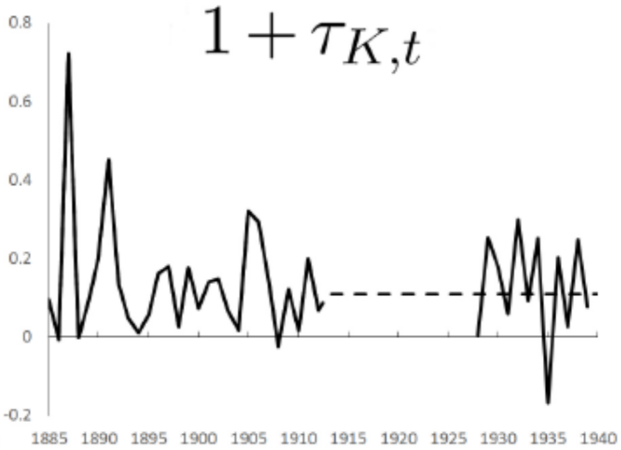
Wedges


Manufacturing TFP
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940

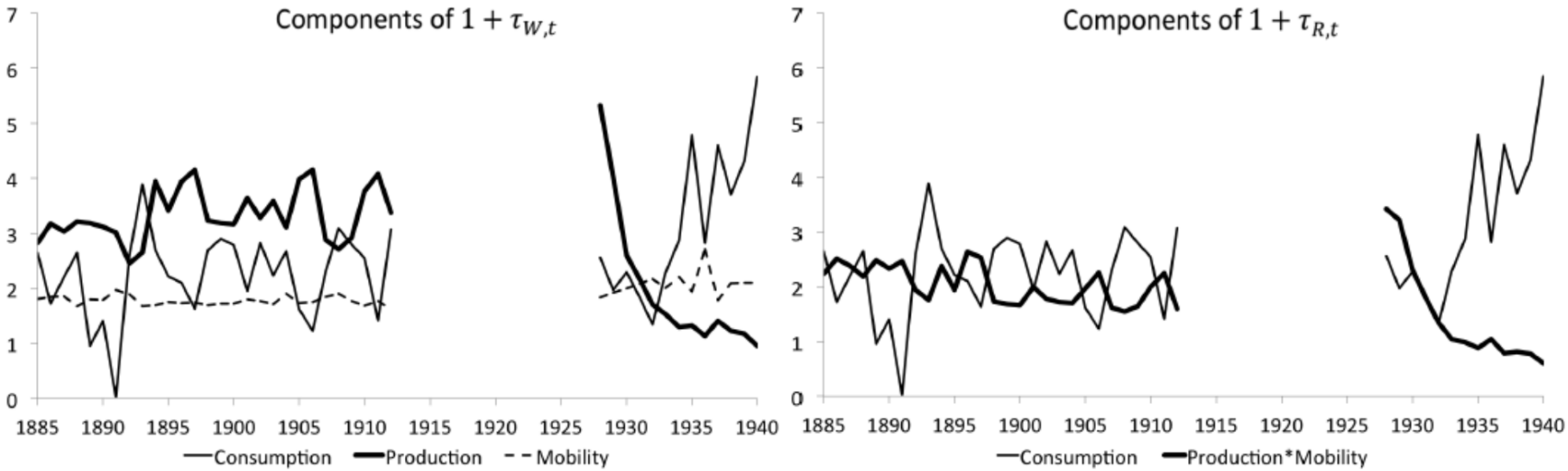

Agricultural TFP
2
1.8
1.6
1.4
1.2
1
0.8
1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940


$1+\tau_{W,t}$
25
20
15
10
5
0
1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940


$1+\tau_{R,t}$
9
8
7
6
5
4
3
2
1
0
1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940


$1+\tau_{K,t}$
0.8
0.6
0.4
0.2
0
-0.2
1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940

Components of wedges



Discussion of results

- Tsarist Russia had very high wedges prior to 1914, preventing reallocation
  - production component of intratemporal wedges particularly high
- All wedges in 1932-1940 become worse, except production components
  - by 1940, this wedge become 1
- Can decompose further into contribution of numerator and denominator

$$\begin{aligned} & \Delta \ln (\text{production component}) \\ = \quad & \Delta \ln (\text{mark up in non-ag}) - \Delta \ln (\text{mark up in ag}) \end{aligned}$$

- 88% of drop in production component comes from decrease in non-ag mark ups

Big picture

- Small labor share in non-ag in tsarist Russia driven by monopoly distortions
- Removal of monopoly distortions can lead to structural transformation
  - can be done by removal of barriers to entry
  - or by incentivizing managers to increase production using threat of prosecution
- Soviet approach reduced the monopoly distortions but also lowered productivity
  - also led to mass famine and political terror